NUTRITIONAL PROFILE OF ELDERLY IN KOCHI, KERALA

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INTRODUCTION

A grey wave is rapidly setting on the world with the rate of growth of aging population exceeding that of the general population. What was an extra ordinary achievement for the last century will be one of the greatest challenges for the present one – ensuring quality of life of an exceptionally large elderly population (World Health Organization, 2000).

Currently there are 605 million people in the world aged 60 years and above and this figure is expected to soar up within the next 20 years – a 75 percent increase in elderly population compared to less than 50 percent increase in the global population as a whole (Department of Social and Economic Affairs, United Nations, 2009). To put in simpler terms, today almost one in ten people are over 60 years of age. By 2050, the figure will be higher than one in five (HelpAge International, 2010).

The proportion of elderly is rising more rapidly in developing countries than in developed ones. WHO projections (2002) indicate that by the year 2020, more than 70 percent of the world's elderly people will be in developing countries, with the absolute numbers exceeding 700 million compared to 318 million in developed regions.

UN reports (2010) also indicate that although the percentages of older persons are significantly greater in more developed regions, the number of older people is increasingly larger in the less developed regions. Over the last half century, the number of people aged 60 or older, increased globally by an average of 8 million persons every year. Of this increase, 66 percent occurred in less developed regions and 34 percent in more developed regions. As a result, the proportion of the world's population over 60 living in less developed regions rose from slightly over half (54%) in 1950 to 62 percent in the year 2000. Figures indicate that by 2050, nearly four fifths of the world's older population will be living in less developed regions.

A notable aspect of the global ageing process is the progressive demographic ageing of the older population itself. It is projected that (U.N, 2010) in 2050, six countries will have more than 10 million people aged 80 years or above- China (99 million), India (48 million), USA (30 million), Japan (17 million), Brazil (10 million) and Indonesia (10 million). Together they will account for 57 percent of all those 80 or over in the world.

This enormous increase in elderly population all over the world is due to the reduction in mortality rates resulting from prevention of infectious diseases, improved hygiene and sanitation and overall social development and living standards. The decline in mortality rate was accompanied by an equally sharp fall in birth rates. Ultimately the demographic transition leading to population ageing is actually a shift from high mortality / high fertility to low mortality / low fertility. As fertility declines and more people live longer, the relative weight of society's main dependent groups – children and older persons- is gradually shifting towards older persons.

The demographic shift of global elderly has immense implications for India as the Indian society has been undergoing rapid transformation under the impact of several factors like industrialization, urbanization and education. The demographic trends visible in India in this respect are that the death rate declined to 29.1 per 1000 and life expectancy increased to 59.4 years, whereas the birth rate declined to 29.5 per 1000 in 1991 (Registrar General India, 2010). As a combined effect of these changes, the proportion of elderly in India is growing at a rate faster than the general population.

India has nearly seven percent of its total population shuffling across the line that defines the elderly with seventy six million aged above sixty (Census Report, 2001). By 2016, it is expected to rise to 114 million constituting 8 to 9 percent of the total population. The Indian aged population is currently the second largest in the world to that of China leading with 100 million elderly. The life expectancy at birth which was 70 years in 1990 is projected to reach 82 years by

2020 (IIPS,2009). From 1961 to 2001, there has been a 200 percent increase in the population of older adults in India.

The challenges for elderly are more complex in the Indian situation as indicated by the rising old age dependency ratios (defined as the number of persons aged 60 and over divided by the working population of age 15 to 59 years). The Registrar General of India (2010) predicted Indian old age dependency ratios to reach 14 by the year 2016 and WHO (2002) predicts that globally there will be 40 old people economically dependent on the 100 working people by the year 2025. Such large dependency ratios require policy responses to improve the health of older persons thereby increasing their ability to contribute longer to the society.

Another challenge presented by the demographic transition is 'feminisation of ageing' – projections indicate that 51 percent of the elderly population would be women by the year 2016. This is due to the greater life expectancy at birth and at older ages for women than for men (WHO,2008). Vulnerability among the elderly also depends on their living arrangement since the elderly are less capable of taking care of themselves compared to young persons. The significance of living arrangement among elderly becomes evident when seen in the context of their level of economic dependence also (Rajan, 2006). According to 2001 census 33.1 percent of elderly in India live without their spouses. Added to these factors are concerns regarding their failing health.

Remaining self reliant and productive during old age depends on them continuing in good health. Therefore there is urgent need to ensure that older persons remain in good health and play active roles in society. This is imperative especially in developing countries without the capability of providing security schemes to large segments of population.

The most recent findings regarding health status of elderly show that the leading causes of death have shifted dramatically from infectious to non-communicable diseases and from younger to older individuals (Wahlqvist, 1998). Ischemic heart disease and cerebro vascular diseases followed by respiratory diseases cause a vast majority of deaths occurring at older ages in low income

countries. Thus developing countries face the dual challenge of coping with high morbidity and disability rates due to infectious diseases and high rates for the super imposed emerging chronic diseases characteristic of aging societies.

A major survey (NNMB, 2002) on socio economic and health profile of elderly in India covering 5000 households over 8000 villages and 4500 urban blocks showed that 45 percent of both men and women ,both urban and rural, reported chronic illnesses. In two other studies (Joshi et al., 2006 and Mehta, 2003) on older people, virtually everyone included in the study had multiple symptoms ranging from musculo-skeletal problems, visual defects, central nervous system problems and respiratory problems. In addition 43 percent had some form of depressive illnesses.

These statistics point to the fact that the central challenge of the growing elderly population is indeed their health. A growing body of evidence suggests that there are nutritional components to many of the health problems and preventive nutrition strategies may play a significant role in chronic conditions which do affect independence, quality of life and health care expenditure. Thus, the inseparable triad of nutrition, aging and health seems to be the logical basis for appropriate management of problems of the old that arise due to a host of inter dependent factors.

A review of descriptive epidemiological data from developed and developing countries reveal that chronic health problems can be related to differences in life style patterns and diet in particular (WHO,2002). Malnutrition among elderly is yet another problem of concern due to the risk factors which may range from decreased functionality, poverty, loneliness, alcoholism, dental problems, medical problems, drug usage and dementia.

Data gathered by the National Nutrition Monitoring Bureau (NNMB) over a period of time on the Indian elderly population showed that under nutrition still continues to be a public health problem in India (Brahmam, 2007).Based on NNMB Surveys, Arlappa et al., (2004) also reported a higher prevalence of Chronic Energy Deficiency among elderly than their adult counterparts in India. The proportion of elderly meeting 100 percent of recommended dietary allowances (RDA) for all

nutrients were as low as 2.8 percent and only in 4 percent of elderly, the intake of macronutrients and micronutrients were equal to or more than the RDA.

The setting of the present study, the state Kerala, has unique demographic attributes in this context. Kerala has low per capita income as given by official statistics, but with regard to the social development indicators it is far ahead of any other Indian state and stands out among low income countries of the world and is even on par with some middle income European countries (Franke & Chasen, 1993)

Kerala's credentials are distributed equally across urban-rural, male- female and low caste – high caste populations. In this respect, Kerala outshines the rest of the world. Thus the male-female literary rates are the highest in India, life expectancy for females was higher than males and it is the only state in India in which women outnumber men. This achievement is the result of the greater access that women have to food, education and health care in the state (Sen, 1994).

However, Kerala's most striking achievement is the attainment of third stage of demographic transition" with lowest fertility and mortality rates,and as a consequence, the state has the largest proportion of elderly in India (10.8%). Kerala is expected to maintain it's lead with 9.79, 11.71 and 15.63 percent of elderly in 2001, 2011 and 2021 respectively (Tripathi, 1999). The life expectancy of the state is projected to reach 82 years by 2020 (IIPS,2009). Kerala also has the largest number of old age homes in India (Kerala Ageing Survey, 2004-2005).

The interesting paradox about Kerala regarding the health status of it's population is that, though it is the most advanced state in India in terms demographic transition with mortality levels close to those of developed nations for the last two decades, the morbidity levels are comparatively higher than anywhere in India (Dilip, 2007). Kerala Aging Survey (2004-05) conducted among 5013 elderly throughout Kerala, found high incidence of chronic non-communicable diseases and disabilities. At least one form of disability was found among majority (675/1000) of the elderly in Kerala. A health issue of much focus in Kerala is the prevalence of psychological problems including dementia, which afflicts approximately 3 percent of the aged (Menon, 2006). According to estimates, Kerala's rates compare with that of developed countries in this regard.

However comprehensive information on health and nutritional status of elderly in Kerala is scanty. Though a few studies (Rajan 2007, 2003; Moli, 2004) have examined the sociological aspects regarding the 'Geriatric boom' in Kerala, investigations to assess the nutritional profile and related factors of elderly have not been carried out. 'Malnutrition free Kerala' a programme launched in 2005 by Government of Kerala included the geriatric group as targeted beneficiaries for nutrition support, but not much has been implemented at the field level till date. The large scale NFHS surveys have also focused on women and children as the vulnerable groups. So little information is available regarding nutritional profile of elderly in Kerala .

Among the districts of Kerala, Ernakulam district has the largest number of old age homes as per the available data. (HelpAge India, 2005) The trend is obviously increasing as revealed by statistics. Kochi is the largest urban agglomeration in Kerala under the administrative purview of Ernakulam district. The state of Kerala, particularly the area of Kochi, is an ideal setting to study the determinants related to aging, given the dramatic population aging phenomenon evident in this region.

Thus, when the world is anticipating the emergence of elderly as the most important population group in this century, a micro level study on dietary habits, morbidity pattern, psychological status and functionality in relation to overall health and nutritional status will aid in giving direction to policy decisions regarding the aged in Kerala. The present research aims to address this issue. Keeping in view the existing lacunae on our body of knowledge regarding the elderly in Kerala, the present study entitled "Nutritional Profile of elderly in Kochi, Kerala" was undertaken with the following specific objectives:

1. To elicit information on socio-economic background, psychological status and quality of life of the elderly
2. To appraise the functionality and morbidity profile of elderly subjects
3. To ascertain the nutritional profile of the selected elderly with respect to their anthropometry, biochemical status, clinical profile and dietary intake
4. To study the feasibility of use of the non-invasive tool, Mini Nutritional Assessment (MNA),among elderly in Kochi to define nutritional status and
5. To elucidate factors associated with nutritional status of the elderly population.

II. REVIEW OF LITERATURE

Relevant literature pertaining to the present study entitled **'Nutritional Profile of Elderly in Kochi, Kerala'** is presented under the following heads.

2.1 Ageing: Concepts, Definitions and Demographic trend

2.1.1 Concepts and definitions.

Ageing is a gradual developmental process involving biological, psychological, sociological and behavioural changes, that begins at the moment an individual is born (Chandrasekhar and Bhooma,1999).It signifies the progression of biochemical changes which determine the structural and functional alteration with age in the cellular and non-cellular tissues (Venkataraman, 1998).

Mohanty and Maulik (2003) conceptualized the process of ageing as irreversible progressive changes in cellular functions causing under-functioning of various organs of human body. This view was supported by Ghosh (2004) stating that ageing is a manifestation of replacement and repair of the orderly sequence of DNA double strand. According to Natarajan (1999), ageing starts when the first calcific deposition occurs in the vessels and ligments. Moody (2000) also defined

ageing as a time dependent series of cumulative, progressive, intrinsic and harmful changes that begin to manifest themselves at reproductive maturity and eventually end in death.

From a sociological perspective, Natarajan (1999)has defined old age as the age of retirement, as the combined effect of ageing,social changes and diseases cause a breakdown in health. Neuhaus (1982) and Hemalatha (1999) opined that ageing is a complex phenomenon accompanied by physiological, psychological and social changes which contribute to a decline in health status. Thus it could be stated that the physiological age of an individual is not the same as that of chronological age in biological terms, since ageing process differs from person to person.

However cut off points to denote ageing and its progression is very essential. Sreeramulu and Raghuramalu (1999) also opined that though there are no precise definitions of elderly population, generally all those above the age of 65 years may be considered to be elderly. The U.S Department of Health and Human Service (2002) and US Census Bureau (2001) consider people who are above the age of 65 years as elderly.

But according to World Health Organization (2002), persons who have attained the age 60 are considered as elderly. ICMR (1991) also supported the above WHO definition. WHO (1999) also suggested some cut off points to indicate the progression of ageing. As per this, people who are in the age range of 60 to 75 years are designated as the young old, 75 to 89 years as old and 90 plus as very old.

Biological explanation of ageing process, as given by Chadha (1997), fall under three major categories – Genetic theories, Non-genetic cellular theories and Physiological theories. A genetic programme that sets the upper limit of the life span of all species and loss of replicability (Bird, 2007) may be a good model of the finite characteristics of cells in vitro but it does not appear to be a complete model of ageing. The life span of cell populations in vivo may be very different (Mickey, 1992).But as per Chadha (1997) the DNA damage theory, somatic mutation theory and cellular error theory are the basic theories related to ageing.

Accumulation theories suggested by Hughes and Reynolds (2005) attributed ageing to the accumulation of deleterious substances called toxins in the ageing organism. The free radical theory proposed that molecular fragments containing a single impaired electron makes them highly reactive to proteins, lipids, carbohydrates and chromosomal material in the cells and this probably leads to changes associated with ageing.

Non biological theories of ageing include disengagement theory which was first proposed by Cumming and Henry (1996).The idea is that separation of older people from active roles in society is normal and appropriate and beneficial to both society and older individuals. However this theory has been much criticized (Stuart ,1998).In contrast to disengagement theory the activity theory implied that the more active elderly people are the more likely they are to be satisfied with life.

The selectivity theory as suggested by Carstensen(2003) also proposed that that it may benefit older people to become more active in some aspects of their life, more disengaged in others . Continuity theory described best by Atchley (1989) viewed that ageing people are inclined to maintain as much as they can the same lifestyle developed in earlier years. However many authors view the above theories to be optimal for certain people in old age, depending upon both the circumstances and personality traits of the individual concerned.

Thus ageing has been conceived to be a reflection of cellular and systemic processes that occur with time (Mc Ardle et al., 2002) or as a progressive loss in the individual of his physiological adaptability to the environment culminating in death (Shephard,1987).The basic biological nature of the ageing process is still not very clear. Thus ageing must be viewed in terms of a man as a whole (Potter et al., 1995) since ageing, nutrition and health and/ or diseases are intimately interwoven (Souba,1997) and it is not possible to isolate these factors to evaluate the effect of each component separately. In addition these factors are continually influenced by a multitude of environmental, bio-social, bio- cultural and physiological factors during one's life to death process. The very multiplicity of hypotheses concerning ageing emphasizes that no current view offers a complete and unique explanation of the known facts about ageing.

2.1.2 Demographic trend

Populations pass through various stages termed as the "epidemiological transition" which represent a shift from high mortality and high fertility to low mortality and low fertility and from a low proportion to high proportion of older persons. The world is at present passing through the third stage of epidemiological transition (UN Department of Public Information, 1999). Throughout the world in both developed and developing countries there has been a shift in the age structure of elderly population because of a combination of increased longevity and decreased mortality (Patil, 2000).

Demographic ageing is a global phenomenon. WHO (2002) reports indicated that the life expectancy at birth for men has shown a steady rise from 42 years in 1960s, to 58 years in 1990s. It is projected to reach 67 years in 2011-16. An increase of about 9 years in a twenty five year period was noted. In case of females, the increase in expectation of life has been higher by about 11 years during the same period from 58 years in 1986-90 to 69 years in 2011-16.

According to Reilly (2007), globally the number of persons 60 years or above is expected to triple, increasing from 673 million in 2005 to 2 billion by 2050. The annual gradual increase of 2.5 percent in the global elderly population is reported to be due to the geriatric boom.

These projections are supported by the Department of Social and Economic Affairs (2009). Accordingly the elderly population globally, is expected to reach 1.18 billion by 2025. Of the global population of over 6 billion, almost 10 percent would be elderly. Further it is projected that the older population in developing countries will increase much faster than the developed countries. By the year 2020 it will be 100 crores and by 2030, one third of the population is projected to be elderly and by 2050 developing countries will have three fourth of the global elderly.

On the basis of the 2001 census, India comprising of 28 states and 8 Union territories had a total elderly population of 71 million (Rajan, 2004). Currently India

ranks second only to China among the countries of the world, in terms of population of the aged (WHO, 2002). By 2061, it is estimated that India will have the largest population of older persons in the world (www.aging.stat, 2004).

As per the World Bank projections, old age population in India is likely to increase from 70 million in 1995 to 141 million by 2020 and 508 million by 2100 (Rajagopalan, 2000). The World Health Report (2000) predicts that by 2061, while the present Indian population would climb five times, the number of elderly would soar 13 times. Thus in India population of elderly is fast growing. Aged persons constituted 5.8 percent of the population in 1961 and 6.8 percent in 1991. In 2016 older persons will constitute 8.9 percent of total Indian population. This increasing trend of aged population tend to have an impact on the dependency ratio. As Rajagopalan (2000) reported, in India, 57.4 percent of the population in the age group 15 to59 years had to support 42.6 percent of the children and old age people in 1995. By 2100, 46.2% children and old population have to be supported by 53.8 percent of the population in the age group 15-59. Such large dependency ratio seems to be one of the inevitable consequences of demographic transition.

Among the Indian states, Kerala has the largest proportion of elderly population and the growth rate among the aged is increasing higher and higher (Moli, 2004). The Kerala Ageing Survey (2005) brought out the dramatic phenomenon of population ageing and feminization of ageing in Kerala. The survey results indicated that Kerala is a 'grey state' with more than 10 percent of its population being over 60 years. Luthra (1991) reported that the rate of growth of older women is even more pronounced in Kerala indicating a faster growth of women at older ages as compared to men.

The study undertaken by Centre for Development Studies (CDS) Trivandrum found that Kerala took 20 years to increase the share of its elderly population from 6 to 8 percent and the same increment is expected every 10 years in the immediate future (Rajan, 2007).

According to Nayar (2000) the population of Kerala is ageing more rapidly than any other state in India. As per the 1991 census, around nine percent of the

population in Kerala is 60 years or older. The elderly will form 20 percent of Kerala's population by 2021 while all India figures would be about 14 percent. The author also pointed out that in another 10-15 years, Kerala will become an aged society, a status now enjoyed only by industrialized countries.

WHO(2002) reported that there is a virtual decline in mortality rates due to improvement in medical facilities, and as a result, the life expectancy throughout the world is projected to reach 73 years in 2020. Translating this to Kerala, which is the most advanced state in India, in terms of demographic transition with mortality levels close to the developed nations for the last two decades, means that the rapidity of aging in India would be most pronounced in Kerala (Dilip, 2001).

2.2 Nutritional and Health Problems of Elderly

Ageing has many dimensions - physical, physiological, nutritional, social, psychological and economic with many components including family dynamics and relationships. The challenges come from several areas and are interrelated (Shearer, 2002).

Woo (2000) opined that majority of health problems among the aged are diet related and nutritionally dependent and that appropriate and adequate nutrition is essential for health and well being of the elderly. Several studies (Chernoff, 2001; Fishman, 2000 and Andrew, 2000) have brought out the consequences of malnutrition in older persons. The sequence ranges from physical, mental and social disability. If inadequate dietary intake continues for a longer time, gross undernutrition results which leads to diminished muscle mass and vigour, functional impairment and disability. Malnutrition also causes further lack of enjoyment in eating and anorexia which may generate psychological, medical and social problems (Amarantos, 2001).

2.2.1 *Nutritional problems*

Several studies have documented the association of nutrition and the phenomenon of ageing. Johnson and Audrey (2003) substantiated the role of

optimal nutrition in maintaining the health, overall physical and mental well being and reduction of costly health care resources for older persons.

According to Mahan and Stump (2000), older persons are more susceptible to undernutrition than younger persons, since there is an advancing loss of lean body mass in addition to alteration in most systems including sensory, gastro-intestinal, metabolic, cardiovascular, renal, musculo skeletal, neurological and immuno competence.

Sibai (2003) reported that Good Nutrition improves Health Related Quality of Life (HRQOL) by ameliorating secondary malnutrition that is caused by or associated with other diseases. Deteriorated nutritional status as given by Crogan and Pasvagel (2003) can influence the quality of life and psychosocial well being of elderly. According to Grieger (2006) malnutrition results from an imbalance between energy and micronutrient input and output. This may be due to the impaired absorption of nutrients by the body and a decrease in appetite and food intake. Janssen et al., (2005) stated that the negative energy balance results in body weight loss and micronutrient deficiencies among older people.

Many studies have brought forth figures relating to prevalence of malnutrition among elderly. The prevalence of malnutrition in elderly has been reported to be 30 to 50 percent (Corrish and Kennedy, 2000). Studies of Burden et al., (2001) and Mackintosh and Hankey (2001) have reported much lower prevalence figures (15-17%) in slightly younger groups. Kostika (2002) highlighted the importance of constant monitoring of the nutritional status of older persons taking into account the high prevalence of malnutrition.

A study conducted by Grieger and Nowson (2006) in Australia among a group of institutional elderly revealed that 68 percent of subjects had low levels of atleast one serum marker indicating that nearly three fourths may be at risk of malnutrition and nutrition related diseases.

Malnutrition is a major risk factor for morbidity and mortality among elderly in hospitals (20-60%) or nursing homes (85%). Prevalence of malnutrition

in community dwelling elderly was found to be 10 to 51% by Mion et al., (1994). The factors associated with malnutrition were physical function, cognition, mood, alcohol use, socialization, living arrangements, finances and medications.

Undernutrition has been frequently reported among hospitalized elderly (Corish and Kennedy, 2000) also. Thorsdottir et al., (2005) reported 56.3 percent of hospitalized older persons to be malnourished with low BMI, serum albumin, pre-albumin and MUAC. Robinson (2001) in a study in UK reported that malnutrition is likely to be twice as common in over 80's as in those elderly people less than 80 years of age.

Natarajan (1999) has also reported that the prevalence of underweight in elderly was high in a rural Indian community. Chandrasekhar and Bhooma (1999) also substantiated that the health and nutritional status of rural Indian elderly was not satisfactory.

Reports by Natarajan (1999) on his clinical studies on 800 rural elderly in Tamil Nadu revealed high prevalence of nutritional disorders. Hypochromic microcytic anaemia (mild to severe) was observed in 47 percent of the elderly. Glossitis (11%), peripheral neuritis (5.1%), angular stomatitis (4.1%), cheilosis (3.9%) and xerophthalmia (1.75%) were detected. Osteoarthritis was observed among 21% of the subjets. Acid peptic diseases were found in 6% of the elderly. Studies on rural elderly in India (Natarajan, 1999) also revealed a high prevalence of nutritional disorders in the elderly population

The National Nutrition Monitoring Bureau surveys (1997) indicated that in India 29 percent of aged among 60-69 years and 38 percent among 70 plus years had Chronic energy Deficiency. The NNMB (1999) conducted a study on the diet and nutritional status of elderly in rural areas of seven states of South India and found that the proportion of elderly meeting 100 percent RDA of all nutrients were 2.8 percent. The mean intake levels of energy and protein among the elderly were found to be lower than those reported for Chinese elderly as given by Stooky et al., (2000). Repeat surveys (NNMB, 2005-2006) showed that majority of health problems among the aged are diet related and nutrition dependent.

A study conducted at Meerut (Wahlquist and Savige, 2001) to assess the average dietary intake as well as nutritional status of elderly revealed that the average dietary intake was much lower than the Recommended Dietary Allowances.

Vijayaraghavan et al., (2003) observed that $1/5^{th}$ of Indian elderly were underweight, a finding similar to Bagchi (2001). Nutritionally related key health problems affecting older persons as reported by Wahlqvist and Savige (2000) are frailty, depression and chronic non communicable diseases. Campbell and Buchner (1997) defined fraility as a syndrome which results from a multi system reduction in reserve capacity to the extent that a number of physiological systems are past the threshold of symptomatic clinical failure. Nutritional reserve is certainly one of the key components of frailty (Winograd et al., 1991). Province et al., (1995) listed falls, incontinence and confusion as the clinical consequences of fraility. Urinary continence and / or protein energy malnutrition which are two factors contributing often results in restriction of fluid intake (Bidlack and Wang ,1995).

Feldblum et al., (2007) compared malnourished elderly with those at nurtritional risk and identified lower intake of fruits, vegetables and fluid, poor appetite and eating difficulties as the most sensitive and specific predictors of malnutrition. Frauenrath et al., (1999) has also reported that malnutrition among elderly was related to poor intake of high nutrient density foods. Food intake was shown to be largely independent of factors such as sex, age or life situation thus emphasizing the need for better nutrition education of the elderly.

Regarding the type of nutritional deficiencies observed among the elderly, the following studies have been noteworthy.

Ageing adults, according to Wahlqvist and Savige (2000) are at risk of nutritionally inadequate diets especially in relation to protein, vitamin D, B_1, B_6, B_2, fluids and other compounds. Beck (1999) has documented marginal or inadequate energy intake and vitamin status in homebound, disabled or institutionalized elderly.

Many studies on nutritional deficiencies of the elderly focused on Calcium and Vitamin D stature. Smit et al (2008) in Longitudinal Aging Study Amsterdam (LASA) study among 1311 community dwelling older men and women of the found that 82.4 percent had serum calcium levels below 30 mg/ml. Further, more than 8.5 percent had one or more osteoporotic fractures.

Delappe et al., (2006) in the same context concluded that despite supplementation of the osteoporotic patients with 1g Calcium and 800 IU Vitamin D_3, significant improvement in mean 25-hydroxy-vitamin D levels were achieved but optimum levels were not reached.

Sohyun and Mary (2006) reported prevalence of Vitamin B_{12} deficiency increases in elderly. The authors found that approximately 10 to 30 percent of older adults had malabsorption of protein bound Vitamin B_{12} and about 1to 2 percent lacked the intrinsic factor required for active uptake of vitamin B_{12} in the small intestine.

In a study conducted by Clarke et al., (2007) it was found that low vitamin B_{12} status was associated with more rapid cognitive decline in older adults. The relevance of vitamin B_{12} supplementation for prevention of dementia was also tested by randomized trials. Cobalamin deficiency in older people have been reported by Andres et al., (2007).

Koehler et al., (1997) found that elderly people with better folate and vitamin B_{12} status have lower homocysteine concentrations and may have lower risk for vascular disease. Mulligan et al., (2007) also suggested that older adults may be at risk for inadequate folate intake if their energy intake is low and they do not take a supplement or are not consuming fortified cereals. However, older adults may be at risk for excess folic acid intake, if supplementation is not medically supervised.

Malik (2007) reported greatest prevalence of low vitamin D status in the institutionalized elderly and several risk factors noted included decreased sun exposure, poor oral intake and multiple co-morbidities. He suggested that long-

term care residents should be prescribed higher doses of calcium and vitamin D for adequate bone mineral density and fracture prevention.

Another study by Toss et al., (1980) also found that the serum concentrations of 25-hydroxy vitamin D in a group of 47 elderly people living in homes for the aged were lower than those in a matched control group living in their homes. The low serum concentration of 25-hydroxy vitamin D may be due to less outdoor activities or a smaller dietary vitamin D intake in the institutionalized group.

Anaemia in older individuals is associated with a wide range of complications including increased risk of mortality, cognitive dysfunction, longer hospitalization, reduced bone density and falls and fractures. Anaemia also has a significant effect on the quality of life of the elderly and most cases in older individuals result from iron deficiency, chronic inflammation or kidney disease (Richard et al., 2006).

Beghe et al., (2004) reported a systematic review of literature on prevalence and outcomes of anemia in geriatrics and found that the prevalence rates ranged from 2.9 percent to 61 percent in elderly men and 3.3 percent to 41 percent in elderly women. Incidence of anemia increased with age and prevalence of anemia was highest in the oldest subjects (> 85 years of age).

The elderly are reported to be vulnerable to anaemia because of poor eating habits and impaired iron absorption. (Looker et al.,1997). The effects of anaemia on elderly include impaired work performance and productivity (Johnson et al., 1994). Also iron status has strong association with ageing process which affects adversely the immune as well as neurological functions (Chandra, 1993 and Beard et al., 1993). Anaemia in older individuals is associated with a very wide range of complications, including increased risk for mortality, cognitive dysfunction, co-morbid conditions, reduced bone density and falls and fractures. Anaemia also has a significant effect on the quality of life of the elderly and most cases in older individuals result from iron deficiency, chronic inflammatory diseases or may be unexplained (Richard et al., 2006).

Large scale data on anaemia status of elderly population in India is not available. But nation wide studies on anaemia in other age groups have established that anaemia status is inversely associated with the level of educational status (National Family Health Survey, 1999) and was significantly higher in females (Bagchi, 2001).

2.2.2 Health problems

Central to the challenges faced by the growing elderly population are their health concerns. WHO (1999) defined health as a state of complete physical, mental and social well being. According to Sivaraju (2002) as age advances, due to deteriorating physiological conditions, body becomes more prone to illnesses which are multiple and chronic in nature. Quality of life of the aged is largely determined by their health. With declining health, individuals lose their independence, social roles, become isolated, experience economic hardship, change their perception and become stigmatized. Therefore the greatest challenge of the ageing population is related to maintenance of their health.

Wadhwa and Sharma (1999) indicated that the most common chronic health problems of aged in developed world included cardio vascular diseases, diabetes, cancer and hearing impairments. In India, blindness, respiratory diseases, nutritional deficiencies such as anaemia, B complex deficiencies and osteoporosis are added. Dutta (2002) reported that 45 percent of the elderly suffer from chronic illness and 70 percent depend on others for their daily needs.

Surveys indicate that 45 to 55 percent of Indian elderly have chronic illnesses (Shah and Prabhakar, 1997). A nationwide survey conducted by NSSO (1991) also revealed that about 45% elderly suffered from chronic illness. According to Government of India Statistics one third of deaths among the elderly are attributable to cardiovascular disorders, 10 percent to respiratory disorders, another 10 percent to infections, 6 percent to neoplasm and 4 percent each account for nutritional, metabolic and gastrointestinal disorders (Brahmam, 2005).

It is reported that morbidity levels in Kerala are comparatively higher than anywhere in India (Dilip, 2007). This is partly due to the fact that the life expectancy of the state is higher than any other state and as a result more and more frail persons survive until old age and the aged population as such becomes frail and prone to illness. Health surveys in Kerala showed that the incidence of chronic and degenerative disease is increasing very rapidly. Diabetes, hypertension, cardiovascular diseases, coronary heart diseases and cancer incidence has been progressively increasing in Kerala.(Nayar ,2000)

As reported by Singh (2004), heart diseases and its risk factors such as hypertension, hypercholesterolemia, diabetes and central obesity are of sufficient magnitude in the elderly population of India and formed major public health problems. Friedewald (2002) also reported that cardiovascular diseases was a leading cause of death in elderly people.

According to Kumar (2005) the risk of developing coronary artery disease in the Indian population is higher than in other countries. Moreover coronary artery disease is a major cause of disability, limiting the activity and eroding the quality of life of millions of elderly people each year.

Community surveys in India (Das et al., 2005) have documented that between the past 3 to 6 decades prevalence of hypertension among urban elderly has increased by 30 times and by about 10 times among rural elderly. Age and sex specific prevalence of hypertension showed progressive rise of systolic and diastolic hypertension in women compared to men. Contributory factors to this trend have been confirmed as changes in lifestyle pattern, diet and stress (Natarajan,2000).Hanna et al., (2000) found that CAD was a leading cause of mortality with 84 percent elderly affected by it with variable inputs on morbidity, mortality and quality of life.

Epidemiological studies have demonstrated that in certain populations blood pressure did not rise with age but in industrialized population a high percentage of hypertension has been associated with increasing age (Reddy et al.,1991). Nabi

et al., (2010) reported that symptoms of depression in a healthy elderly group put them at higher risk of coronary heart disease and total mortality.

Another health problem associated with increased incidence of CAD is Diabetes. Studies on NIDDM elderly are among the most important efforts in geriatric medicine (Elias, 2000). Studies reveal that the prevalence rate of diabetes is high in India and it increases with advancing age. (Ham, 1997).

In industrialized countries, about 75 percent of deaths of people over 65 years of age are from heart disease, cancer and cerebrovascular disease (WHO, 2002). Narayanamurthy (1995) reported hyperlipidemia with atherosclerosis, hypertension and decreased blood circulation as a major source of morbidity and mortality in elderly.

WHO projections also indicate that for the foreseeable future low income countries will face the dual challenge of coping with both high morbidity and disability rates due to infectious diseases and high rates for emerging chronic diseases.

Literature demonstrates that Protein Energy undernutrition, a common problem in older persons , is rarely recognized (Mowe and Bohmer, 1991 and Miller et al, 1990) and has been associated with altered immune function (Kaiser and Morley, 1994), hip fractures (Barstow et al, 1983) cognitive dysfunction (Goodwin and Gary, 1983), anaemia (lipschitz, 1990) and falls (Vellas, 1992).

WHO (2002) reported osteoporosis and associated bone fractures to be a major cause of disability that result in enormous medical expense the world over. About 25 percent of Indian women over the age of 50 develop osteoporosis and among people aged 80 years and over, osteoporosis becomes the rule and not the exception (Prabhakaran, 2002). Fractures in old age seriously interfere with mobility and leads to a loss of muscle tone and muscle mass and thereafter the former level of physical activity may never be regained (Royal College of Physicians, 1991).

Bhooma (2005) and Rashmi (2005) also reported increased mortality and morbidity from vertebral, hip and other fractures, particularly in Indian elderly women. Edmund (2001) and Cobbs (2001) agree in the statement that prevalence of osteoarthritis increases steadily with age and it becomes almost universal at age 80.

Earlier studies in the USA (Dwyer, 1994) showed a decrease in mobility with age, with 3.5 percent of elderly of 65 to 69 years having restricted mobility rising to 26.1 percent of those aged over 70 years. Apart from this normal loss of muscle coordination, there is little clinical evidence that significant malnutrition occurs in any normal elderly person as a result of ageing process itself (Lovat, 1996).

Factors such as diet, physical activity and smoking are closely associated with osteoporosis. Lifestyle modifications particularly increased calcium intake and physical activity have an important impact on fracture rates (WHO, 2002). Vijayakumar (1998) enlisted joint pains, gastro intestinal abnormalities and fatigue as the major medical problems of Indian elderly.

Regarding gastro intestinal problems affecting the old, peptic ulcer and constipation are significant. According to Hall (2001) peptic ulcer is an important problem in older patients although the pathogenesis may differ from younger individuals. Twenty percent of deaths due to ulcers occur in patients over the age of 65, primarily due to bleeding. Decreased fibre and fluid intake, immobility and decreased exercise lead to the tendency of constipation among the old. The condition needs aggressive monitoring and management (Dodd, 1999; Anderson et al., 1999). Coni et al., (1989) observed that incidence of acid peptic diseases rises with age. Association of Protein Energy Malnutrition among elderly with the development of decubitus ulcers has been reported by Pinchofsky et al., (1986).

Another health related concern that can substantially alter the quality of life and independence of older people are sensory changes. Compiling data from several studies initiated by the Indian Council of Medical Research, Shah and Prabhakar (1997) reported visual impairments in 11 million older population in India, while 38 million had hearing impairments. Hearing loss can make the patient appear and feel

cognitively impaired and its consequences include withdrawal, frustration, irritability, cognitive impairment, loneliness and physical immobility (Elias, 2000). Thus elderly suffer from multiple health problems apart from socio economic and behavioural problems which necessitate the need for giving special attention to their health care needs.

Health problems as a major risk factor affecting the nutritional status of elderly has been documented by many studies as reviewed further.

The sense of taste and smell decrease with age (Schiffman and Gatlin, 1993) resulting in a decreased appetite while dental problems decrease the ability to chew certain foods (Garry, 1994). Physiological changes such as visual loss or diminution of auditory sense or osteoarthritis that affects mobility may decrease an older person's ability to purchase and prepare food.

Taste and smell changes occur with advancing age and this can lead to poor appetite (De Jong et al., 1995), inappropriate food choices (Duffy et al., 1995) and / or lower nutrient intake (Griep et al., 1996). Loss of appetite is especially serious in elderly who are already chronically ill and thus at high risk to develop protein energy malnutrition as well as micronutrient deficiencies (Opper and Burakoff, 1994).

Laboratory studies of taste and smell perception in the elderly indicate that there are significant chemosensory losses with age (Schiffiman, 1997; Stevens et al., 1995). Hyposmia and hypogeusia tend to become noticeable around 60 years of age and the losses tend to progress more rapidly after 70 years of age (Schiffman and Warwick, 1991).

Taste dysfunction in the elderly generally result from normal ageing, from certain disease states, medications, surgical interventions, malnutrition and environmental exposure. Over 250 drugs have been reported clinically to cause taste complaints in elderly (Schiffman, 1991). The degree of taste loss depends on the medical condition and pharmacological regimen of the individual (Cowart et al., 1994). For unmedicated healthy elderly threshold increases for common tastes are

modest, while for elderly who take a modest number of medications greater losses in taste sensitivity at threshold levels are found (Schiffman and Wedral, 1996). Mistretta (1984) concluded that the process of continuous renewal of taste cells with a life span of 10- 10 ½ days is compromised by cancer therapy in the elderly.

Losses in smell perception in the elderly result from normal ageing, certain disease states (Cain and Gent, 1991). Greip et al., (1996) and Doty et al., (1995) have demonstrated that odour perception is related to medical condition and medication use. Most research suggests that the sense of smell is even more impaired by ageing than the sense of taste.

When food is perceived as unpalatable, patients often reduce the diversity of foods consumed and fail to eat enough to meet nutritional requirements (Bernstein, 1981). Inadequate intake results in weight loss and malnutrition which impairs a patent's response to therapies and increase mortality (Trant et al., 1982).

Several studies have documented effect of declining taste and odour perception to cause changes in food consumption and diminished food appreciation (Wyscocki and Pelchat, 1993; Ferris and Duffy 1989) and Friedman and Mattes (1991). Decreased taste sensitivity, loss of teeth and decreased digestion leading to reduced food intake which adversely affects the nutritional status of elderly has been documented by Mehta and Thakore (1995) also.

Poor oral health which includes caries, periodontal disease, defective dentures and poor oral or denture hygiene are quite common among older people (de Baat et al., 1993). It has been suggested that the proportion of people with an insufficient intake of nutrients to be higher among edentulous than dentate people (Steen, 1992). Impaired dental status can alter sensory aspects of eating as retronasally, volatile odours enter the nasal cavity during mastication and declining chewing ability among the elderly prevents the odours from being released from the food (Doty, 1990). There are contradictory studies which reported that there is no clear evidence to support the hypothesis that natural dentition is necessary for elderly to maintain satisfactory nutritional state (Horwath, 1989; Kaurich, 1991).

But population based studies suggest that edentulousness is correlated with lower nutrient intakes and multiple dietary inadequacies (Shay and Ship, 1995). Papas et al., (1989) show a 20 percent drop in nutritional quality of food consumption of those who had one or two full dentures as compared to those who had natural teeth. De Marchi et al., (2008) also found that patients who were dissatisfied with gingival health and partial denture wearers were more likely to be at risk of malnutrition. Griep et al., (1996) concluded that dental state per se may not be a direct cause of poor nutrition but a contributing factor in those elderly who have other risk factors. Significant separate effects of dental state were observed for animal protein, niacin and mono unsaturated fat intake. Kimura et al., (2009) also substantiates that elderly with chewing difficulty were more disabled, depressed and had lower quality of life scores.

Chernoff (1994) indicated a strong correlation between nutritional status and functional dependency in elderly. Dwyer (1994) found that eating ability, oral health and mobility to be important factors related to functional status of elderly. The National Diet and Nutrition Survey in United Kingdom (1998) confirmed the association between dental health and nutritional status and revealed the absence of natural teeth to have a significant impact on the intake of a range of nutrients.

The inter relationships of many factors with nutritional status of elderly are complex. Burg and Gazibarich (1999) found that the commonly reported risk factors for poor nutrition among elderly were polypharmacy, eating alone, having an illness or a condition leading to changed eating habits.

Dwyer (1994) indicated that over four fifth of older adults have chronic diseases that are affected by diet, one fifth have confusion or memory loss and one eighth feel depressed much of the time thus significantly affecting appetite, digestion, body weight and the feeling of well being.

The incidence of malnutrition as per Hengsterman et al., (2008) have been related to demographic and medical factors, self perceived health and health related quality of life. Johansson et al., (2008) further analysed these factors and reported lower hand grip strength and lower self perceived health as two factors with highest

power to predict malnutrition in elderly. Increased number of depressive symptoms and higher age were found to be second and third predictors. Malnutrition in elderly is also associated with reduced grip strength, depression (Cederholm, 1993), high prevalence of infections (Michel et al., 1991) and poor clinical outcome (Sullivan et al., 1991).

Other factors of health concern among the elderly as Lovat (1996) found were age related changes in gut physiology resulting gastric hypochlorhydria with small bowel bacterial over growth and gastrointestinal dysmotility caused by subclinical hypothyroidism which make older people highly sensitive to minor nutritional insults. However Neri et al., (1996) found no correlation between prevalence of Helicobacter pylori infection in elderly inpatients and their nutritional status.

Roe (1994) reported that single drug and drug combinations taken by elderly individuals impose nutritional risk including anorexia, decreased taste sensation, excessive increase in appetite, drug induced nutritional deficiencies and toxic reactions. Moral et al., (1996) recommended instructing the elderly and their care givers to avoid timing errors in drug intake and toxic reactions due to food incompatibility. In addition appropriate levels of nutrient intake would ensure avoidance of drug induced malnutrition.

Few studies have examined effect of ageing and exercise on immunosenescence in elderly people. Sa Kamoto et al., (2009) examined effect of low intensity exercise on Secretory Immuno globulin A concentration (SigA) levels and found a marked increase in SIg levels which influenced mucosal immune function response to exercise in elderly people over 75 years of age.

Shimizu et al., (2007) studied the effect of exercise, age and gender on salivary secretory Immunoglobulin A (SIgA) in elderly subjects and found that enhancement of mucosal immune function following regular to moderate exercise training occurs in elderly. Studies in healthy centenarians also suggested that an appropriate regular regimen of endurance exercise might help elderly to preserve their immune function (Vengatraman and Fernandes, 1997).

2.2.3 Psychosocial Problems

The Indian society has always considered the elderly indispensable for the community, assuring a well defined status and security for them (Shearer, 2002). They were considered treasure troves of culture, knowledge and wisdom and their learning and experience were the only source of transferring occupational skills and cultural values. But the impact of several factors like industrialization, urbanization and education have eroded these traditional concepts and therefore the elderly to a great extent are not enjoying the authority and security as earlier (Singh, 2004; Mehta, 2001; Rao 1999 and Kumar 1996).

Studies by Pushpam (1999) have shown that the problems of elderly are compounded by the feeling of insecurity and dependence. They suffer from a feeling of dispossession and reflect loss of roles and status as they are deprived of their earlier identities. Attitude towards old age, degradation of status in the community, problems of isolation, loneliness and generation gap are the prominent thrust areas resulting in socio-psychological frustration among old persons.

Specifically the needs and problems of elderly vary according to their age, family background, health, economic status and living environment as they are by no means a homogenous group (Swaminathan, 1996). Pushpam (2004) also opined that most of the problems of old people are feelings of insecurity, maladjustment, constant fear of ageing and death, loss of self esteem, conflict with younger generation, disappointment from family, dependency, frustration, depression and feeling of loneliness. Moli(1994) was also of the opinion that food, clothing, housing, emotional security, attention and recognition are the generally expressed primary needs of the elderly.

The Chronic Poverty Research Centre has identified the elderly as one of the groups likely to be vulnerable to chronic poverty (Rajan, 2004). In a nationwide survey (NSSO, 1991)it was found that 34.2 percent of rural elderly were financially independent as against 28.94 percent of the their urban counterparts. Rajan (1999) has also found that elderly having no substantial assets or a good source of income

and who are economically dependent find the attitude and behaviour of their family members as unsatisfactory.

Other psychosocial problems of elderly included loss of prestige and status, alienation and loneliness, neglect and lack of attention and care, alcoholism and disengagement (Help Age India, 1999). Further the plight of disabled aged, widows and widowers, chronically sick and the homeless elderly call for immediate attention (Sudhir, 1998).

According to Ganguli et al., (1999) psychosocial problems cripple the elderly most. The high degree of financial uncertainity when not engaged in active work and the loss of prestige and authority lead to development of a negative self image. Social isolation and loneliness are also commonly experienced. These may all mount up to depression in many older people.

Pawaskar (2007) stated that impairments in daily activities and lower health related Quality of Life (HRQoL) were specific predictors of depressive symptomatology in elderly. Jongenelis et al., (2004) adds risk indicators for depression to be pain, functional limitations, visual impairments, loneliness, lack of social support, negative life events and perceived inadequacy of care. Johnson (2005) identified a wide range of factors have a negative influence on the health and nutrition of elderly including lack of family support, economic constraints, loneliness and feeling of unwantedness .He also suggested that at risk elderly had lower levels of social support ,life satisfaction and higher levels of depression.

Reports by Solomons (1992) also indicated that fears associated with ageing resulted in emotional stress, loss of appetite and reduced food consumption Consequently they recommend optimal physical treatment and special focus on psychosocial factors to be major goals in developing care programmes for the elderly.

Several nutritional factors have been associated with depression. One of the common causes of weight loss in elderly is depression. Wurtman and Wurtman (1998) have shown that carbohydrates influence brain serotonin levels and in

individuals under stress a preference for sweet, simple carbohydrates have been demonstrated (Christensen, 1997). .The most common cause of weight loss in the elderly was found to be depression also. Marcus and Berny (1998) reported that elevated levels of corticotrophin releasing hormone in the cerebrospinal fluid of depressive patients plays a role in the pathogenesis of anorexia in depression .There is also a growing body of evidence which links omega 3 fatty acids to aetiology of depression (Feet and Edwards, 1997; Hibbeln and Salem, 1995). Variation in rates of depression found in different countries also correlate with fish consumption. (Hibbeln and Salem, 1995).

Another important psychological problem which affects older people is dementia and associated problems. Two epidemiological studies of dementia conducted in older residents in Chennai and a rural block of southern India showed a prevalence of 27 per 1000 and 36 per 1000 respectively (Raj Kumar and Kumar, 1997). Tzeng et al., (2002) reported that 15 to 20% dementia may be caused by problems of vascular system such as stroke, hypertension and atherosclerosis. Vas and Robinson (2001) reported an overall prevalence of dementia as 18 per 1000 for those aged 65 years and above in an urban population in Mumbai.

Patients with dementia can have difficulty in interpreting sensory data relating to vision, taste, smell or touch. German et al., (2008) found that after controlling for age, cognitive status, functional ability and number of illnesses, undernutrition was significantly associated with depression. Park and Suh (2007) recommended focus on psychological well being of elderly as a higher depression score was found to be significantly related to a higher risk of becoming malnourished. Nutritional risk was found to be associated with diminished cognitive status and diminished self care ability, but not associated with living alone as reported by Pearson et al., (2001).

Many of the psychosocial problems have been identified to be risk factors for malnutrition among the elderly as evident from the following studies. The risk factors for poor nutritional status of older persons as summarized by Bermudez and Dwyer (1999) included socio economic status (low income, low education, single marital status or living alone), mental and physical functioning (physical disability,

difficulty with activities of daily living, poor cognitive function and depression), health status (lack of access to health services, presence of chronic illness, dental / oral problems, over or under medication), health behaviours (sedentary lifestyle, alcohol consumption, drug use, smoking), lack of hygienic environment or potable water) and food access (limited food availability, food fads and taboos, lack of knowledge on food selection).

Leaf (1992) also enlisted a variety of physiologic, psychologic, economic and social changes accompanying ageing that compromises nutritional status. According to Tripp (1997) the nutritional risk factors affecting the elderly included inappropriate food intake, poverty, social isolation, multiple and chronic medication use, decreased functional status, changes in physiology, advanced age, morbidities, oral health problems, sensory impairment and cognitive or emotional impairment.

Cook et al., (2002) reported that the most common risk factors for poor nutrition among elderly were eating alone, not having enough money for food, having illness or conditions affecting eating ,eating few meals per day and polypharmacy. Lack of care, poor economic status, social deprivation and inappropriate dietary intake will lead to multiple nutritional deficiencies in elderly (Venkateswarlu et al., 2003).

Since old people are isolated, are on a low income or disabled, socio economic factors and disease together are likely to have more influence on their nutritional status than age alone as indicated by Dawson (1990).Health and social factors affecting food choices as reported by Wylie et al., (1999) pointed out inadequate money, food storage facilities loneliness and bereavement to be linked to poor nutritional status. Natarajan et al., (1991) also found that a combination of lack of finance, poor knowledge about nutrition, environmental factors and hygiene, poor dentition, loneliness and physical disability to be the main factors responsible for multiple nutritional deficiencies in the elderly.

Mehta and Shringarpure (2000) also found a strong influence of financial status on nutritional status of elderly. Schuler et al., (2003) also opined that nutrient intake and socio economic characteristics significantly affect the nutritional status

of the elderly. On similar lines Robinson (2001) reported that economic status of elderly greatly influenced their nutritional status.

Economic status of elderly as reported by Robinson (2001) plays an important role in their nutritional status. Coleman and Krondal (1993) observed malnutrition among elderly people who were impoverished or have an isolated household. Poverty due to joblessness will be a hindrance to elderly for affording protective foods as reported by Solanki (1986). Prakash (1999) reported alteration of diet during ageing to be linked to retirement, economic factors, loneliness, change in taste and masticatory performance or a combination of these factors.

Stitt et al., (1995) specifically monitored the effect of income on nutritional status of elderly people. The study revealed that dietary intake of low income subjects showed substantial short falls from Recommended Dietary Allowances and it was not due to ignorance or mental decline. Weimer (1997) also found that low income elderly have a substantially greater risk of deficient calorie, calcium, magnesium and zinc intakes than do elderly as a whole.

Castel et al., (2006) evaluated gender differences in nutritional risk of older people and concluded that being a female increased risk of under nutrition by 3.3 fold. Nutritional risk for men was associated with higher depression score, longer hospitalization and poor appetite whereas for women lower functional status and higher morbidity levels were significant factors.

Ritchi indicated that low educational level was significantly associated with a low BMI (Ritchi et al., 1997). Murphy et al., (1990) assessed the impact of social factors and found that companionship was positively related to appetite and nutrient intake. Goyal and Goyal (1999) substantiated that social factors like widowhood may intervene to change the diet of elderly and lead to potential health problems.

Steele (1998) also found that the choice of social factors like when, where and with whom to eat were much limited for the elderly, thus negatively affecting their nutritional status. Guigoz (2006) reported a complete review of literature on preparing on prevalence of mal nutrition on various population segment of elderly.

The prevalence ranged from two percent in community dwelling elderly to 23% in hospitalized elderly. Institutionalized elderly had a prevalence of 21 per cent.

Studies on protein-calorie nutrition in institutionalized elderly produced markedly different results than those reported for community dwelling elderly subjects. Although total energy intake is not reported to be lower in institutionalized subjects, the proportion of subjects with clinically apparent undernutrition was much higher as reported by Sandman et al., (1987) and Pinchcofsky et al .,(1986).

Rudman et al., (1990) hypothesized that higher prevalence of malnutrition in institutionalized elderly resulted from an increased energy requirement secondary to multiple infection and other chronic illnesses in the institutionalized population.

A widely cited study published in 1986 by Baker et al., provides a major basis for the claim that micro nutrient requirements may be increased in institutionalized elderly persons. Chen and Fan Chiang (1986) assessed riboflavin and vitamin B_6 nutritive in a sample of institutionalized elderly and found evidence of riboflavin deficiency in 34 percent and B_6 deficiency in 56 percent of the population.

Data from developed countries show that the prevalence of undernutrition is not very high in free living elderly (5-8%) (Cederholm, 1992; Lowink, 1992) but in nursing homes, homebound elderly and hospitalized elderly, it reaches significant levels (Constans et al., 1993 and Volkert et al., 1992). Undernutrition in the elderly is associated with higher mortality and morbidity (Sullivan et al., 1991), delayed functional recovery (Davalos et al., 1996) impaired immuno-competance and wound healing (Closs, 1993), organ system dysfunction and more frequent hospitalizations (Sullivan, 2000).

In institutions, lack of supervision and assistance at meal times maybe an important factor resulting in poor food intake as found by Hoffman (1993).Hollis and Henry (2007) have reported that older people permanently residing in institutions are at an increased risk of developing under nutrition partly due to lack of dietary varieties.

2.3 Nutritional Assessment of Elderly

Nutritional assessment is a process of several evaluations which when combined defines an individual's nutritional status (Charles, 1998). Nutritional assessment has several prognostic implications and nutritional variables are now considered a cardinal component of multidisciplinary assessment in acute care setting . Nutritional assessment can take two forms – a screen which identifies those at-risk individuals or a detailed assessment of risk degree and severity using a score system which when repeated at subsequent intervals can map the risk progression and even give an indication of the success of any intervention (Guigoz,1994).

The principal reason for continued focus on nutritional status in the older adult is due to the widespread occurrence of under nutrition in this age group (Keller, 1993, Mowe and Bohmer, 1991). Therefore accurate assessment of the nutritional status of elderly assumes importance. But due to the great individual diversity, the ageing segment of the population presents unique problems in the assessment of nutritional status (Shils and Young, 1988). So many factors have to be integrated to provide a comprehensive picture of the nutritional status of aged individuals that the process becomes complex and multidimensional.

Combinations of standard measurements of anthropometric, biochemical, clinical and dietary indices have been selected by most researchers to assess nutritional status of elderly.

2.3.1 Anthropometry

Anthropometry is the measure of body size, weight and proportion. Anthropometric characteristics of individuals and populations are simple and strong predictors of future ill health, functional impairment and mortality (WHO TRS 854, 1995). Technical Report Series of the WHO (1995) has highlighted that in elderly individuals who are not in ideal health, anthropometry has limitations both in the application of methods and in interpretation of results. It also recommends that clinicians recognize the limitations of using anthropometry in such individuals.

Anthropometric measurements in elderly will therefore be meaningful as long as body systems are in homeostasis, the measurer is trained in anthropometric techniques, equipment required is available and standardized and body sites used are also standardized (Charles, 1998).

The values obtained in the older adult will be affected by reduction in stature (as body height declines by 10-20 mm per decade after 55 years of age), changes in the amount and distribution of body fat and altered tissue elasticity and compressibility (Chumlea et al., 1998).

Little information regarding the use and suitability of anthropometry in older adults was available until Chumlea et al.,(1987) standardized methodology, recommended equipment and established reference values, though several reference data are available from Celtic populations (Lehman et al., 1991) and Europeans (De Groot et al., 1992). World Health Organization recommended collection of data to describe local levels and patterns rather than universal reference data (WHO, 1995).

2.3.1.1 Height

Height is important in nutritional assessment as it is expected to be constant and therefore a reference point against which other measurements are compared. However, height decreases with age.

Estimates of height loss range from 1.2 cm / 20 years to 4.2 cm / 20 years. Loss of height is due to the thinning of vertebrae (kyphosis) and osteoporosis as documented by several studies (Pieterse, 1999; Kwok and Whitelaw, 1991). Wahlquist and Flint (1988) reported vertebral compressions in height and alterations in shape of vertebral discs with aging. Furthermore postural changes such as bowing of the legs and bent knees due to decreased muscle strength might also lead to inaccurate height measurements (Pieterse, 1999). WHO (1995) also reported that the Standard BMI cut off values may not be appropriate for use in individuals 70 years and over, because of age related changes in body composition and hence their relationship to final outcome.

A number of studies have demonstrated that other skeletal measurements might be employed as alternative to height when assessing the nutritional status in older age groups (Kwok and Whitelaw, 1991; Allen, 1989 and Bassey, 1986,). The long bone measurement, armspan, has been shown to approximate to height at maturity and is relatively independent of ageing (Reeves et al, 1996), suggesting that it may offer an alternative to height in calculating BMI in older populations (Kwok and Whitelaw, 1991). However most of the studies that looked at the association between armspan and height have focused on specific ethnic groups. Large differences in the association between height and armspan in varying ethnicites have been noticed (Reves et al., 1991).

Lucia et al., (2002) found that armspan and height of elderly subjects highly correlated in all ethnic groups studied and concluded that armspan can be used as a proxy for height to estimate BMI, if sex and ethnic group specific cut offs are applied. WHO (1995) has also confirmed that it is possible to estimate true height from armspan in elderly people who have conditions limiting their ability to stand straight (eg. Kyphosis) offering a simple and easy way of assessing nutritional status of older adults.

2.3.1.2 Weight

Body weight is clinically important as an independent predictor of increased mortality (Charles, 1998). Weight also declines with age, but the pattern of change is quite different from that of height and varies by sex. In affluent countries the average weight of both men and women increases through middle age. But, weight gain in men tend to plateau at around 65 years and weight generally declines hereafter; in women, however the weight increases are frequently greater and the plateau occurs about 10 years later than in men (WHO, 1995).

Body weight varies not only among individuals but also within a given individual during ageing. Reduction in body water content has been reported as an important cause of decline in weight after 65 years (Steen, 1992). Changes accompanying weight loss include a decline in muscle cell mass and cell mass in general, which is more pronounced in men (Micozzi and Harris, 1990). General

muscle strength, gait and balance may also be impaired in the elderly, thus increasing the risk of falls and consequent injury (Vellas et al., 2000). Functional ability of older persons are generally found to correlate well with lean body mass and muscle mass (Frontera, 1991).

The importance of monitoring body weight of elderly especially in institutionalized settings has been stressed by Dwyer (1994) and Potter (1988). A four to five percent unintentional weight loss over a one year period is clinically significant as reported by Wallace (1995). The study found association of weight loss with loss of skeletal muscle, decreased bone mass, restricted reserves and decreased compensatory abilities.

Morley (1998) also suggested weight loss as one of the most sensitive indicators of individuals at risk for developing malnutrition. A weight loss of greater than 10 percent of the individual's previous weight is highly suggestive of malnutrition. The issue of whether associations between weight and mortality change with age has been a subject of intense debate (Willet, 1997).

The effect of age on body weight associated with the lowest mortality and the effect of age on the mortality risk associated with obesity among older adults are complex issues. Many observational studies suggest that weight changes (weight increase, weight loss and weight fluctuations) are predictors of mortality (Seidell and Visscher, 2000). Current evidence (Stevens, 2000) suggested that body mass index associated with the lowest mortality falls within the range of 18.5 to 24.9 in men and women between the ages of 30 to74.

Lehmann et al., (1991) have described a range of desirable weights for the older adults. Medical screening is recommended for those individuals who are below the 10^{th} centile of this data.

For those countries who have no local anthropometric data or that lack the resources to develop them, the WHO expert committee (1995) recommended the use of National Health and National Examination Survey (NHANES) – III data for comparison purpose. These data are pertinent if used exclusively as reference data

for comparison purposes, that is, to compare means and standard deviations across populations. This provides a gold standard for comparison of body weights of older individuals.

In young and middle aged men and women, there is evidence that overweight is associated with excess morbidity and reduced life expectancy. However Campbell et al., (1997) and Mattila et al., (1986) postulated that being moderately overweight is not associated with any excess mortality risk whereas underweight is associated with increased mortality, increased risk of fractures, infections and specific nutrient deficiencies. Campbell (1997) reported that anthropometric indicators of low body weight, low body fat stores and low muscle bulk were associated with an increased risk of death. Mattila (1986) found a progressive increase in the five year survival rate of the elderly over 85 years, as the BMI increased.

2.3.1.3 Body Mass Index

WHO (1995) reports indicated that the average Body Mass Index tends to increase in middle age and stabilizes somewhat earlier in men than in women. In men the plateau begins at 50 to 60 years whereas in women it starts 70 years or later. Both sexes generally show decrease in average BMI after 70-75 years of age (Waaler, 1988).

Data from NHANES I and II have shown that BMI is more highly correlated with subcutaneous fat in younger than in older men and women and with muscle mass in older than in younger adults (Micozzi and Harris, 1990). However age related changes in vertebral morphology influences mobility, balance and posture of older subjects. Body height and weight changes with age have also been documented (Willet, 1997).

These age related changes may make use of the standard classification system for BMI less reliable (Webb and Copeman, 1996). Also, the basic assumption of using the BMI values to grade nutritional status is that increasing weight at any given height reflects increasing amounts of stored fat. In elderly

people, especially elderly women, loss of bone and lean tissue may mean that the amount of body fat is much higher than the BMI would suggest (Chumlea et al., 1998).

Expert consultations on nutritional assessment of elderly people (COMA, 1992 and WHO, 1995) recommended that there should be more research aimed at clarifying the prognostic significance of BMI in the elderly. The relationship between mortality and BMI was u-shaped with a tendency for mortality to rise at the extremes of BMI (Rissanen, 1991).

The reference values for Body Mass Index specially for elderly are ill defined. Bailey et al., (1995) suggested values of less than 19 as underweight, 19 to 21 as normal, 21-23 as overweight and more than 23 as obese levels for elderly. Nutrition Screening Initiative (NSI) USA has adopted BMI cut offs of less than 22 as undernourished, 22 to 27 as normal and >27 as overweight for the elderly. The BMI cut offs suggested by the WHO (1995) are <18.49 undernourished, 18.5 to 24.99 as normal and >25 overweight. Coelho et al., (2006) compared the cut off values suggested by NSI (1992) and WHO (1995) and concluded that NSI cut offs relate specifically to older individuals, whereas WHO data is not specific for elderly individuals and were derived from extrapolation of data obtained from younger individuals.

As given by WHO (1995) conventional BMI cut offs for defining CED may not be appropriate for older people 70 years and over because of age related changes in body composition but fail to propose alternative. However all the classical studies on nutritional status assessment of older persons the world over have included BMI as a parameter and the data have been mostly presented as means, SDs and percentiles and compared to NHANES III data as proposed by the WHO (1995).

2.3.1.4 Mid Upper Arm Circumference

MUAC has emerged in the literature as a potential screening tool for poor nutritional status. James et al., (1994) analyzed its usefulness in adults and

calculated cut offs equivalent to Body Mass Index (BMI) and chronic energy deficiency (CED) using a range of data sets from developing countries. Ismail (1999) reported that with good training highly reliable MUAC values could be achieved. A MUAC cut off value of 21.7 in which had a sensitivity of nearly 86 percent in relation to a BMI cut off of 16 kg/m^2 was also suggested by Ismail (1999) as an alternative to BMI as part of a screening in an emergency.

Mid Upper Arm Circumference is particularly useful in bed ridden elderly patients. Webb and Copemann (1996) suggested a cut off value of less than 22 cm to indicate increased risk of malnutrition in elderly.

Deurenberg and Roubenoff (2002) described equations using mid upper arm circumference in combination with triceps skinfold thickness to obtain information on muscle mass and fat mass of the upper arm. Average value from NHANES for Mid Arm Muscle Circumference (MAMC) have been compiled by Frisancho (1981) and Bishop (1981). These values do not show significant decreases between the ages of 30 and 70 years and are not consistent with the knowledge that decrease in lean body mass occurs with age. Therefore the WHO (1995) recommended using the 5^{th} percentile values of NHANES data as reference values, in the absence of age, race and sex specific normative data reflective of each age decade through the age of 90 years.

Collins et al., (2000) reported that the use of MUAC may be affected by the redistribution of subcutaneous fat towards central areas of the body during ageing. But still MUAC as an indicator of muscle development would identify acute adult malnutrition and estimate prevalence of undernutrition at a population level.

2.3.1.5 Calf Circumference

Calf circumference is considered to provide the most sensitive measure of muscle mass in the elderly and is superior to arm circumference. It indicates the changes in fat free mass that occur with ageing and with decreased activity (Conceino, 1993).

WHO (1995) reported that changes in fat free mass occur with ageing and decreased activity. On retirement men in developed countries tend to spend an increasing amount of time in sedentary activities which explains age-related loss in fat free mass. A significant negative correlation between age and calf circumference is noted in elderly men but not in women and may be due to general loss of muscle in response to the reported greater reduction in physical activity among men than women. Calf circumference is considered the most sensitive measure of muscle mass in the elderly. Bonney et al., (2002) also reported that calf circumference is a pertinent marker of nutritional state in the elderly.

Cuervo et al., (2009) assessed the utility of calf circumference as an indicator of the risk of malnutrition in elderly. The study concluded that an association between calf circumference and the risk of undernutrition was highly significant and the association was similar among men and women in all age ranges.

2.3.1.6 Body fat measurements

Triceps skinfold measurements provide an estimate of fat stores as measured by a skinfold caliper. The deltoid triceps is reported by many (Russell et al., 1985; Kwok et al., (1997) as an ideal site for skinfold measurements in elderly since this area is usually absent of oedema. The skinfold measurements appear most appropriate as an anthropometric measurement for the elderly because they are less affected by state of hydration than is weight and are relatively independent of height (Bowman and Rosenberg, 1982).

Garcia et al., (2005) developed improved predictive regression equations by combining skinfold thicknesses with circumferences and / or bone breadth measures to provide a more precise prediction of percent body fat in comparison with established skinfold equations. Triceps skinfold measurements are variable from study to study and few measurements have been reported on which a standard may be based.

Results from Ten State Nutrition Survey (TSNS) suggest that the TSF is relatively independent of age in men but affected by age in women. This trend was also observed by Bishop and associates (1981) when examining triceps skinfold measurements from cross sectional data collected by NHANES I. Norms for triceps skinfold as recommended by WHO (1995) need to be derived from NHANES – III data for developing countries.

The use of bioelectrical impedence to calculate the body composition in elderly is difficult since most equations have been found to be inadequate, especially in malnourished elderly (Norman et al., 2007).Bauer et al., (2007) opined that due to unsolved methodical problems, bioelectrical impedance analysis can currently be recommended only to those who are experienced with this method and its limitations.

2.3.2 Biochemical assessment

A diet may appear to be adequate when assessed according to the present dietary standards, yet a change in metabolism and decreased absorption of nutrient may lead to biochemical deficiencies. WHO (2002) has indicated that it is unusual that food intake will explain even 50 percent of variance in blood, urine or tissue levels of that nutrient. WHO reports indicate that biomarkers are more likely to indicate various genetic and lifestyle factors. Interpretation of biochemical results is limited for the same reasons found when interpreting dietary and anthropometric parameters.

Not only might the ageing process itself affect the metabolism of nutrients, resulting in altered biochemical values as well as an altered ability to utilize nutrients, but standards and results that are used for interpretation of biochemical values vary from study to study (Shils et al., 1995).

2.3.2.1 Serum protein markers

Reports on serum protein values in the elderly adult population are conflicting. The TSNS reported that the prevalence of low values of serum protein

appeared to increase with age. Reduced organ function associated with ageing may result in low serum protein among the elderly (Cereda and Pe drolli, 2009).

In a classical study on serum albumin values in elderly, serum albumin values were approximately 0.4 g/dl lower in people over the age of 80, as compared with people over the age of 40. In this study, it appeared that the lower albumin level could not be pushed higher with dietary protein, indicating that a lower set point for albumin synthesis may occur with the ageing process reported. Lack of normative values for serum albumin or pre-albumin that may be applied specifically to the elderly population and recommended using a cut-off point below 20 percent the lower limit as an indication of malnutrition. (Kuzuya et al., 2007)

A study conducted by Sergi et al., (2006) found that albumin, pre-albumin and Retinol binding protein were significantly lower in underweight elderly subjects and suggested that these indices were useful in detecting malnutrition in the elderly. Miyazaki et al., (2002) focused on Serum albumin is a marker of long term protein intake and concentrations less than 35g/l was found to be a risk factor for protein-energy malnutrition.Banks et al., (2001) has also documented a decrease of some negative acute phase proteins like transferrin, albumin and Retinol Binding Protein in malnourished elderly.

Omran and Morley (2000) detected significantly reduced pre-albumin and Retinol Binding Protein in underweight elderly. A correlation between hypo albuminemia and mortality in general elderly population (Corti et al., 1999) and in hospitalized older patients (Sullivan et al., 2000) has also been reported.

Wallace (1995) have documented adult Kwashiorkor in elderly patients with inadequate protein and calorie intakes. According to him decreased serum albumin with a longer half life is a poor marker of malnutrition. The cut off values suggested were 2.8 – 3.4 mg/dl indicating mild deficiency. 2.1 – 2.8 mg/dl n moderate deficiency and < 2.1 mg/dl indicating severe deficiency. Bauer et al., (2006) also reported that diagnosis of serum albumin is of minor importance due to its low specificity.

Decreased serum pre albumin or transthyretin which is more sensitive than albumin due to shorter half life is suggested by Wallace (1995) .Other indicators suggested to screen for elderly malnutrition are Retinol Binding Protein, fibronectin, serum transferrin and serum TIBC. But inflammatory conditions elevate these parameters and poor sensitivity is seen in such conditions.

Bouillanne et al., (2007) determined the biological parameters best related to anthropometric markers of malnutrition in elderly. Nutritional status (BMI, skinfold thickness , albumin, transthyretin) and biological parameters (leptin, IGF – I, C-reactive protein (CRP) were assessed. They concluded that leptin concentration is highly correlated with anthropometric data whereas albumin or transthyretin are also known to be influenced by morbidity and inflammatory conditions.

Lemonnier et al., (1991) had also reported that there was discrepancy between anthropometry and biochemistry in the assessment of nutritional status of the elderly. Usual blood parameters and biochemical markers of protein and energy status (viz. albumin, transthyretin, transferring, somatomedin C as well as serum levels of apolipoproteins) were not affected in the depleted group. However moderate iron deficiency and marked zinc deficiency were found in malnourished elderly. Sergi et al., (2006) investigated the reliability of visceral proteins (albumin, prealbumin, retinol binding protein and transferring) in evaluating nutritional status and their relationship with Fat Free Mass. They concluded that visceral proteins except transferrin were useful in detecting malnutrition and suggested careful evaluation of normal values also.

Berner (2003) also substantiated that nutritional assessment using objective biochemical markers was complicated in elderly due to metabolic changes which affect routine biochemical tests and the reference values for anthropometry being not age adjusted.

2.3.2.2 Hematologic Indices

Evidence indicate both a reduction in hematopoiesis and increased incidence of anaemia in the aged (Ramel et al., 2008). WHO (2002) recommended

haemoglobin estimation and blood film indices as invaluable and cost effective in an assessment of elderly population. However whether the lower hematologic values reflect effect of the ageing process remains controversial and interpretation of hematologic findings remain complex (Cunietti et al., 2004).

Yearick and Associates (1990) reported low levels of folate among elderly subjects but these findings did not appear to correlate with any hematologic parameters. Low serum folate in elderly have also been reported by Mulligan et al., (2007). However correlation between low folate values and low haemoglobin were not found.

Among nursing home residents low mean haemoglobin and hematocrit values were observed in patients with adequate mean folic acid, plasma iron and transferrin saturation. Both TSNS and NHANES reported a high prevalence of low haemoglobin and hematocrit levels among the elderly subjects. Both surveys also revealed low serum iron and serum transferrin levels in the elderly.

However the above studies excluded iron deficiency as its cause and confirmed the effect of age and sex on biochemical measures. Johnson et al., (1994) have indicated normative changes in iron status indicators with age .

2.3.2.3 Other Biochemical Markers

WHO (2002) recommended the use of Total Lymphocyte Count (TLC) as an index of immune function, since no known decreases in lymphocyte counts occur with age. However cell function does decrease with age. Though a low values, when considered TLC is associated with decreased serum albumin values, when considered alone, TLC is a poor prognostic indicator, reflecting changes in immunological function secondary to PEM. WHO (2002) indicated the use of antibody level testing following vaccination also to be a useful immune indicator.

Biochemical and other indicators of nutritional deficiency have been found to be associated with reduced responses in immune function tests in disease free, elderly people. Nutritional supplementation has been associated with improvements

in both the measures of nutritional status and the measures of immunocompetance (Chandra, 1992).

Woo et al., (1994) has also reported that various measures of well being and measures of nutritional status were higher in supplemented group of elderly than in the controls. Trauma whether surgical or accidental also has an immuno suppressive effect as reported by Lennard and Browell (1993).

WHO (2002) recommended low technology dry chemistry techniques to assess metabolic disorders like glycaemic disorders and lipid disorders as realistic options. The shift towards chronic non communicable diseases in disease patterns among older persons make estimations of the same highly valuable.

Studies conducted at NIN (2001) on Indians to compare the activity of a key antioxidant enzyme, glutathione peroxidase between young and old subjects. The study showed that there was a significant decrease in the activity of this enzyme in subjects above 60 years as compared to normal controls of 40 years and below.

2.3.3 Clinical assessment

Clinical assessment of nutritional status attempts to identify the initial nutritional state as well as the interplay of factors influencing the progression of nutritional abnormalities (Jee jeebhoy and Keith, 2005).

WHO (2002) identified two caveates which need to be recognized in interpreting clinical studies namely non specificity of the earliest clinical signs of malnutrition and the fact that single nutrient deficits rarely occur alone.

Also, the use of clinical signs to diagnose malnutrition may be less applicable in the elderly than in younger age groups since many changes that accompany the aging process closely resemble specific signs of malnutrition (Russell et al., 1998). Therefore clinical data should be corroborated with dietary, anthropometric or biochemical data in order to make a definite judgement as to nutritional inadequacy (Baker et al., 1986). Bauer et al., (2006) specified general

muscular atrophy, loss of subcutaneous fat and signs of nutrient deficiencies to be of value in clinical assessment of elderly.

In the NHANES survey, (Lowenstein, 1990) clinical signs of niacin deficiency were seen in 15 percent of elderly. However the symptom was more prevalent among upper income groups. Similarly bleeding gums were found to have no correlation with vitamin C dietary intakes. The clinical signs suggesting malnutrition present in more than 5 percent of elderly were atrophy and fissuring of tongue, absence of knee and ankle jerks, bowing of legs, follicular hyperkeratosis and bleeding gums. However evidence was lacking that these signs actually represented malnutrition of specificnutrients.

Other factors that may result in poor clinical outcome among the elderly are depression or loneliness, chronic illness, medication usage, chronic obstructive pulmonary disease or cancer, use of diuretics, changes in gastro intestinal and liver functions, decline in taste and smell acuity, ill fitting dentures, difficulty in swallowing and neurologic disabilities. (Payette et al., 2000). Since most of the malnutrition cases in developed countries are subclinical only, using functional tests along with the clinical assessment may reveal such instances.

According to Prabavathy and Tamilarasi (2005) many of the nutritional deficiency symptoms that occurred in older persons were either a result of reduced appetite and intake, impaired absorption or excessive utilization. Kehli et al., (1998) on nutritional assessment of the North Indian elderly found that there is a higher incidence of chronic diseases with advancing age and nutritional deficiencies play an important role in the occurrence and susceptibility to these symptoms. A nationwide survey conducted by NSSO (1991 and 2004) also revealed that about 45 percent of the Indian elderly presented one or more of poor clinical outcomes.

2.3.4 Dietary assessment

Methods used for carrying out diet surveys are varied. Weighment of food items before consumption (prospective) and oral questionnaire to recall the food

items consumed already (retrospective) are the well utilized methods of such surveys.

Very few studies are available in India about the agreement between these diet survey methods. Pasricha (1959) stated that the oral questionnaire method was just as reliable as the three day weighment method and recommended the oral questionnaire method as the more suitable of the two methods for the computation of dietary intake of individuals in the clinic and field.

Swaminathan (1996) also found that the interview questionnaire method was as good as the commonly used weighment method for estimating dietary pattern and nutrient intake level of communities belonging to low socio economic group and there was a good agreement between the two methods to assess the intake of minerals, vitamin A and proximate principles.

Szostak (1994) opined that a combination of different methods provides more reliable information than the use of a single method, but cautioned against such usage unless standardization of such methods are done by international organizations to be used in nutritional epidemiological studies.

Paired t – test results for both the 24 hour recall and seven day record provide about equally accurate estimates of the mean intake and that regression validity suggested that the recall is prone to over reporting and under reporting Gersovitz et al., (1978).

Borreli et al., (1989) observed that the agreement accuracy among three dietary assessment methods namely diet history, 24 hour recall and 3 day record was poor. While Posner et al., (1992) found that the estimate of group mean intake for 24 hour recall and 3 day record were with difference of less than 10 percent for most of the nutrients

Crawford et al., (1994) concluded that errors in food reporting and quantification can vary with the type of dietary methodology and that agreement

between observed and reported intake from 3 day food records made it the best overall choice.

Diet surveys by weighment and 24 hour recall methods were compared by a case study in Hyderabad, India by Rahman and Visweswara Rao (2000). Results indicated that in general there is under estimation of dietary intake in 24 hour recall compared to actual weighment of food items. But it was concluded that most of the food items and nutrients show an agreement between the two methods of diet survey with a few exceptions among the overall population and different income groups.

2.3.4.1 Computing dietary requirements of elderly.

Several surveys have been conducted to assess the nutritional needs of elderly, but only limited information can be inferred from these studies.

Confounding factors such as socio economic status of survey participants, rural and urban differences, life setting and sample size, limit the ability to compare and compile the results from several studies. Also individual differences in levels of physical activity, presence of a range of degenerative diseases and effect of drugs on nutrient utilization may affect the dietary needs of the elderly.

Therefore nutritional recommendations for the elderly have been derived mainly by extrapolation of data from younger adults. However recent studies (Boston Nutritional Status Survey (BNSS); New Mexico Ageing Process Study (NMAPS) and Euronut-Seneca Cross Sectional Survey) as reported by Hartz et al., (1992), Gary et al., (1992) and De Groot et al., (1991) have shed more light on the specific needs of the elderly in the West.

a) Energy

However the nutrient requirements for elderly in India have not been specifically worked out. Assumptions based on energy expenditure suggest that calorie intake may be decreased when compared to young adults.

The requirement of other nutrients for the elderly are recommended based on whether or not the nutrient is a function of energy intake (Prabhu, 1998). The reduction in energy requirements on ageing is attributed to the decrease in Basal Metabolic Rate (BMR) due to reduction in muscle mass tissues and physical activity. The ICMR (1995) recommends a 25% reduction in calories for the elderly than the RDA of a sedentary adult. The calorie requirement suggested for Indian elderly men is 1800 kcal and that for elderly women is 1400 kcal. Further it is recommended that the calorie intake should be adjusted to maintain constant body weight.

Hagopian (2009) reported that energy restriction retards ageing process in humans and prolongs life, due to decreased production of free radicals reducing oxidative stress and resultant improvement in functioning of organ systems. But Russel and Suter (1993) estimated that when energy intake is lower than 1200 Kcal/day it becomes difficult to meet the requirements of vitamins and minerals. Also Coma report (1992) pointed out the increased energy requirements of some older people who have long standing chronic illnesses or are suffering from dementia.

Nevertheless, Roberts et al (1993) have shown an underestimation of the amount of energy expenditure required for routine physical activities associated with daily living. They have calculated a ratio of 1.75 between Total energy expenditure and Resting energy expenditure. Saltzman et al., (1996) demonstrated impaired capacity possibly associated with increased body fat, for energy expenditure to adapt to short term changes in energy intake.

Pending final resolution of these issues the WHO (2002) suggested that the energy requirements of old age appear to be 1.4 to 1.8 times multiples of BMR to maintain body weight at different levels of physical activity. Levels of physical activity that result in energy requirements in the higher end of the range are desirable for reducing mortality and morbidity.

b) Calcium

Several large scale intervention studies have been completed in an attempt to arrive at calcium requirement for older persons based on the effect of calcium intakes on bone mineral loss (Prince et al., 1991, Polley et al.,1987).

Dawson and Hughes et al., (1984) suggested in the presence of adequate vitamin D nutrition, calcium intakes in the range of 800 to 1200 mg/day has a beneficial effect on bone mineral density of the femur, neck and lumbar spine and a reduction in fracture rates.

WHO (2002) reports indicate that high calcium intakes have the potential benefit of reduced blood pressure and decreased risk of colon cancer though data are insufficient to know for certain. Based on turnover studies by ICMR (1989),Pasricha and Thimmayamma(2000) recommended 880 mg and 865mg calcium intake for elderly men and women respectively.

c) Protein

The results of various studies on protein balance are difficult to compare since different nitrogen balance formulas were used and different assumptions applied. Campbell et al., (1985) assessed nitrogen balance data from four studies on older persons and determined that the overall protein requirement for older persons is 0.91 ± 0.04g/kg per day. This is higher than the 0.75 g protein/kg per day recommended by FAO/WHO/UNU consultation.(1985) .

Castenada et al., (1995) in a study assessing long term adaptation to marginal protein intakes in 12 older women (66 to 79 years). All women on lower protein intakes (0.45 g/kg/day) were in negative nitrogen balance and when nitrogen equilibrium was established, there was a decline decline in body cell mass by 8 percent. In contrast, women eating higher protein (0.92 g/kg/day) showed increased muscle mass and IGF-I levels, suggesting that this level of protein intake was more than adequate.

Campbell and Evans (1985) via a regression analysis from both low and high protein diets estimated a mean protein requirement of 0.78 g/protein/kg. WHO (2002) suggested an average of 0.9-1.1 g/kg per day as beneficial for older persons. ICMR(1995) has also adopted the above recommendations and suggested 60 gm and 50 gm protein per day as the RDA for Indian elderly men and women.

d) Fats

FAO/ WHO joint expert consultation on fats and oils in Human Nutrition (1994) suggested that except where overweight and obesity are problems there is no further health benefit from restricting fat calories in older persons beyond 30% for sedentary and 35 percent for active older persons.

Robinson (1992) has also documented that fat restriction to 30 to 35 percent of calories with preference given to sources of fat high in PUFA is beneficial in old age. ICMR (1995) has also suggested the RDA of fat to be 50 gm and 40 gm respectively for Indian elderly men and women. The fat recommended is to contain at least 20 percent PUFA.

e) Folate

Macrocytic anaemia and serum folate values were used as markers of folate levels in elderly for a long time (Jagarstad, 1979 and Rosenberg et al, 1992). More recently, as reported by Selhub (1993) homocysteine levels have come to widespread use as a folate marker. The Boston Nutritional Status Survey (Rosenberg et al., 1992) identified 15% of older persons having deficient folate levels (<5µg/ml). There is also interest in the role of homocysteine as an atherogenic agent (Framingham heart study, 1993). The RDA for folate for Indian elderly has not been specified by the ICMR (1995).

f) Riboflavin

Boisvert et al., (1993) studied riboflavin depleted older persons and gradually repleted them with increasing amounts of dietary riboflavin. The slope of urinary riboflavin excretion rose sharply when intake was 1.1mg/dl which was

identical in younger adults. This contradicts earlier assumptions that riboflavin requirements diminish in older people.

g) Vitamin B_{12}

The absorption of protein bound vitamin B_{12} is poor in older people. However Carmel (1988) reported that absorption of crystalline vitamin B_{12} proceeds normally in the elderly. Many of the patients with malabsorption of protein bound vitamin B_{12} had atrophic gastritis, a prevalent condition affecting 10 to 30% of those over 60 (Hurwitz et al., 1997 and Krasinki et al., 1986).

The mechanism of protein bound vitamin B_{12} absorption in atrophic gastritis involves both maldigestion of the food protein - vitamin B_{12} complex in the stomach and uptake of any free vitamin B_{12} by the large number of bacteria that proliferates in the lower part of the stomach (Suter et al.,1991).

However there is no evidence that once absorbed vitamin B_{12} is metabolized differently in older persons than in younger people.

h) Iron

WHO (2002) indicated that iron absorption is not affected by ageing. Serum ferritin levels in older persons are difficult to interpret since inflammation can elevate serum ferritin (Yip and Dallman, 1988). Since iron is a pro-oxidant, WHO(2002) recommended additional research on whether there is progressive body iron accumulation with ageing and on possible linkages between iron status and chronic disease. On the assumption that there are no excessive iron losses, WHO (2002) has recommended 10 mg/day for older men and women. But the ICMR (1995) taking into account factors like poor quality of average Indian diet which contains non-haem iron mostly and the use of substances that lower iron absorption like phytates, tannins, antacids, EDTA and calcium and phosphate salts, (Lowenstein, 1990) recommended the RDA of iron for Indian elderly man and woman to be 42 mg and 38 mg per day respectively (Pasricha and Thimmanyamma, 2000).

i) Vitamin C

Many studies have reported age related declines in serum ascorbic acid concentrations however, the pharmokinetics of a 500 mg oral dose of vitamin C is no different between older and younger men (Blanchard, 1990). High vitamin C blood levels and / or intakes have been associated with a lower prevalence of senile cataract, higher HDL - cholesterol concentrations and lower incidence of coronary artery disease (Jialal et al., 1990 and Nyyssonen et al 1997). WHO (2002) reports indicated that an intake level of 60 to 100 mg / day to be adequate in older people. However, ICMR (1995) recommendations for Indian elderly are fixed at 40 mg / day.

2.3.5 Non invasive assessment methods

Use of valid and reliable tool to assess nutritional status has been absent in most of the geriatric assessment programme. Simple and rapid screening tests are however in use in comprehensive geriatric assessment of cognitive problems (Chumlea, 1996). Rubenstein (1997) reported that the use of well-validated instruments makes geriatric assessment more reliable and easier.The rapid assessment tool, the MNA(Mini Nutritional Assessment) was validated in two populations of elderly (Toulose 91 and Toulose 93). The results showed that MNA test can accurately assess the nutritional status of elderly as normal, borderline (at risk) or undernourished. Both normal and malnutrition classification were the same as those obtained using the nutritional clinical assessment by a physician, with comprehensive clinical files.

While the normal or well nourished group showed normal value for haemoglobin or albumin, the assessment of malnourished subjects corresponded to low serum albumin (Ferguson et al., 1993).Malnutrition in the elderly has been associated with greater susceptibility to infection, longer stay at hospital and higher morality (Tjani, 2000).

The Mini Nutritional Assessment (MNA), which is composed of simple measurements and brief questions that can be completed in about 10 minutes was

designed and validated to provide a rapid assessment of the nutritional status of frail elderly people in order to facilitate nutrition intervention (Guigoz *et al*., 2002).

The MNA has been validated on elderly population (>600 people) ranging in age from 65 to 90 years and above, from the very frail to the very active, in three successive studies (i) a study set on 155 elderly subjects from very healthy to severely malnourished elderly patients of Toulouse. (ii) Discriminatory potential of the MNA on 120 elderly subjects from the frail to the healthy elderly of Toulouse. (iii) A complementary validation study in a different cultural context on non-institutionalized elderly people from New Mexico Aging Process study (Guigoz et al., 1996).

The specificity of the MNA was performed by cross-classification of the two populations (Toulouse 1993 and Toulouse 1991) using the equations from the discriminant analysis. These results showed that for these two studies, the MNA without biochemical indices could definitely classify 70 to 75 percent of elderly people as normal or undernourished.

A study conducted by Chumlea (1996) at National Institute of Health on over 24 men and 37 women on the validation of MNA found that the MNA is an acceptable screening method for classifying the nutritional status of elderly subjects.

A study conducted to investigate the relationship between osteoporosis and nutritional status as determined by MNA by Salminen *et al*., (2006), in an elderly female population, showed that MNA scores indicating risk of malnutrition were more associated with coexisting diseases and medications than with the women's risk of having osteoporosis. Another study revealed that there is an association between BMD as assessed by DEXA and nutritional status indicated by the MNA questionnaire (Gerber, 2003).

A study conducted at two private nursing homes in Spain to assess the nutritional status (Lopez *et al.,* 2003), revealed that MNA test could identify the older people with the risk of malnutrition.

The researchers of Japan, evaluated the MNA test as a screening tool for malnutrition in the Japanese elderly population (Akner, 2005) from which it was concluded that MNA was a useful screening tool for identifying Japanese elderly with malnutrition or at risk of malnutrition.

Another study conducted in Finland among 270 house care elderly patients by Soini *et al*., (2004), to assess their nutritional status using MNA suggested that MNA is a useful tool in identifying malnutrition. Horn (2005) also reported that MNA provides an advantage over using visceral proteins in screening and assessing nutritional status of elderly with pressure ulcers.

The aim of determining validity is to assess how precise the screening tools are in identifying malnutrition among patients. The precision of a screening tool is compromised by the large-scale implementation and use by staffs, who have got only minimal training in nutrition (Burden et al., 2001).

Assessing the validity of a tool is hampered by the lack of one golden standard to determine nutritional status. Markers used for this validation can be subject to criticism (Burden et al., 2001).Initially the MNA was developed for and validated in relatively healthy elderly for assessing nutritional status. Later a shortened version of the MNA was derived for use as a quick screening tool. The MNA screening form has 98 percent sensitivity, 100 percent specificity and 99 percent diagnostic accuracy for predicting under nutrition (Henken *et al.*, 2005).

MNA was developed and validated among the elderly for detecting protein energy malnutrition (Guigoz and Vellas, 2002). It fulfilled the criteria of nutritional evaluation like sensitivity, specificity, cost and targeting to a specific group (Rush, 2004). It has now been translated by specialists into more than 15 languages and is freely available. The MNA allows physicians and health professionals to make a rapid and reliable evaluation of the nutritional status of elderly patients, to recognize those at risk of nutritional problems (Irvin *et al*., 1999).

III. METHODOLOGY

The methodology adopted for the present study entitled **'Nutritional Profile of Elderly in Kochi, Kerala'** is presented under the following headings.

3.1 Selection of Area

The State of Kerala lies in the South west corner of India. It constitutes only 1.18% of the total area of India but houses 3.4% of it's population. With regard to the social development indicators, Kerala is far ahead of any other Indian state and is even on par with some of the developed countries of the world. A striking achievement in this regard is the attainment of the third stage of demographic transition with lowest fertility and mortality rates in India. As a consequence, Kerala has the highest proportion of elderly in India (10.87%) as per the latest estimates (IIPS, 2009).

Unlike other parts of the country, the entire state of Kerala represents the picture of an urban rural continuum and Kerala society by and large can be termed as urbanized.

The selected area for the present study was Kochi, which is the largest urban agglomeration in Kerala. As per the City Development Plan (CDP), Kochi is demarcated into one corporation area, two municipality areas and thirteen panchayat areas for administrative purpose. The corporation area is further divided into 71 wards classified as rural, urban and coastal wards. Kochi comes under the administrative purview of Ernakulam district in Central Kerala.

Among all districts in Kerala, as per Census 2001, the highest number of elderly was enumerated in Ernakulam district. (2,97,261 persons). According to Helpage India statistics also (2005), Ernakulam district has the largest number of old age homes in India (49 old age homes).

The above data on the elderly and services for them is indicative of the rapid industrialization and urbanization which is underway in the study region. These changes will essentially reflect on the lifestyle of the population with possible impact on their health and nutritional status. This is relevant especially in Kochi which is hailed as the industrial capital of Kerala. Several recent studies have investigated the nutritional status of elderly in different parts of India. However, there is scanty information on the nutritional status of elderly in Kerala. Owing to the above reasons, the area of Kochi was selected for the present study.

Figure 1 presents an overview of the selected study region.

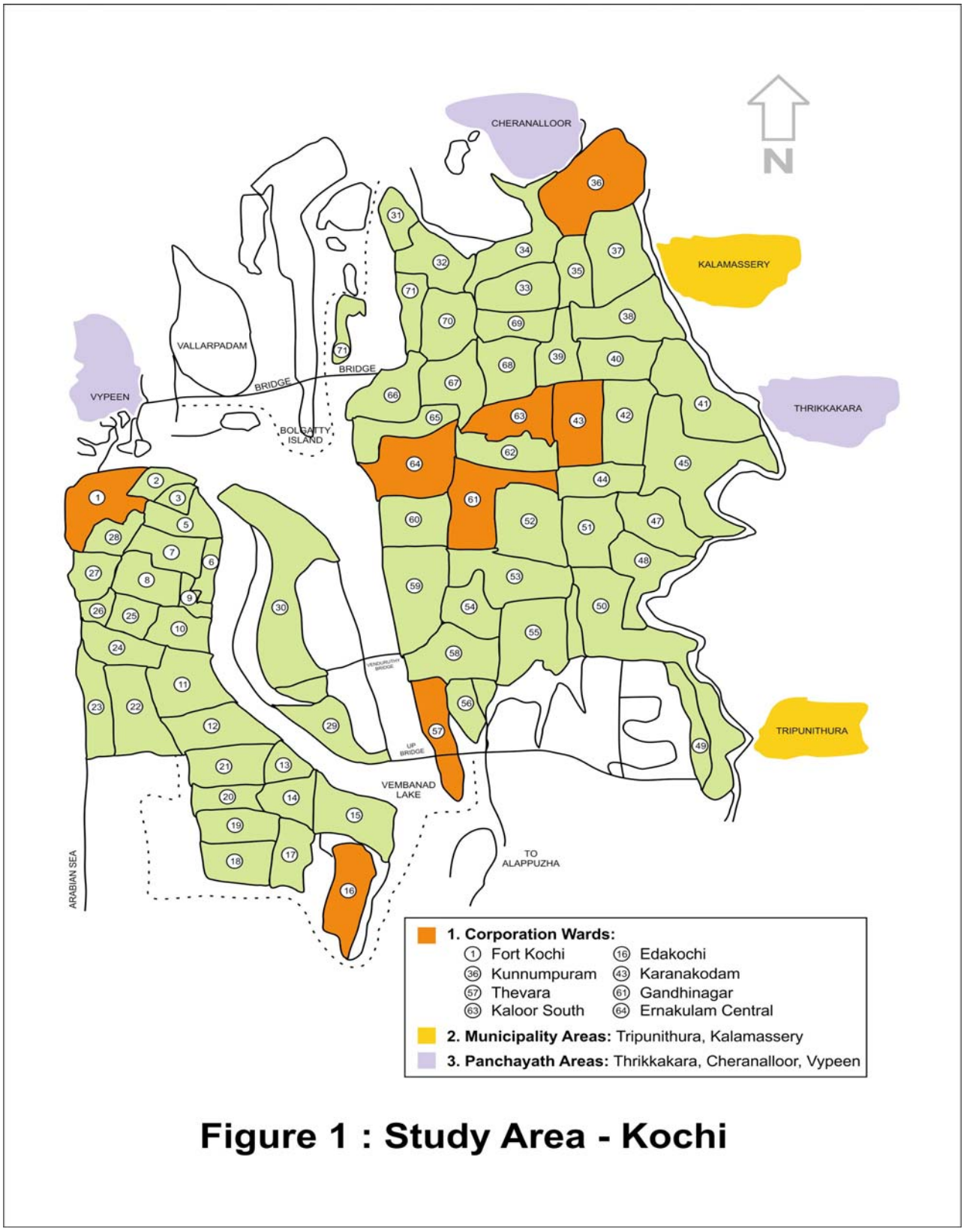


Figure 1 : Study Area - Kochi

3.2 Selection of Subjects

Elderly population of above 60 years (WHO,2002) was estimated as 61,139 persons in Kochi by Census India (2002) of which approximately 835 persons reside in old age homes (Rajan, 2004).Therefore, the sample for the present study consisted of both free living and institutionalized elderly, who were selected by appropriate sampling techniques. Sampling ensures that the selected subjects form a representative cross section of the actual population (Gupta, 2003).

3.2.1 Sample Size Determination

Sample size for the present study was determined by the equation for sample size based on proportions (Gupta, 2003).

$$n > \frac{Z^2 \times pq}{d^2}$$

where n is sample size

Z is confidence co-efficient

p is proportion of selected problem in the total population

q is 1-p

d is allowable difference between estimated value and true value in the population

Substituting

Z = 1.96 (95% confidence)

p = 50% (based on previous published reports on prevalence of malnutrition among elderly in India) (NNMB, 2006)

q = 1-p = 50%

d = 4.5%

$$n = \frac{1.96^2 \times 50 \times 50}{4.5^2} = 475$$

Considering the possibility of drop outs of subjects due to mortality or non-co-operation during the course of study, the sample size was fixed as five hundred elderly.

3.2.2 Sampling Technique

Two stage cluster sampling was adopted for the selection of free living and institutionalized subjects. Inclusion criteria for selecting elderly were deemed to be persons above 60 years of age, free from apparent terminal illnesses or psychological abnormalities.

Two stage cluster sampling was done as described below:

3.2.2.1 Free Living elderly

First stage sampling

The already existing administrative classification of Kochi into Corporation, Municipality and Panchayat areas was made use of . Kochi is classified into one Corporation area (comprised of 71 wards), two Municipality areas and 13 Panchayat areas as given in Appendix I. As rural-urban continuum is a unique feature of Kerala and Kochi being the industrial capital of the state, the population irrespective of the above geographical demarcation is largely urbanised.

Therefore, out of the total wards/areas enlisted under Corporation, Municipality and Panchayat administrations, a representative sample of 15 areas were selected by drawing lots. All the 15 wards/areas were visited by the investigator to obtain official sanction from local authorities and to explore possibility of conducting the proposed research activities. Criteria to assess the feasibility of conduct of study included:

a) availability of sample population
b) willingness of local leaders and sample population to co-operate with the study and
c) availability of infra structural facilities for the conduct of clinical camps as part of the study

Two areas were dropped from the initial list owing to the lack of the above mentioned criteria. So a total of 13 wards/areas were selected for the study which is depicted in figure 1.

Second stage sampling

A complete voters list of the above selected areas were obtained from local committee offices. A cluster of 25 households with elderly were selected from each locality by purposive sampling technique. Some households had more than one elderly subject. In the absence of elderly subjects in any household , the next household from the list was included in the study. All the selected households were visited by the investigator and all available subjects were interviewed, after obtaining their verbal consent. Thus, 350 free living elderly were included in the study.

3.2.2.2 Institutionalized elderly

Two stage cluster sampling was followed for selection of institutionalized elderly also as detailed below.

First stage sampling

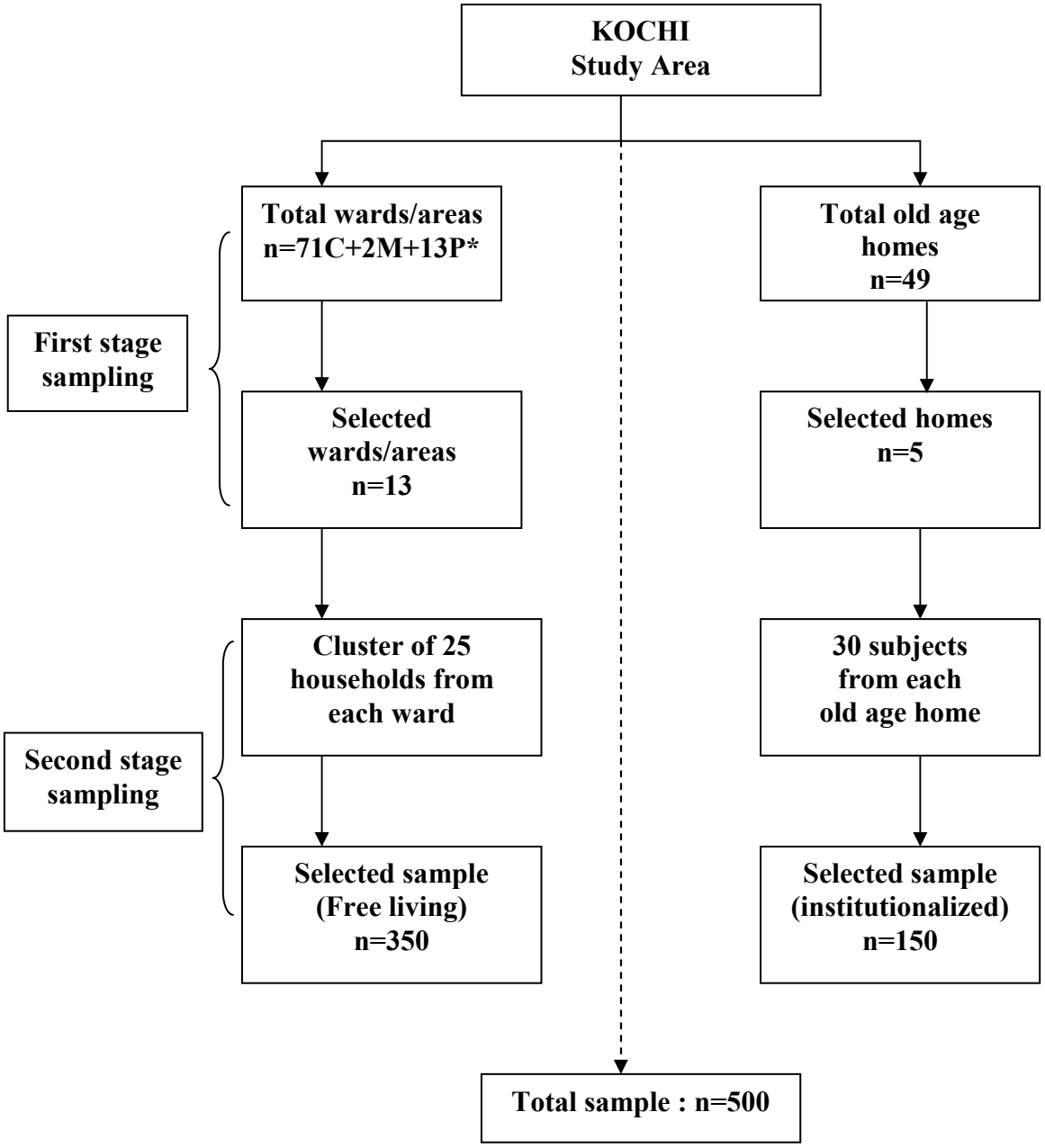
A complete list of old age homes in the study region was obtained from the Department of Social Welfare, Ernakulam (2008). From the total 49 old age homes enlisted, five old age homes were selected taking care to include two paid homes, two government aided homes and one government old age home so that the selected institutionalized sample be representative of the actual institutionalized elderly population of the study area. Willingness of home authorities and the inmates to cooperate with the study was also taken into consideration. The list of old age homes selected for the study is given in Appendix II

Second Stage Sampling

From the five selected old age homes, 150 elderly were included in the present study by purposive sampling. On an average 30 elderly were included from

each home. The inclusion criteria was the same as for free living elders i.e, persons above 60 years of age, free from apparent terminal illnesses or psychological abnormalities. Verbal consent was obtained from both authorities and subjects to conduct the study.

Figure 2 illustrates the details of two stage cluster sampling adopted for the present study.



*71 Corporation wards, 2 Municipality areas and 13 Panchayat areas

Figure 2 – Sampling : Two Stage Cluster Sampling

3.3 Tools and Techniques of data collection

Appropriate and accurate tools ensure the creditability of information in any research study. An interview schedule, pre-formulated in accordance with the objectives of the study, was the main tool used in the present study. Anthropometric, Clinical, Biochemical and Dietary assessments were conducted as per standard techniques along with the Mini Nutritional Assessment tool (MNA) to define the nutritional status of the elderly.

3.3.1 Development of Interview Schedule and Data Collection

Comprehensiveness, convenience and possibility of obtaining genuine information make interview method apt for procuring research data (Chaudhary, 1991). Kothari (1991) also emphasized the superiority of interview method to other data gathering methods, especially for the elderly, as they are more willing to talk than to write. Also, non-responsiveness could be reduced to a minimum and accuracy of statements could be checked by supplementary questions wherever necessary.

Hence an interview schedule was formulated to elicit information regarding the socio economic background, psychological status, age-related inabilities, medical and dietary factors of the elderly. The selected areas of focus are detailed herewith.

3.3.1.1 Socio economic background and life satisfaction of subjects.

Nutritional vulnerability of elderly population is reported to be compounded by their low socio economic status (Arlappa et al., 2004) widowhood, loss of independence (Vijayakumar, 1996), economic insecurity and lack of familial and social support(Bali ,1997) .Studies have also revealed lack of life satisfaction among a sizeable proportion of elders (Rajan, 2004). Taking into account the above factors, questions to elicit information on these lines were included in the schedule.

Social Activity Profile: Data about the social activity profile of elderly were collected using 10 measures of socially relevant activities designed by Christensen et al.,(1996). The answers were scored on a three point scale and levels of social activity of each subject were scored and rated as good, average or poor.

Life Satisfaction Assessment: As suggested by Farquhar (2008), measuring life satisfaction through use of structured scales is difficult, as different populations have different subjective notions on determinants of life satisfaction. Since a validated scale for assessing life satisfaction among elderly in Kerala was not available, most relevant aspects in this respect were selected and grouped under four major domains of life satisfaction as given by by WHO (2002) and Ferrans and Powers Quality of Life Index (1998) .

The four major domains included were emotional, economic, health and dietary quality. Miscellaneous aspects like avenues for social contacts, recreational activities and spiritual activities were also enquired about. Life satisfaction with regard to each aspect was rated on a three point scale to indicate excellent, average or poor life satisfaction.

3.3.1.2 Psychological status of the elderly.

To assess the prevalence of depression among the subjects of the present study, the Geriatric Depression Scale(GDS) developed by Yesavage et al., (1983) was included in the interview schedule. The Geriatric Depression Scale (GDS) is a simple scale to administer and does not require the skills of a trained interviewer. Each of the 15 questions has a yes/no answer, with the scoring dependent on the answer given. As stated by Burns et al., (2002), it is probably the most common version currently used.

3.3.1.3 Functional abilities and age related inabilities.

Functional health was ascertained by using Physical Activities of Daily Living (PADL) scale proposed by Katz(1986). The PADL scale measures level of independence in activities of daily living by the elderly.

The status of the elderly with regard to oral health was assessed using the Dental Screening Initiative (DSI) tool (Morley,1998). Self perceived status regarding eyesight, hearing, mobility, smell and taste perception were also ascertained by closed ended questions. Visual disability was detected if the person did not have the perception of light (blind) or if he was having perception of light but could not count the fingers of hand with or without glasses from a distance of three meters. (Dilip, 2001).

3.3.1.4 Medical factors

It is reported that morbidity and duration of life lived with disease is higher in Kerala (Dilip, 2007). Though mortality levels are close to those of developed nations for the last two decades, the morbidity levels are comparatively higher than elsewhere in India. Multiple health problems interfere with the health and well being of elderly. Hence the interview schedule consisted of queries related to the type of acute and chronic medical problems, their management and drug use.

The interview schedule draft thus constructed was submitted for approval by a committee of experts including medical professionals of geriatric care, nutrition experts, practicing psychiatrists and statisticians. After incorporating necessary modifications the schedule was administered to 30 elderly selected from the same locality, but who were not included in the study, as a pilot test. Further changes with regard to clarity and brevity of questions based on the pilot test were also incorporated. The interview schedule thus developed entitled as Comprehensive Health Assessment Schedule for Elderly (CHASE) is presented in Appendix III.

All five hundred subjects included in the study (350 free living and 150 institutionalized) were interviewed personally by the investigator. Care was taken to ensure the genuinity and confidentiality of information, by ensuring that nobody overheard the interview without the subject's consent.

The objectives and conceptual frame work of the study were kept in mind while formulating the interview schedule. The overall research design and conceptual frame work of the study is presented further in figures 3 & 4.

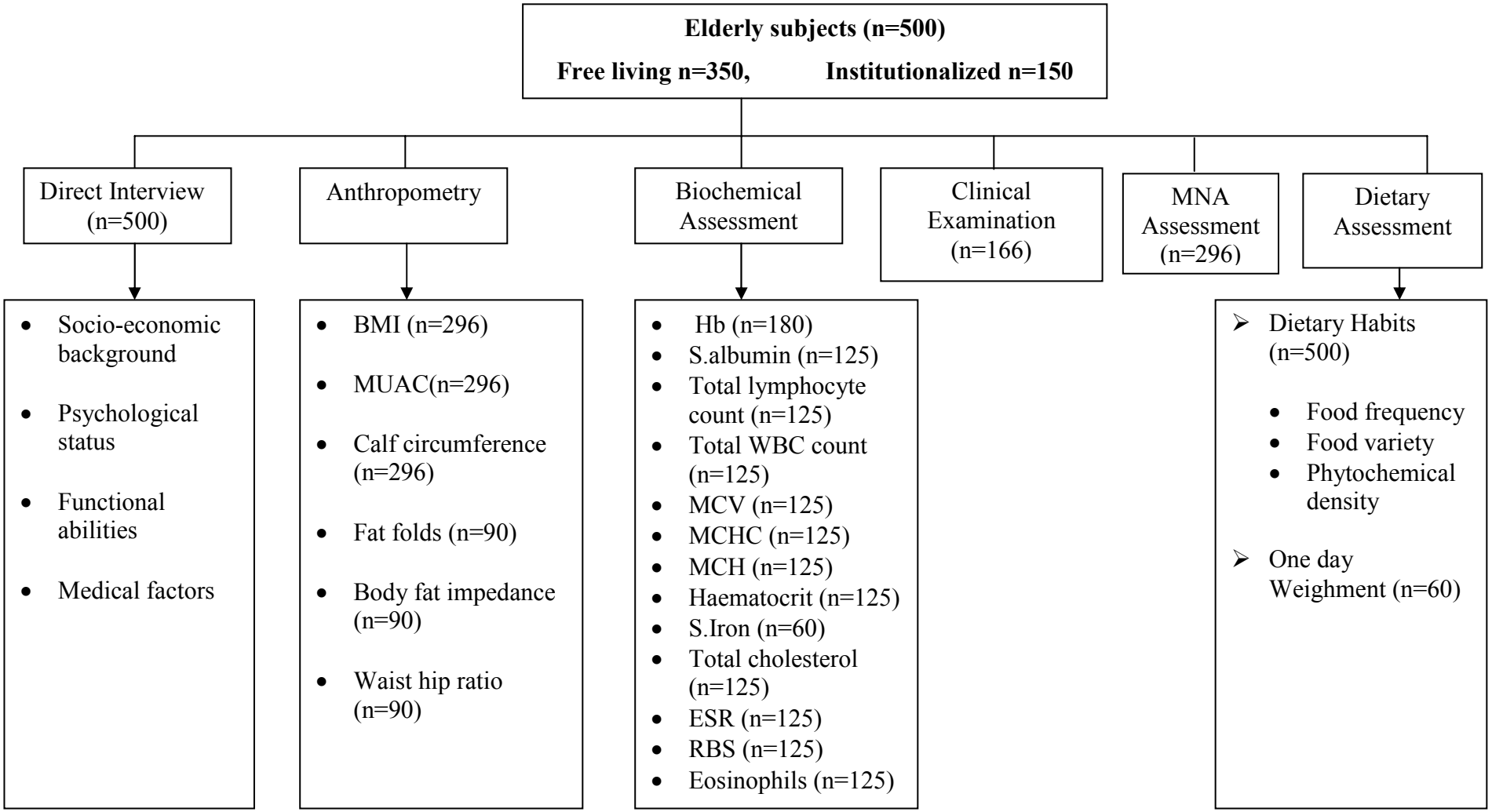


Figure 3 : Research Design

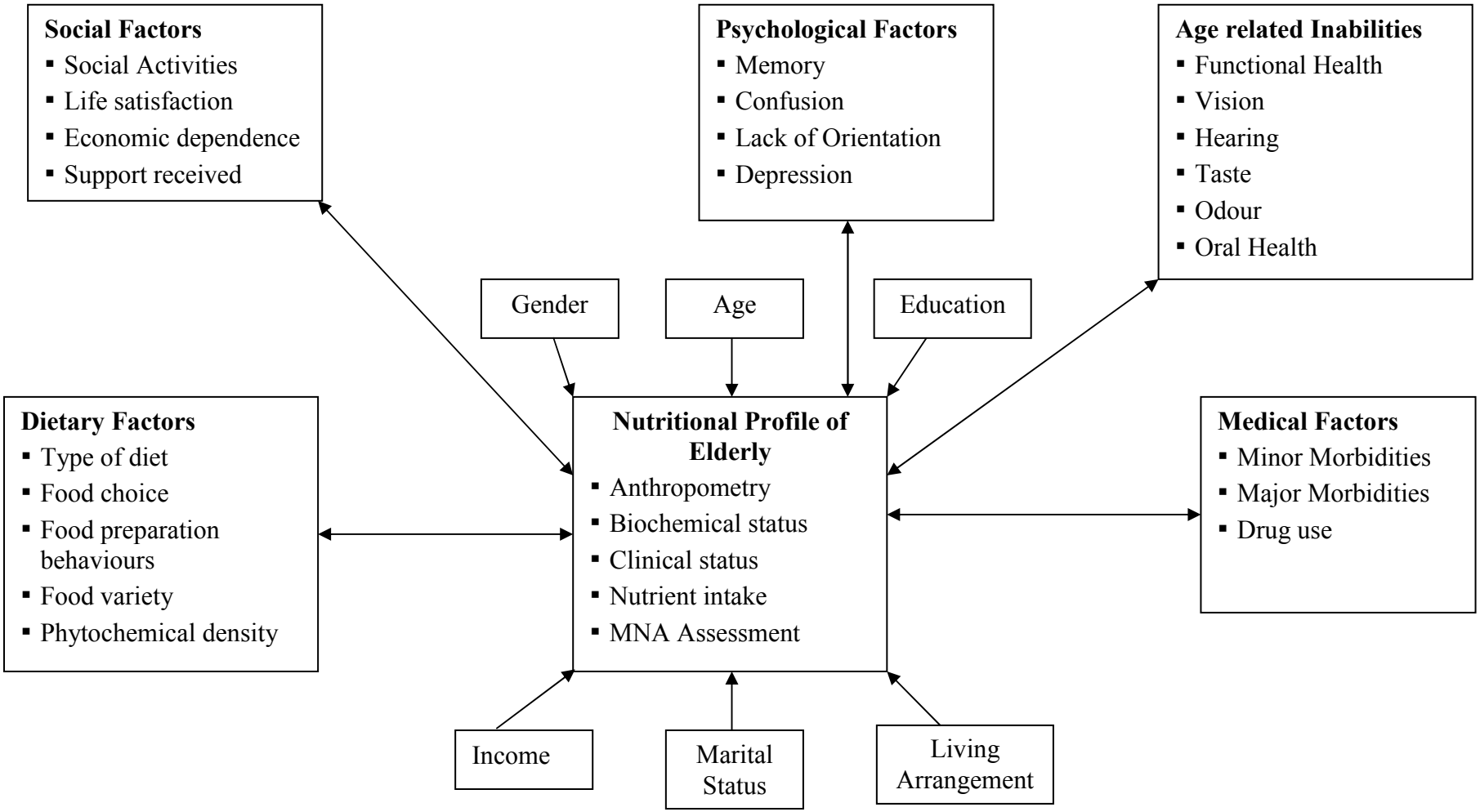


Figure 4: Conceptual Framework of the study

3.3.2 Assessment of Nutritional Status of the Elderly

Nutritional status is conventionally assessed by anthropometric measurements, biochemical measurement of nutrients or their by products in blood or urine, clinical examination and dietary analysis. (Swaminathan, 2003., Bamji et al., 2003., Robinson, 2001). Accurate assessment of nutritional status of elderly assumes significance due to individual variability in factors affecting the same during ageing. The four main assessment domains integrated to provide a comprehensive picture of nutritional status of the elderly are detailed below.

3.3.2.1 Anthropometric assessment

Chapman et al., (1996) suggested that anthropometry is an important method of assessing the nutritional status in elderly people as it is the single most valuable, universally acceptable, inexpensive and non invasive technique for assessing the size, proportions and composition of human body. It reflects both health and nutritional status and predicts performance, health and survival (WHO,1995). Even the physiologic changes in stature and body composition that accompany ageing can also be detected by means of nutritional anthropometry (Rahman et al., 1998).

However certain practical constraints of using anthropometry in the elderly have been pointed out by the WHO expert committee (WHO,1995). The committee suggested that the anthropometry of elderly is likely to vary with a number of factors such as age related biological changes, illness, childhood diseases, functional abilities and lifelong practices. Also, the intrinsic limitations common to the use of anthropometry include the effect of body fluid changes on weight, skinfolds and circumferences and especially in elderly when a large proportion of population is unable to walk or stand , these difficulties are compounded.

After careful consideration of the above factors, the anthropometric measurements of significance in elderly which were assessed in the present study were height, weight

and body mass index, arm span measurements, calf circumference, mid upper Arm circumference , sub scapular and triceps skinfold thickness and waist hip ratio.

a) Body height

Height is important in nutritional assessment. But in elderly the height decreases with age. The spinal curvature in elderly would interfere with the actual acquired height. But at present there are no guidelines regarding the degree of spinal curvature that would invalidate the measurement of height. Height measurements of both free living and institutionalized elderly were taken, observing the techniques suggested by WHO (1995).

Body heights of a subsample of elderly (n= 296), were measured using a non-stretchable fibre glass tape affixed on the wall. Subjects were made to stand barefoot with heels together and buttocks, shoulders and back of head touching the wall. The head was held comfortably erect and arms left hanging by the sides in a natural manner. A metallic scale was gently lowered compressing the hair and making contact with the top of the head and the reading measured to the nearest 0.1 cm.

b) Armspan measurement

Armspan measurement has been suggested (WHO, 2002 and Lucia et al., 2002) as a proxy to height in the elderly who are kyphotic or bed ridden. In the present study there were no subjects who had significant postural problems due to kyphosis or were bed ridden . Therefore to validate the relationship between armspan and height measurements, a subsample of 106 elderly including both free living and institutionalized subjects were studied regarding this aspect.

Armspan was measured by the following technique suggested by WHO (1995). The measurement was taken while the subjects were standing erect and looking straight ahead with back against the wall to provide support. The arms were kept at shoulder height during the measurement. When this was difficult for some, the

observers helped to raise the arm and hold in position. The measurement was made with a measuring tape at least two meters long, with an observer at each end of the tape and the reading was recorded to the nearest 0.1 cm.

Studies (Reeves et al., 1996 and Allen, 1989) indicate that armspan measurement is relatively independent of ageing and could be used as an alternative to height in calculating the BMI in older population. The relationship between the two varies according to ethnicity and sex (Ismail, 2002) and therefore in the present study this aspect was investigated.

c) Body weight

Body weight, according to Jelliffe (1966) in one of the simplest anthropometric measurements, that is important and useful. In combination with height measurements it has been used extensively in screening and monitoring programmes for all age groups.

The subjects (n=296),including both free living and institutionalized elderly, were asked to stand straight with foot placed on a calibrated weighing scale adjusted to zero. The scale was set to zero before each measurement and weight was recorded to the nearest 0.5kg (WHO,1995)

d) Body Mass Index (BMI)

BMI is reported to provide reasonable indication of the nutritional status of adults (Rao and Vijayaraghavan, 2003) and is a good index for assessing the current form of malnutrition .

From the recorded height and weight values , BMI values were computed for 296 elderly using the following equation :

$$\text{BMI} = \frac{\text{Weight in Kg}}{\text{Height in m}^2}$$

The cut off points for BMI suggested by Shetty and James (1994) and James et al.,(1988) was used to classify the elderly into different grades of nutritional status.

e) Mid Upper Arm Circumference (MUAC)

Mid Upper Arm Circumference is recognized to indicate muscle development. It is simple, easily accessible and is practical to measure. It has been reported to correlate well with weight, height and clinical signs (Rao and Vijayaraghavan, 2003). But the use of MUAC may be affected by the redistribution of subcutaneous fat towards central areas of the body during ageing . MUAC is an appropriate indicator for both screening acute adult undernutrition and for estimating prevalence of under nutrition at a population level (Collins et al., 2000).

The MUAC of 296 subjects, including both free living and institutionalized elderly,were measured using the technique described by WHO (1995).The circumference of the left upper arm was measured at it's mid point located after bending the right elbow to a 90^{o}C angle and placing the forearm palm down across the trunk. The upper arm was made approximately parallel to the trunk. Using a flexible fibre glass tape, the observer identified and marked the mid point of the arm, half way between the tip of acromion process and tip of olecranon process . At the marked mid point the measuring tape was pulled snug around the arm without compressing the tissues. The circumference was recorded to the nearest 0.1 cm and an average of three successive measurements was noted.

f) Calf circumference

Calf circumference is considered to provide the most sensitive measure of muscle mass in the elderly and is superior to arm circumference.Calf circumference is also an indicator of muscle development and the adipose tissue is evenly distributed around the area.

WHO (1995) suggested calf circumference along with MUAC as an indicator of protein malnutrition. It indicates the changes in fat free mass that occur with ageing and decreased activity. Bonnefoy et al., (2002) also reported that calf circumference is a pertinent marker of nutritional status in the elderly.

Measurement of calf circumference on a subsample of 296 elderly, including both free living and institutionalized, was done by the following technique as given by WHO (1995).Kneeling at the side of the calf of the subject, the observer passed a loop of measuring tape around the calf moving it up and down to locate the largest circumference. The reading was taken to the nearest 0.1 cm.

g) Body fat measurements

Fat distribution in the body varies with age, sex ,physiology, nutritional and health status. Body fat of a sub- sample of 90 elderly subjects were assessed by measuring the triceps and subscapular skin fold thickness. Also direct measurement of body fat was done using body fat impedance scale on these 90 subjects.

(i) Skin fold measurements.

Skin fold thickness was measured at triceps and subscapula using Harpenden's calipers and the values were recorded for 90 subjects. Triceps fat fold was measured on the dorsal side at the same mid point on the back of right arm over the triceps muscle, where the mid upper arm circumference was measured.

The investigator gently grasped a double fold of skin and the subcutaneous adipose tissue between the fingers and the thumb about 1.0 cm from the marked level. The fold of skin was on the back of the arm in the mid line and parallel to the long axis of the upper arm . The jaws of the caliper were applied perpendicular to the length of the skin fold at the level of the marked mid point and the observer bent down to read the caliper to avoid errors due t o parallax. (WHO , 1995).

The sub scapular fat fold was measured in the same way as described above. The measurement site was located just below and lateral to the angle of the left scapula in a line running approximately 45^{o} to the spine, in the natural line of skin cleavage . Average of three measurements were noted for both triceps and sub scapular measurements.The mean triceps and subscapular fat folds were compared to the mean values and percentile values of NHANES III.(1994)

(ii) Body fat percentage

Body fat percentage of 90 elderly subjects, including both free living and institutionalized, were recorded using body fat impedance scale(Beurer). It measures impedance from foot to foot while standing on a weighing scale and provides body fat percentage, using a built-in software programme in which weight, height, age and gender have to be entered.

The general principle behind bioelectrical impedence analysis is that two conductors are attached to the subject's body and a small electrical current is sent through the body. The resistance (impedance) between the conductors will provide a measurement of body fat since the resistance to electricity varies between adipose, muscular and skeletal tissue. Higher fat levels result in more resistance to the current.(Deurenberg and Roubenoff, 2002).The mean body fat percentage values provided by WHO (2002) was used as the reference to which the mean values were compared.

(iii) Waist Hip Ratio

Waist and Hip circumferences of 90 elderly subjects, both free living and institutionalized, were recorded using a fibre glass tape. Waist Hip ratio was calculated by the equation, $\text{WHR} = \frac{\text{Waist Circumference (cm)}}{\text{Hip Circumeference (cm)}}$

The mean waist hip ratio values were compared with the gender specific reference values provided by NHANES III.

3.3.2.2 Clinical examination of elderly

Clinical examination is reported to be a valuable and useful tool which can give information regarding Nutritionally Related Disorders (NRD) prevalence to the public health worker (Joshi, 2002). NRD covers a wide range of conditions from malnutrition to chronic degenerative diseases.

Clinical Assessment, according to Swaminathan(1990) is the most essential part of nutrition surveys since the ultimate objective is to assess levels of health of individuals or population groups as influenced by the diets they consume. It also provides direct information on the signs and symptoms of dietary deficiencies prevalent among the population.

A subsample of 166 elderly including freeliving (n=85) and institutionalized (81) were subjected to detailed clinical examination by qualified physicans. The clinical Assessment Schedule developed by National Advisory Committee – Indian Council of Medical Research (N.A.C- I.C.M.R) as given by Swaminathan (2003) was used (Appendix IV).

Clinical examination was conducted along with biochemical tests by arranging medical camps at Thrikkakara and Kacherippady in collaboration with Geriatric Medical Centre of Red Cross Society, Ernakulam. Clinical examination camps were organized at old age homes also, wherever consent was given.

Intimation regarding the camps was given via news paper advertisements, banners at public places and radio announcements. Transportation to the camp sites were also arranged in advance for the needy. The elderly who attended the camps were subjected to detailed clinical examination by the qualified physicians from geriatric care departments of reputed hospitals in the city.

3.3.2.3 Biochemical assessment

According to Mahan and Stump (2000) biochemical tests are a subjective and sensitive measure of nutritional status. In the development of any deficiency diseases, biochemical changes can be expected to occur prior to clinical manifestations. Therefore biochemical tests conducted on easily accessible body fluids can help to diagnose disease at the sub- clinical state and confirm clinical diagnosis (Bamji, 2003). Biochemical parameters were studied on a subsample of 125 elderly who volunteered for the same as part of the medical camps organized.

The following biochemical parameters were studied and the observed values were compared with the corresponding reference values to study the nutritional profile of the subjects.

a) Blood Haemoglobin.

Haemoglobin estimation is an useful index of overall state of nutrition irrespective of its significance in anaemia (Swaminathan, 2003). In the present study Haemoglobin estimation was done on a subsample of 180 subjects (72 elderly men and 108 elderly women) by cyanmetheamoglobin method. (Appendix V)

b) Serum Albumin

Albumin is abundant in serum, is simple to prepare , stable, highly soluble in water and easily purified. So it has been one of the most intensively studied of all proteins. Low serum albumin levels are associated with reduced muscle mass and hence it is a good indicator of malnutrition. Albumin is also lowered in nephrotic syndrome and liver dysfunction (Satyanarayana and Chakrapani, 2006). But albumin concentrations tend to fall slowly as its degradation is slow and so it is not a good indicator of acute depletion.(Webb and Copeman,1996). Serum Albumin was determined on a subsample of 125 elderly subjects, 60 men and 65 women, of free living and institutionalized category.

The Biuret and BCG method were employed in the assessment of Serum albumin (Appendix VI)

c) Complete blood count

Complete Blood count of 125 subjects were determined by diluent technique using haematology auto analyser BC 3000, MINDRAI, of Agappe diagnostics. Complete blood count included Total lymphocyte count, Total WBC count, Red blood cell count, Mean Corpuscular Volume, Mean Corpuscular Haemoglobin Concentration, Mean Corpuscular Haemoglobin and Packed Cell Volume. The significance of the above parameters are described further.

(i) Total Lymphocyte count

Decreased total lymphocyte count evidences diminished immunological resistance (Simmons, 1997). Since lymphocytes generally comprise 20 to 40 percent of total leucocytes, their measurement can be used as an index of malnutrition (Tietz, 1995).

(ii) Total WBC count

White blood cells or leucocytes are cells of the immune system defending the body against both infectious diseases and foreign materials. An elevated number can result from bacterial infections, inflammation, trauma, and stress. A decreased WBC count called leucopenia can result from chemotherapy, radiation therapy or disease of immune system (Simmons, 1997).

(iii) Red Blood Cell count

RBC count can help to diagnose anaemia and other conditions affecting Red blood cells (Mc Pherson et al., 2007) .

(iv) Mean Corpuscular Volume (MCV)

MCV is an useful index for classification and diagnosis of anaemia.

$$\text{MCV} = \frac{Hemato\ crit}{RBC\ count}$$ (Simmons, 1997)

(v) Mean corpuscular Haemoglobin concentration (MCHC)

Severity of MCHC is also used for detection of anemia . It is decreased to less than 30 g/dl in hypochromic anemia.

$$\text{MCHC} = \frac{Hemoglobin}{Haemotocrit}$$ (Simmons,1997)

(vi) Mean Corpuscular Haemoglobin (MCH)

Though with limited meaning, MCH is used in the differential diagnosis of anemia. $\text{MCH} = \frac{Haemoglobin}{RBC\ Count}$

(vii) Haematocrit or Packed Cell Volume (PCV)

Haematocrit or PCV is a good indicator for general anemia status in the elderly. The normal range is three times the Haemoglobin concentration.

d) Serum Iron

Abnormal Serum iron is suggested as a marker of poor health in the elderly (Corti et al.,1999). Serum Iron was estimated in 60 elderly with low haemoglobin values by IRN method of Siemens Diagnostics.(Appendix VII).

e) *Eosinophils*

Eosinophils are WBCs that become active during certain allergic diseases, infections and other medical conditions. The eosinophil count usually helps confirm rather than make a diagnosis . High numbers are usually associated with allergic diseases and infections (Hoffman et al., 2005).Eosinophil count was assessed on 125 subjects by differential count detection method. (Appendix VIII)

f) Erythrocyte Sedimentation Rate (ESR)

ESR is a non–specific test that indirectly measures how much inflammation is in the body. It is a screening test which cannot be used to diagnose a specific disorder (Hoffman et al.,2005). Craig et al.,(2002) reported that increased ESR levels in old

age is associated with chronic or sub acute diseases. Estimation of ESR was done on a subsample of 125 elderly by Westergren method (Appendix IX).

g) Random Blood Glucose

With increasing age there is reduced tissue sensitivity to insulin and thus increased risk of impaired glucose tolerance (Colledge , 2002).Random Blood glucose levels of 125 subjects were determined for detection of diabetes mellitus, by GOD–POD end point assay. (Appendix X)

h) Total Cholesterol

Blood cholesterol level is also an important biochemical parameter especially in association with chronic diseases like coronary heart disease, obesity etc. It is used for screening primary and secondary hyperlipidemias. Total cholesterol was estimated on 125 elderly by CHOD- PAP method (Appendix XI)

3.3.2.4 Dietary Assessment

Diet is a vital determinant of health and nutritional status of people (Thimmayamma and Rao, 1996) . A diet survey provides information about dietary intake pattern of specific foods and helps to estimate nutrient intake.

Szostak (1990) reported that as the number of days of dietary survey increases, the degree of co-operation decreases. Therefore food frequency method (n=500) and one day food weighment survey (n=60) were the techniques of diet survey adopted in the present study to collect information on the food and nutrient consumption pattern of the elderly.

a) Food Frequency Assessment

To ascertain the qualitative and quantitative aspects of diets, the frequency of intake of various food groups by the elderly (n=500) were assessed by a food frequency questionnaire which included a comprehensive list of all food items familiar in the study region . The same data was used to assess the food variety and phytochemical density of diets of elderly by checklists suggested for the same by WHO (2002).Minor modifications of the above checklist was done like omission of totally unfamiliar foods

and suitable readjustment of scoring was done. Food variety and phytochemical density checklists were incorporated in CHASE schedule II (Appendix XII) which was designed to procure details regarding other qualitative aspects of diets of the elderly

b) One day weighment survey.

To conduct the weighment survey, willingness of the subjects, members of households and authorities of institutions to co-operate with the same were taken into consideration. Care was also taken to have gender wise representation of the subjects (n=60).

The raw weight of ingredients used for the preparation of meals for the day was recorded prior to each meal. The total cooked weight of food and the weight of foods consumed by the elderly were also recorded in the food weighment survey schedule (Appendix XIII). Plate wastage, if any, was also noted to arrive at the actual food consumption of the subjects.

The raw equivalents of major food ingredients in the meals were computed using the formula

$$\frac{\text{Raw weight of the ingredients (g)}}{\text{Total cooked weight of food items (g)}} x \text{ Individual intake of cooked food items (g)}$$

The standard procedure was slightly modified to suit elderly people. A set of standard cups and spoons were used to quantify the food intake whenever actual weighing of food was not possible. The person in-charge of procuring food items, cooking and serving food in the households or old age homes were interviewed for procuring the baseline information.

The nutrient consumption was estimated by calculating the same using the food composition table (Gopalan et al., 2002). The mean food and nutrient intake of subjects were computed and compared with RDA for Sedentary Indian elderly as suggested by Pasricha and Thimmayamma(2000).

3.3.3 Mini Nutritional Assessment (MNA)

Use of a valid and reliable tool to assess nutritional status of elderly has been absent in most geriatric assessment programmes. Though anthropometric and biochemical measurements are usually performed to define the type and severity of malnutrition, there is no generally accepted 'gold standard' for diagnosis of geriatric malnutrition .

In this context, WHO (2002) has stressed the need to assess the validity of already developed tools rather than going for detailed procedures in developing an entirely new tool. Mini Nutritional Assessment (MNA) , a tool developed by the Nestle Research Centre, Switzerland in 1994 has been reported to be a simple and effective tool for geriatric nutritional assessment (Sergi et al., 2006., Thorsdottir et al., 2005., and Christenson, 2002). The MNA fulfilled criteria like sensitivity, specificity, cost and targeting of a specific group. Since it was freely available and composed of simple measurements and brief questions, the MNA was selected as a suitable tool for geriatric nutritional assessment.

More over the MNA has been validated on elderly people ranging in age from 65 to 90 years and the very frail to very active (Guigoz et al., 2002). Many studies have been done at various parts of the world on the MNA(Akner,2005; Horn,2005; Soini et al., 2004; Lopez et al., 2003 and Burden et al., 2001) for being used as a routine geriatric assessment tool. Henken et al., (2005) and Irvin et al., (1999) have also reported that MNA allows health professionals to make a rapid and reliable evaluation of the nutritional status of elderly patients, to recognize those at risk of nutritional problems.

So the applicability Mini Nutritional Assessment tool in the study locale (Kochi, Kerala) has been attempted. The main intention was to study the feasibility of use of MNA tool in nutritional studies of elderly to define precisely whether the screening tool is able to identify malnutrition.

In the present attempt, the following assessments were chosen as given by Thorsdottir et al., (2005) and Guigoz et al., (2002) to test the applicability of the MNA.

- Anthropometry - Body mass Index(n=296), Mid Upper Arm Circumference (n=296)and Calf Circumference (n=296)
- Biochemical indices- Serum albumin (n=125), Haemoglobin (n=180), Haematocrit (n=125) and Total Cholesterol(n=125)
- Clinical Assessment using a subjective assessment of nutritional status by a qualified physician (n=166).

MNA assessment was done on 296 elderly, including free living and institutionalized sample. Cross tabulations of the MNA results to the selected markers of nutritional status and further sensitivity-specificity analysis was done to evaluate its feasibility of use. The Mini Nutritional Assessment tool is presented in Appendix XIV.

3.4 Statistical Analysis of Data :

The statistical software SPSS version 11.5 was used for data analysis. Using Pearsons chi-square, variations in prevalence of various risk factors between elderly in the two living arrangements, age ranges and gender were tested. The 't' test and one way ANOVA was used to test the equality of means with respect to anthropometric parameters, biochemical values and food and nutrient intake. Sensitivity and Specificity of MNA tool was tested with other accepted parameters of Nutritional Status assessment. Armspan and height measurement equations were arrived at using linear regression.

Multivariate logistic regression was used for finding significant determinants of chronic energy deficiency, obesity/over weight, Malnutrition (as per MNA) and depression among the elderly. The "Step-wise" forward procedure was adopted for the multitivariate analysis.

To meaningfully interpret a group of related factors, two indices were constructed, the details given below.

Quality of Life Index:

Five factors affecting Quality of Life of the elderly were scored on a two point scale. And further weighted average for each factor was computed. The total mean

weighted average for the elderly indicated as percentage value was assumed to be indicative of quality of life of the elderly.

$$\text{Quality of life Index} = \frac{\sum x_i w_i}{\sum w_i} x\,100$$

Where, x_i is scores for no problem (0) and having a problem (1)

w_i is number of subjects in each class.

Grading was done after computing the mean values and standard deviations of the quality of life index of the subjects (n=500). Subjects who obtained a score greater than or equal to the sum of mean and standard deviation ($\geq$Mean + Standard Deviation) was categorized as having poor quality of life. Those who obtained the score less than or equal to the difference of mean and standard deviation ($\leq$ Mean – Standard Deviation) were categorized as having excellent quality of life and those who obtained scores between the above two values were categorized as having average quality of life.

Malnutrition Risk Index:

Six significant risk factors related to malnutrition among elderly as elucidated by multivariate logistic regression were assigned weighted scores according to their relative risk magnitude.

The weighted mean scores for each strata of elderly were computed by the formula

$$\text{Malnutrition Risk Index} = \frac{\sum x_i w_i}{\sum w_i} \text{ x } 100$$

Where

x_i - is the weighted risk scores

w_i - is the subjects in each class

$\sum w_i$ - is the total number of subjects considered

The mean and median Malnutrition Risk Index values of different strata of elderly (based on living arrangement, age and gender) were computed so as to identify the strata having the highest risk of malnutrition.

IV. RESULTS AND DISCUSSION

The results of the present study entitled **'Nutritional Profile of Elderly in Kochi, Kerala'** is presented under the following headings:

4.1 General Profile of the Elderly

- ***4.1.1 Socio-economic background***
- ***4.1.2 Emotional and Psychological aspects***
- ***4.1.3 Functional disabilities and morbidity profile of the elderly***
- ***4.1.4 Quality of Life Index of the elderly***

4.2 Assessment of Nutritional Status of the Elderly

- ***4.2.1 Anthropometric measurements***
- ***4.2.2 Biochemical Assessment***
- ***4.2.3 Clinical Assessment***
- ***4.2.4 Dietary Assessment***
- ***4.2.5 MNA- Non invasive Assessment of the nutritional status of elderly.***

4.3 Risk factors associated with Nutritional Status of the Elderly.

- ***4.3.1 Relative Risk of Independent Variables to Chronic Energy Deficiency(CED) among elderly***
- ***4.3.2 Relative Risk of Independent variables to Malnutrition as per the MNA***
- ***4.3.3 Malnutrition Risk – Scoring and classification***
- ***4.3.4 Relative Risk of independent variables to incidence of depression among elderly***
- ***4.3.5 Relative Risk of independent variables to incidence of overweight among elderly***
- ***4.3.6 Interrelation of risk factors to nutritional well being of elderly***

4.1 General Profile of the Elderly

4.1.1 Socio-economic background :

The needs and problems of the elderly vary according to their age, living arrangements, gender, economic and occupational status. So data on these aspects was procured and is presented in Table 1

Table I

Socio-economic profile of the elderly

Variables	n	%	n	%	n	%
	Free living (n=350)		Institutionalized (n=150)		Total(n=500)	
Age in years						
60-70	197	56.29	45	30	242	48.4
70-80	103	29.43	72	48	175	35
>80	50	14.28	33	22	83	16.6
Gender						
Male	152	43.4	36	24.0	188	37.6
Female	198	56.6	114	76.0	312	62.4
Occupational status						
Retired	186	53.1	30	20.0	186	53.1
Business	10	2.9	75	50.0	10	2.9
Employed	12	3.4	6	4.0	12	3.4
Retired and re-employed	14	4.0	5	3.3	14	4.0
Homemaker	128	36.6	34	22.7	128	36.6
Income per month (Rs.)						
No Income	25	7.1	102	68.0	127	25.4
<2000	147	42.0	17	11.3	164	32.8
2000-5000	78	22.3	14	9.3	92	18.4
>5000	100	28.6	17	11.3	117	23.4
Source of Income						
Employment	28	8.0	1	0.7	29	5.8
Employment pension	102	29.1	20	13.3	122	24.4
Spouse's pension	34	9.7	8	5.3	42	8.4
Income from property	21	6.0	7	4.7	28	5.6
Business	8	2.3	0	0.0	8	1.6
Savings/Investments	25	7.1	1	0.7	26	5.2
Remittance from children	103	29.4	0	0.0	103	20.6
Old age pension	1	0.3	6	4.0	7	1.4
From other relatives	3	0.9	4	2.7	7	1.4
Old age home / No income	25	7.1	102	68	127	25.4
Economic independence						
Independent	112	32.0	34	22.7	146	29.2
Partially dependent	97	27.7	0	0.0	97	19.4
Fully dependent	141	40.3	116	77.3	257	51.4
Educational Status						
Illiterate	45	12.9	30	20.0	75	15.0
Upto 10^{th} standard	108	30.9	75	50.0	183	36.6
Higher secondary	116	33.1	34	22.7	150	30.0
Graduation	43	12.3	6	4.0	49	9.8
PG / Professional Education	38	10.9	5	3.3	43	8.6
Marital status						
Married	231	66.0	39	26.0	270	54.0
Widower	110	31.4	40	26.7	150	30.0
Unmarried	7	2.0	70	46.7	77	15.4
Divorced /Separated	2	0.6	1	0.7	3	0.6
Religion						
Hindu	132	37.7	95	63.3	227	45.4
Christian	185	52.9	50	33.3	235	47.0
Muslim	33	9.4	5	3.3	38	7.6

Of the 500 elderly subjects studied ,with 350 free living and 150 institutionalized, it was seen that majority (48.4%) belonged to 'young old' category (60-70 years) followed by 70-80 year age group(35%) and 'old old' group(16.6%)with age above 80 years.

This declining trend of the oldest segment of elderly is in congruence with the global projections of International Data Base on Ageing (U.S. Bureau of Census, 2008) which showed that 6.1 percent, 1.8 percent, and 0.7 percent of total population of India would be 60+,70+,80+ respectively. A compilation of past five census data (Rajan,2007) of India also showed a similar trend of 7.5 percent,2.9 percent and 1.01 percent of total population to be comprised of 60+,70+ and 80+ age groups respectively.

Regarding sex ratio among elderly, the female population (62.4%) outnumbered males(37.6%).The higher ratio of women was found in both free living and institutionalised categories. As predicted by Mari Bhat (2002), Hassan (1998) and Luthra (1991), there is a pre ponderance of females in older age groups due to their long life expectancy at birth as a product of biological advantage.

Only a minor percent of elderly were in service (3.4%) or retired and reemployed (4%). The majority (53.1%) were retired and were not engaged in any productive work. A substantial section of women (36.6%) were found to be active as they were housewives and were involved in running of the households.

Individuals with a secure and sufficient income during their old age are less likely to face economic and psychological problems because of their ability to meet their needs, ability to find supportive services and the sense of security that money brings.

Income profile of free living elderly and institutionalized elderly were different. A majority (68%) of institutionalized elderly reported no income, as against only only 7.1 percent of free living elders without any income.

Even though a majority of elders in both groups reported meagre income (up to 5000/-) it was not sufficient to make them economically independent. 51.4 percent of elderly were economically fully dependent on others. Furthermore, it was found that those residing in old age homes were either fully dependent (77.3%) or independent (22.7%) with none reporting partial economic independence, whereas 27.7 percent of free living elders were partially independent. These findings are supported by several studies. The Chronic Poverty Research Centre has identified elderly as one of the groups vulnerable to chronic poverty (Rajan, 2004).A nation wide survey (NSSO ,1991) found that 34.2 percent of rural elderly to be financially independent as against 28.94 percent of their urban counterparts. Rajan (1999) has also found that elderly who were economically dependent were less satisfied with life in general.

The educational status of majority (36.6%) of the elderly studied was below 10^{th} standard. There were more number of illiterate elderly among the institutionalized subjects(20%)than free living(12.9%).Graduates, post graduates and professionals were also found to be more among the free living than institutionalized elderly. Rajan et al., (1999) has also reported that higher educational levels were uncommon among older people in institutions.

Marital status of subjects also presented distinct differences between free living and institutionalized categories. While majority of free living elderly (66 %) were married, 46.7 percent of elderly in old age homes were unmarried. The marital status of older person is an aspect of family structure that deeply affects their living arrangements, support systems and individual well being (Moli, 2004). Widowhood, divorce or separation also influence the family status of elderly and make them dependent on children or relatives as reported by Mallick (2003). In the present study also the percentage of widowed elderly was not negligible (30 percent). This situation further raises the level of dependency of the elderly as pointed out by Rajan (2003).

The elderly included in the present study represented all three major religions with slightly higher percentage (47%) of Hindus, followed by Christians (45 percent) and Muslims (7.6%).

The following figures depicts the socio-economic profile of the subjects.

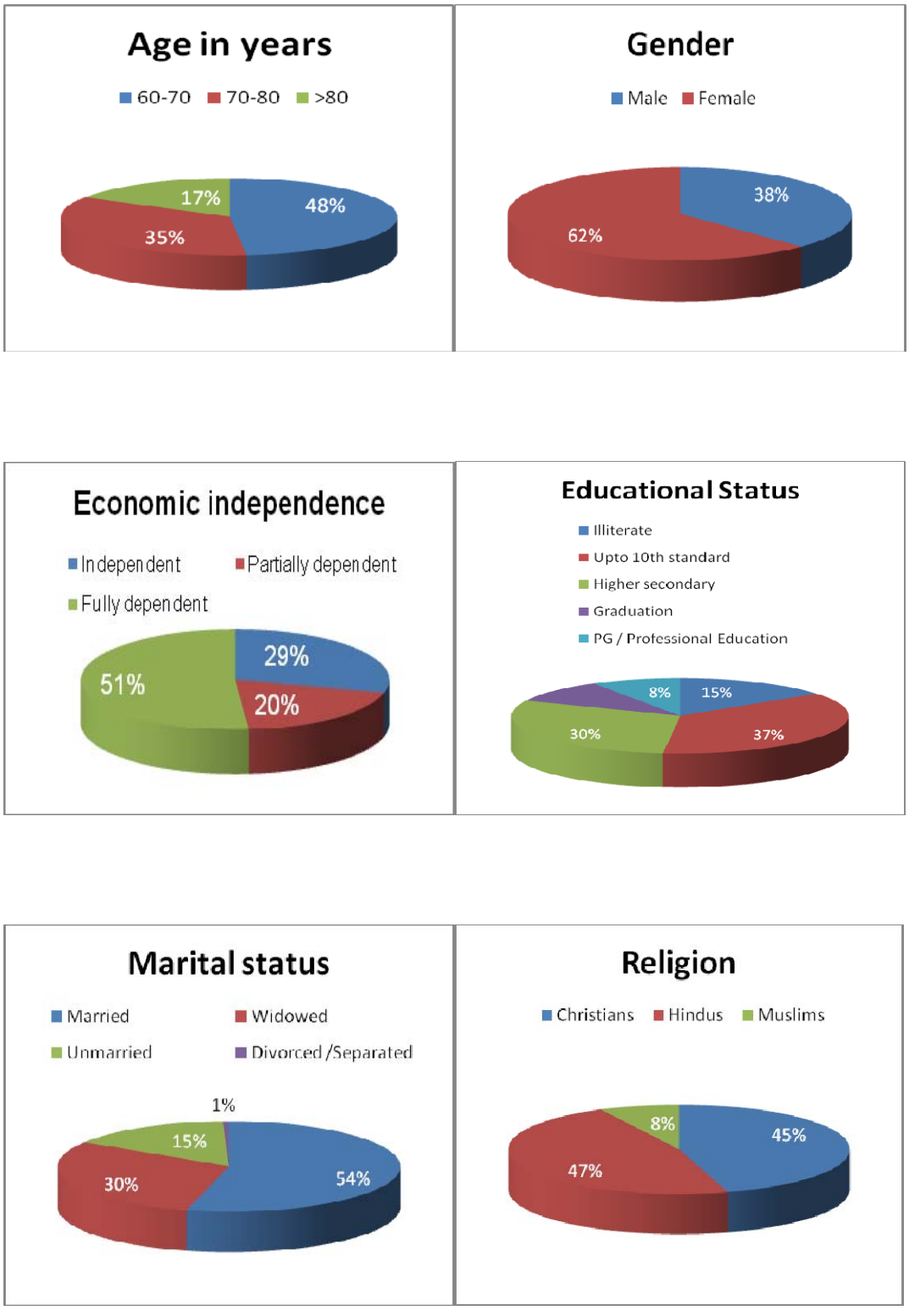


Figure 5- Socio economic Profile of the Elderly

4.1.2 Emotional and Psychological aspects

The domains studied to assess the above aspects included the support and status in their living arrangements, their social activities, life satisfaction, general psychological indices and incidence of depression.

4.1.2.1 Support and status in the living arrangement

Among several indicators of status of elderly in a society, the living arrangement occupies an important place. Concept of living arrangement refers to the familial system of support and care of the elderly, which is an important determinant of their status in the society. Table 2 reveals the support and status of the elderly in their living arrangements.

Table 2

Support for basic needs and self perceived status of elderly

Particulars	Free living(n=350)		Old Age home(n=150)		Total(n=500)	
	n	%	n	%	n	%
Support Availed						
(a)Food						
Regular support	187	53.4	116	77.3	303	60.6
Occasional support	64	18.3	17	11.3	81	16.2
No support	99	28.2	17	11.4	116	23.2
(b)Clothing						
Regular support	137	39.1	51	34.0	188	37.6
Occasional support	97	27.7	82	54.7	179	35.8
No support	116	33.1	17	11.33	133	26.6
(c) Medication						
Regular support	157	44.9	54	54	211	42.2
Occasional support	77	22.0	79	79	156	31.2
No support	116	33.1	17	11.33	133	26.6
Perceived Status in Family or Institution						
Feels neglected	26	7.4	40	26.7	66	13.2
Tolerates others	41	11.7	61	40.7	102	20.4
Loved and respected, not controlling their environment	125	35.7	49	32.7	174	34.8
Loved and respected, controlling their environment	158	45.1	0	0.0	158	31.6

(Contd…)

Particulars	Free living(n=350)		Old Age home(n=150)		Total(n=500)	
	n	%	n	%	n	%
Opinion of present living arrangement						
Happy	307	87.7	144	96.0	451	90.2
Unhappy	43	12.3	6	4.0	49	9.8
Opinion on Ideal living arrangement						
With married son	239	68.3	11	7.3	250	50.0
With married daughter	52	14.9	3	2.0	55	11.0
Separately	36	10.3	4	2.7	40	8.0
In a home for the aged	1	0.3	124	82.7	125	25.0
With Relatives	22	6.3	8	5.3	30	6.0
Reason for institutionalization						
No relatives/children	----	----	75	50.0	----	----
Children not supportive			24	16.0		
Relatives are unhelpful			22	14.7		
Migration of children			15	10.0		
Preferred to live alone			14	9.3		
Duration of institutionalization						
<1 year	----	-----	23	15.3	-----	-----
1 to 5 year			50	33.3		
5-10			24	16.0		
10-15			20	13.3		
>15 years			33	22.0		

Regular support for food was reported by 60.6 percent of the subjects. Full support for medicines and clothing was reported by 42.2 percent and 37.6 percent respectively .Rest of the elders received only partial support or no support at all. The situation was comparatively better among institutionalized than free living elderly especially in the case of food (77.3%) and medicine(54%). This further establishes the higher level of dependency of elderly in old age homes as quoted by Rajan (2003).

The self perceived status of elderly in their living arrangement was ascertained. Results showed that a higher percentage of free living elders felt that they were loved and respected (80.8%) compared to 32.7 percent of elderly in old age homes. A higher

percentage in old age homes also reported neglect (26.7%) and having to tolerate others (40.7%). But, few (4%) in old age homes actually said that they were unhappy with the present living arrangement, probably since they were more dissatisfied with their life situation prior to joining an old age home.

This is further revealed when the reason for institutionalization was probed. 50 percent of institutionalized elderly reported absence of relatives (orphaned) as the reason for joining an old age home. Quite a few(16%) reported lack of support from children (16%) and unhelpful attitude of relatives (14.7%) as the reasons. Only 9.3 percent opted for an old age home by their own preference. The duration of institutionalization ranged from less than one year (15%) to greater than 15 years (22%). It was also found that a majority of free living elders (68.3%) preferred living with married son whereas 82.7 percent in the old age homes preferred their present arrangement itself.

4.1.2.2 *Social Activity Profile of the elderly*

Psycho social problems of elderly revolve around loss of status, alienation and loneliness as indicated by Vijayakumar (1999). Therefore, an attempt was made to evaluate the level of social activities of the elderly, by using a three point scale to score the frequency of participation in ten measures of socially relevant activities designed by Christensen et al.,(1996). Table 3 presents the details.

Table 3

Social activity Profile of the elderly.

Level of social activity	Social activity Score	Living arrangement		Gender		Age Group			Pooled (n=500) %
		Free Living (n=350) %	Institutionalised (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
Good	20-30	49.1	6.0	50.0	27.9	42.0	33.3	18.2	36.2
Average	10-20	48.6	92.7	47.9	70.2	56.5	64.5	78.2	61.8
Poor	<10	2.3	1.3	2.1	1.9	1.5	2.2	3.6	2.0
Chi square value		87.5***		25.331***		12.629**			--

***p< 0.001 **p< 0.01

The social activities of a majority of elderly (61.8%) were rated as average. The selected activities were visits by close relatives, children etc., reading books or newspaper, watching TV, listening to music, cultural programs, prayer meetings and pursuing a hobby. There was significant difference between all categories of elderly with higher percentage of free living elders (49.1%) reporting significantly better ($p<0.001$) social activities than those in old age homes (6%).Similarly a higher percentage of elderly men (50%) had a significantly higher rate($p<0.001$)of social interactions than women (27.9%). It was also found that social activities declined with each decade of age advancement (60-70; 70-80 & > 80 yrs). This negative association was also statistically significant. Figure 6 presents the social activity pattern of the elderly.

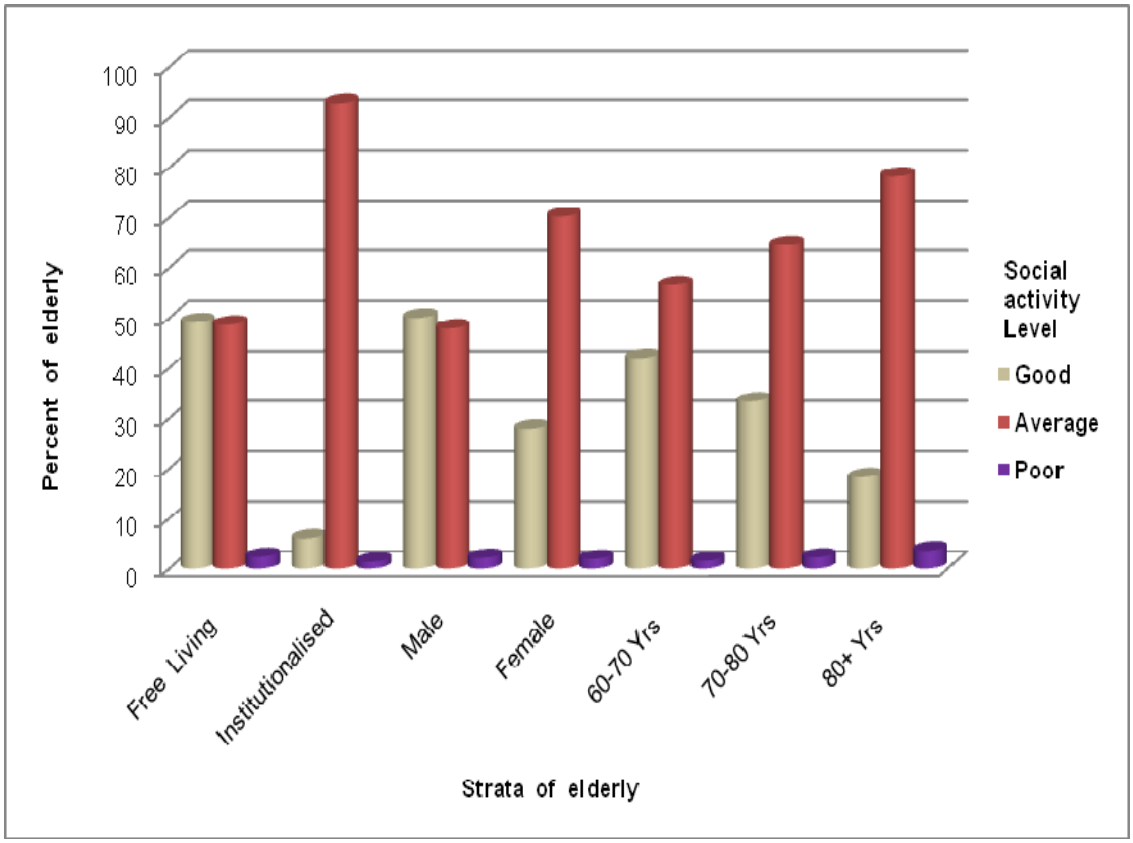


Figure 6 – Social activity pattern of elderly

Participation in social activities is largely determined by the general feeling of well being among elderly. It may also reflect the level of independence enjoyed by them and may partly explain the low levels of social activities reported by the institutionalized elderly, women and the older groups of elders. Similar findings were also reported at International Symposium on active ageing (2008). Rosenberg and Miller (1996) suggested that independence, social contacts and self esteem were interrelated and significantly affected the overall quality of life of older persons.

4.1.2.3 *Life Satisfaction of the elderly.*

Life satisfaction is generally comprised of three major dimensions namely social satisfaction, personal satisfaction and general happiness(Balachandran et al.,2007).The detailed aspects of life satisfaction were selected under four major

domains-emotional, economic, health and dietary quality as suggested by WHO(2002) and Ferrans and Powers Quality of life Index(1998).After scoring on a three point scale, life satisfaction was rated as excellent, average or poor. The results are given in table 4.

Table 4

Overall Life satisfaction of elderly

Life satisfac-tion	Scores	Living arrangement		Gender		Age Group (years)			Pooled (n=500) %
		Free Living (n=350) %	Institutio -nalised (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183 %	80+ (n=55 %	
Excellent	>80	64.0	59.3	71.8	57.1	62.2	63.9	60.0	62.6
Average	50-80	33.4	40.7	27.1	40.7	36.3	35.0	34.5	35.6
Poor	<50	2.6	0.0	1.1	2.2	1.5	1.1	5.5	1.8
Chi square value		5.8*		11.063**		4.885^{ns}			-

The life satisfaction of the elderly was rated as excellent for majority (62.6%) of the elderly. However when different categories of elderly were compared , it was found that there was a significant difference($p<0.05$)in the life satisfaction scores secured by free living elderly and institutionalized elderly, as well as between elderly men and women. Free living elders and elderly men had higher levels of life satisfaction than their counterparts. As far as the age factor was concerned, there was some change in the life satisfaction scores with increasing age, but not to statistically significant levels.

The present findings are however contradictory to a few studies on the same lines. A study conducted by Dandekar (1996) in Delhi revealed that majority of institutionalized elderly reported high satisfaction levels with regard to their living conditions. Balachandran et al., (2007) contended that there was no significant difference in life satisfaction between elderly men or women. A possible justification might be the change in cultural perceptions and outlook between the study areas. The results are illustrated in figure 7.

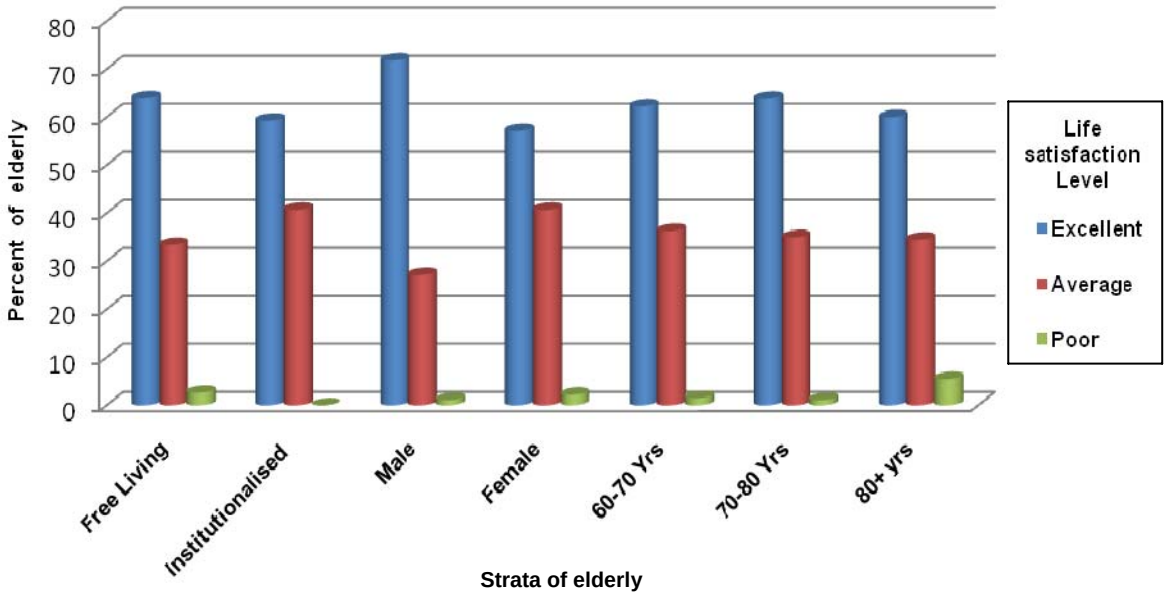


Figure 7 –Overall life satisfaction of the elderly

4.1.2.4 *General Psychological Indices*

General indices which are indicative of psychological morbidity in elders were assessed and is presented in the following table.

Table 5

General psychological morbidities among elderly.

Particulars	Living arrangement			Gender			Age Group				Pooled (n=500) %
	Free Living (n=350) %	Institutionalised (n=150) %	Chi-square value	Male (n=188) %	Female (n=312) %	Chi-square value	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	Chi-square value	
Lack of Orientation											
None	76.0	43.3		67.0	65.7		72.5	62.3	49.1		66.2
Time	11.4	10.0		10.6	11.2		11.5	11.5	7.3		11.0
Place	3.1	5.3	129.38***	3.7	3.8	0.510^{NS}	3.1	3.3	9.1	35.68***	3.8
Person	3.4	41.3		13.8	15.4		7.6	19.7	32.7		14.8
All the above	6.0	0.0		4.8	3.8		5.3	3.3	1.8		4.2
Feel confused	30.6	26.0	1.059^{NS}	23.4	32.7	4.885*	29.2	26.0	40.0	3.889^{NS}	29.2
Disturbed sleep	27.7	34.7	2.421^{NS}	26.1	32.1	2.006^{NS}	28.6	29	38.2	2.08^{NS}	29.8
Hours of sleep											
<6 hours	38.3	30.7		33.0	37.8		36.3	36.6	32.7		36.0
6-8 hours	46.3	34.0	24.853***	48.9	38.8	5.150^{NS}	45.4	42.1	30.9	9.369^{NS}	42.6
>8 hours	15.4	35.3		18.1	23.4		18.3	21.3	36.4		21.4
Recent Bereavement	8.6	6.0	0.963^{NS}	4.8	9.6	3.795^{NS}	7.3	7.7	10.9	0.854^{NS}	7.8
Poor Memory	18.0	36.0	18.842***	18.6	26.3	3.838^{NS}	19.5	25.1	36.4	7.727*	23.4

***p<0.001; **p<0.01; *p<0.05

Results indicated that 66.2 percent of the subjects studied had no problem with regard to orientation. 14.8 percent reported lack of orientation to persons and 11 percent to time. Lack of orientation especially to persons were found to increase with advancing age and this association was found to be highly significant ($p<0.001$). Also the problem was significantly higher among institutionalized elderly ($p<0.001$). Feelings of confusion were significantly more ($p<0.05$) among females than males. This was also found to be statistically significant ($p<0.05$).

Normal sleep is an important requirement for psychological well being. Sleep disturbances among older persons are frequently reported and are associated with increasing number of respiratory symptoms, physical disabilities, non prescription medications, depressive symptoms and poorer self perceived health (Foley et al.,1995). Regarding disturbed sleep, institutionalized elders (34.7%), females (32.1%) and older elders (38.2%) were more affected, though not to any significant extent. Gottileb (1990) has also documented disordered sleep to be pervasive among the elderly especially the institutionalized. Khokhar and Mehra (2001) reported disturbed sleep in 23 percent of elderly in a Delhi study. The present findings showed a comparable prevalence (29.8%) of sleep disturbances among elders.

But higher percentage of institutionalized elderly slept for more number of hours (>8 hours) than free living elders probably due to lack of other engagements. This difference was statistically significant also($p<0.001$). More number of sleep hours was reported with increasing age also. The use of medications which induce sleepiness cannot be over ruled , as older persons normally require lesser sleep , biologically.

Poor memory was reported by 23.4 percent of the elderly. The problem was markedly higher in institutionalized elderly ($p<0.001$) and increased with increasing age ($p<0.05$). More females reported poor memory, though the association was not statistically significant. Negative influence of age on memory has been well documented (Small (2002) and Cockburn and Smith (1999). Recent bereavement was reported by 7.8 percent of elderly. Highest occurrence of episodes of losing their dear ones was for the ‘oldest-old’ age group (10.9%).

4.1.2.5 *Prevalence of depression among Elderly*

Depression among elderly was assessed by the shortened form of Geriatric Depression Scale proposed by Yesavage et al., (1986) and the effect of various factors on depression was also studied. The findings are presented in the following table.

Table 6

Prevalence of Depression among elderly

Variable	% Depressed (n=500)	Chi square value
Living Arrangement		
Free living	20	0.76^{ns}
Institutionalized	16.7	
Gender		
Men	16.5	1.23^{ns}
Women	20.5	
Age group		
60-70	16	
70-80	20.8	4.32*
80+	27.3	
Marital Status		
Married	45.3	
Widowed	38.9	
Single	13.7	9.44*
Separated	2.1	
Education		
Illiterate	69.6	
Below 10th standard	27.4	22.34***
Above 10th standard	3.2	
Economic independence		
Independent	32.6	12.21***
Dependent	67.4	
Overall Depression prevalence	19%	

ns-not significant * p<0.05 *** p<0.001

The overall prevalence of depression (GDS score > 5) was found among 19 percent of elderly. Community based studies on psychiatric morbidity of the elderly indicated widely varying rates of depression. The earliest published study of an Indian geriatric population, found a remarkably high prevalence of 24.1 percent depressive illness.(Ramachandran and Sarada, 1981). Nandi et al., (1997) reported a higher percentage of (52.2%) of elders to be suffering from varying levels of depression. Overall depression prevalence in other countries range from 28 percent in Israeli elderly (German et al.,2008) to 34.7 percent in German elderly(Smoliner et al.,2009).

When the gender wise analysis was made, more women were found to be depressed (20.5%) than men (16.5%). This is well documented in many studies. (Rajkumar et al., 2009; Patil, Gaonkar and Yadav (2003) and Nandi et al., (1997). Niriy & Jhingan (2002) observed that stress events were more evident in females, especially those who perceived crisis in family.

The rates of depression increased with rising age, the association being significant at 5 percent level. This finding also has been replicated in a number of other studies in other Indian states (Ganguli et al., 2000; and Tiwari, 2000).Although the incidence was higher among free living elderly (20%) than the institutionalized (16.7%), this difference was not significant. The free living group had more cases of depression but this is in contrast to reports by Patel (2003) that the institutionalized elders experienced poor psychological well being compared to non institutionalized elders. However as Wu and De Maris (1996) stated, family based strains and economic hardships were significant predictors of higher distress in elderly, especially women. Chronic strains also may explain why prevalence of depression is more pronounced among the married than the unmarried, as found in the present study. Markides and Farrel (1985) also reported that the significance of marital status as a low risk factor for depressive illness diminished in the older generation.

Highly significant ($p<0.001$) association between lower educational status and incidence of depression has been brought out in the present study. This is supported by other reports also. Ganguli et al., (2000 and 1991) in their studies on depressive

symptoms in a population of rural Indian elderly a consistently found that greater number of depressive symptoms were associated with illiterate and educationally disadvantaged elderly.

Prevalence of depression was also found to be significantly higher($p< 0.001$) among economically dependent elderly (67.4%) than those who were more independent(32.6%). Rajkumar et al., (2009) had also established the significant association of depression with economic dependency among elderly.

Figure 8 presents the prevalence of depression in various groups of elderly.

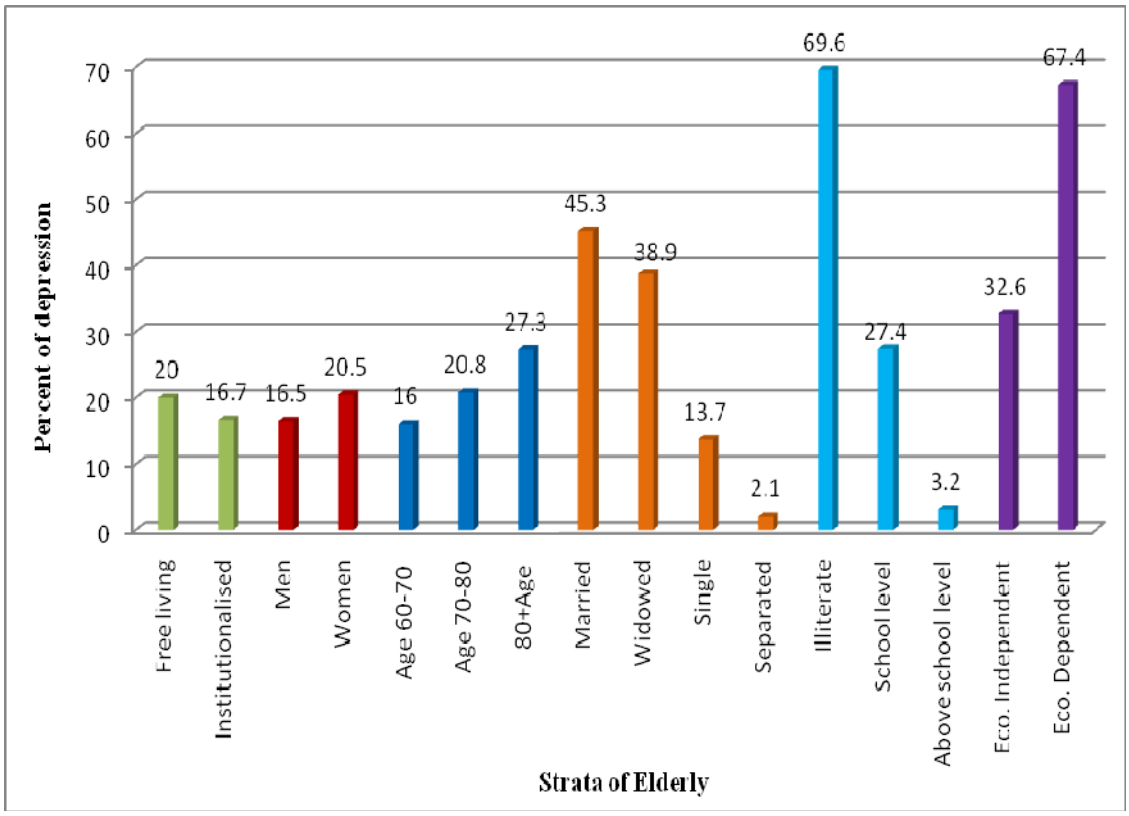


Figure 8 - Prevalence of Depression among Elderly

4.1.3 *Functional disabilities and Morbidity Profile of the Elderly*

When attempting to determine nutritional status of elderly population, factors like mobility, levels of functioning of sense organs and incontinence of bowel/bladder assume significance since they are the determinants of appetite, food consumption and psychological state, which in turn contribute to nutritional intake (Shils and Young,1988).

4.1.3.1 Physical Activities of Daily Living (PADL) Index

Functional assessment of all the subjects was done using the physical activities of daily living (PADL) scale developed by Katz et al., (1986) and recommended by WHO (1995). The results are presented in table 7.

Table 7
Physical Activities of Daily Living (PADL) Index[#] of elderly

Variables	Level of dependence	Living arrangement		Gender		Age Group (Years)			Pooled (500) %
		Free Living (n=350) %	Institutionalized (n=150) %	Male (n=188) %	Female (n=312) %	60-70yrs (n=262) %	70-80yrs (n=183) %	80+ (n=55) %	
Bathing	**Full Dependence**	0.2	1.3	0.53	0.64	0	0	5.5	0.6
	Partial dependence	0.8	0.0	1.06	1.2	0	0.56	9.0	2.1
	Independent	99	98.7	98.4	98	100	99.45	85.4	97.3
Dressing	**Full Dependence**	0.2	1.3	0.53	0.64	0	0	5.5(3)	0.6
	Partial dependence	0	0	0	0	0	0	0	0
	Independent	99.8	98.7	99.47	99.36	100	100	94.5	99.4
Toileting	**Full Dependence**	0.2	1.3	0.53	0.64	0	0	3.2	0.6
	Partial dependence	0.4	0.8	1.59	1.2	0	0	2.6	0.8
	Independent	96.7	97.9	97.7	98.0	100	100	92.2	98.2
Transfer (getting in and out of bed)	**Full Dependence**	0	0	0	0	0	0	0	0
	Partial dependence	0.4	.6	.53	.64	0	1.09	3.6	0.6
	Independent	99.6	99.4	99.47	99.36	100	98.91	96.4	99.4
Continence	**Full Dependence**	0.85	2.6	2.1	0.96	0	1.09	7.2	1.4
	Partial dependence	13.4	9.3	13.3	11.5	**8.8**	**14. 5**	**16.4***	12.2
	Independent	85.75	88.1	84.6	87.54	91.2	84.41	76.4	86.4
Feeding	**Full Dependence**	0	0.6	0	0.64	0	0	1.8	0.2
	Partial dependence	0	1.3	.53	0.64	0	0	5.5	0.6
	Independent	100	98.1	99.47	98.8	100	100	92.7	99.2

[#] Ref. Katz et al., (1986). * Chi-square value – 5.95, $p<0.05$

The PADL index identifies elderly who are dependent on the six major domains regarding functional health i.e. bathing, dressing, toileting, transfer, continence and feeding. Few subjects reported full dependence on others for bathing, dressing, toileting, transfer (getting in and out of bed/chair) and feeding. As obtained from the table, majority of the elderly (86.4% to 99.4%) were functionally independent in all the six domains studied. Partial dependency was reported mainly in bowel and bladder incontinence (12.2%) and bathing (2.1%). The problem of incontinence was higher among the free living (13.4%) than the institutionalized (9.3%) and among men (13.5%) than women (11.5%). Incontinence of bowel or bladder increased with older ages ($p < 0.05$), thus limiting an important facet of functional health of the elderly. There was no gender difference in the overall ADL scores of the elderly. Studies (Moody, 2000 and Dandekar, 1996) have also reported that a vast majority of people over the age 60 are healthy enough to engage in activities of daily living (ADL).

4.1.3.2 Personal Habits of the Elderly

Table 8

Personal habits of the elderly.

Habits	Living arrangement		Gender		Age Group (Years)			Pooled (n=500) %
	Free Living (n=350) %	Institution (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
Smoking								
Yes	9.1	3.3	19.7	0.0	9.5	5.5	3.6	7.4
Quit	0.9	0.0	1.6	0.0	1.1	0.0	0.0	0.6
Alcohol Use								
Daily	12.3	0.0	22.9	0.0	10.7	8.2	0.0	8.6
Social events	2.3	0.0	4.3	0.0	2.3	1.1	0.0	1.6
Tobacco/betel chewing								
Regularly	6.3	0.0	3.7	4.8	5.3	4.4	0.0	4.4
Occasionally	2.3	0.0	1.6	1.6	1.9	1.6	0.0	1.6
Regular Exercise	54.3	28.7	64.9	35.6	51.1	48.1	20.0	53.4

(Contd…)

Habits	Living arrangement		Gender		Age Group (Years)			Pooled (n=500) %
	Free Living (n=350) %	Institution (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
Type of exercise								
Walking	82.6	86.0	88.5	77.5	78.4	89.8	90.9	83.3
Jogging	1.6	2.3	1.6	1.8	2.2	1.1	0.0	1.7
Sports activity	1.1	0.0	0.8	0.9	1.5	0.0	0.0	0.9
Breath exercise	1.1	4.7	0.0	3.6	1.5	1.1	9.1	1.7
Yoga	2.1	0.0	0.0	2.7	2.2	1.1	0.0	1.7
Gardening	6.3	4.7	0.8	8.1	8.2	3.4	0.0	6.0
Walking with other exercises (Jogging , breath exercise, yoga, gardening)	5.3	2.3	8.2	5.4	5.9	3.4	0.0	4.7

As the table depicts, a small percentage of elderly were addicted to unhealthy habits like smoking (7.4%), alcohol use (8.6%) and chewing tobacco (4.4%). Rajan (1999) reported smoking as the most prominent unhealthy habit among elderly, in Kerala. But in the present study alcohol use was found to be more prevalent, especially among elderly men (22.9%) followed by smoking(19.7). Prakash et al., (2003) also reported comparable figures regarding alcohol consumption, whereas Khokhar and Mehra (2001) indicated alcohol consumption by 30.35 percent and smoking by 15.62 percent elderly in an urban community of Delhi. Natarajan et al.,(1991) have found chewing tobacco, betel leaves and smoking as highly prevalent habits in a rural population in Tamil Nadu. But in the present study habitual usage of these was found to be low.

A higher percentage of free living elders (54.3%) reported regular exercise compared to institutionalized elderly (28.7%). So also more elderly men exercised (64.9%) than women (35.6%). However the proportion of elderly involved in regular exercise decreased with advancing age. The type of exercise preferred by majority of elderly was walking (83.3%) followed by gardening activities (8.1%), jogging (3%), yoga (2.6%) and breathing exercises (2.1%).

4.1.3.3 Age Related Inabilities

Age related inabilities of the elderly in terms of oral health problems, problems with sense organs and mobility were studied and are presented in table 9.

Table 9

Age related inabilities among elderly

Factors	Living arrangement		Gender		Age Group (Years)			Pooled (n=500) %
	Free Living (n=350) %	Institution (n=150) %	Male (n=188) %	Female (n=312 %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
1) Dental problem (>2 DSI score)	11.7	8.7	13.3	9.3	8.8	13.1	12.7	10.8
Chi-square	**0.349^{NS}**		**0.181^{NS}**		**2.314^{NS}**			
• Tooth problem								
Loss of teeth	47.7	67.3	44.1	59.3	45.8	62.8	60.0	53.6
Dental Caries	7.4	5.3	6.9	6.7	9.5	3.3	5.5	6.8
Both	2.6	4.7*	3.2	3.2*	3.4	1.6	7.3*	3.2
Chi-square	**20.762*** **		**12.254** **		**20.78** **			
• Problem with chewing	25.7	24.7	20.2	28.5	22.1	26.8	36.4	25.4
Chi-square	**0.69^{NS}**		**4.28***		**5.14** **			
• Problem in swallowing	12.6	4.7	10.1	10.3	10.3	10.9	7.3	10.2
Chi-square	**8.17***		**0.003^{NS}**		**0.624^{NS}**			
2) Eye sight								
• Partially Blind	10.9	10.7	5.3	14.1	10.3	9.3	18.2	10.8
• Blind	0.3	0.7*	0.0	0.6*	0.4	0.0	1.8	0.4
Chi-square	**32.82*** **		**12.313** **		**7.60^{NS}**			
3) Hearing								
• Partially deaf	16.6	11.3	17.6	13.5	10.7	18.0	25.5	15.0
• Deaf	0.3	0.7*	0.0	0.6*	0.4	0.5	0.0	0.4
Chi-square	**2.59^{NS}**		**2.68^{NS}**		**10.15***			
4) Smell and taste								
• Poor	3.1	1.3	2.7	2.6	**2.3**	**1.1**	**9.1***	2.6
Chi-square	**1.47^{NS}**		**0.07^{NS}**		**18.02*** **			

(contd….)

Factors	Living arrangement		Gender		Age Group (Years)			Pooled (500) %
	Free Living (350) %	Institution (150) %	Male (188) %	Female (312) %	60-70 (262) %	70-80 (183) %	80+ (55) %	
5) Incidence of fracture	12.3	7.3	8.0	12.5	9.2	11.5	16.4	10.8
Chi-square	**2.67^{NS}**		**2.5^{NS}**		**2.58^{NS}**			
• Type of fracture								
Leg	3.8	1.6*	3.2	2.9	3.8	1.6	3.6	3.0
Arm	3.4	6.0	2.1	6.4	3.4	6.0	5.5	4.6
Arm and Hip	0.8	0.0	0.0	0.6	0.4	0.0	1.8	0.4
Hip	0.4	0.5	0.0	1.0	0.0	0.5	3.6	0.8
Back Bone	1.1	3.3	2.7	1.9	1.5	3.3	1.8	2.2
6) Stiff Back	**13.7**	**39.3**	**14.9**	**25.3**	**15.6**	**24.0**	**40.0**	**21.4**
Chi-square	**60.88*****		**26.295*****		**18.237*****			
7) Mobility (Walking a distance)								
• Not difficult	86.3	80.7	87.8	82.7	89.7	82.6	67.3	84.6
• Very difficult but possible	8.9	12.7	8.5	10.9	8.0	13.1	18.2	10.0
• No mobility	4.9	6.7	3.7	6.4	2.3	4.4	23.6	5.4
Chi-square	**0.136^{NS}**		**1.159^{NS}**		**18.354*****			
Mean age related inability per person	1.8 ± 1.4	1.7±1.2	1.7±1.3	1.9±1.4	1.6±1.3	1.9±1.4	2.5±1.6	1.8±1.4
Test of significance	**Mann Whitney 'U' test Z=0.837^{NS}**		**Mann Whitney 'U' test Z=1.31^{NS}**		**Kruskal Wallis Test H=20.558*****			

The Dental Screening Initiative (DSI) (Morley, 1998) was used to identify the dental problems in elderly, that may affect their health and nutritional well being. The scale considered eating difficulty, lack of dental care, tooth loss, alternative food selection and presence of lesions/sores in mouth for scoring. Based on DSI, totally 10.8percent of the elders were found to have poor dental status. The incidence of poor dental status as per the DSI was higher among free living elderly (11.7%) than institutionalized (8.7%); among men (13.3%) than women (9.3%) and increased with

increasing age, though none of the associations were statistically significant. Several studies have already documented poor dental status among elderly (De Marchi et al., 2008; Shay and Ship, 1995; de Baat et al., 1993).

The tooth problem most prevalent was loss of teeth (53.6%) and dental caries (6.8%). Incidence of tooth problem was found to have a significant association with living in institution ($P<0.001$) being female ($P<0.01$) and increased with rising age ($P<0.01$). Shah (2003) reported that a higher percentage of Indian elderly men were denture wearers or had filled teeth compared to women but found few differences in the prevalence of dental caries and edentulousness between men and women. Also the prevalence rates of tooth problem in the present study was much lower than other Indian studies wherein more than 60 percent of elderly were indicated to have decayed teeth or tooth loss (Shah & Sundharam, 2004). The low prevalence rates in the present study may be due to better literacy level, personal hygiene and availability and use of dental care .

Problems with chewing was reported by 25.4 percent of elderly, the incidence which was higher in females ($p<0.05$). Difficulty in swallowing was found among 10.2 percent of elderly. It is possible that compromised dental function as indicated by poor Dental Screening Initiative scores in 10.8 percent of elderly, leads to poorly chewed food resulting in swallowing problems (10.2%). Similar observations were reported by Hildebrandt et al., (1997) where elderly with reduced number of dental functional units (opposing tooth pairs) tended to report difficult chewing, food avoidance and difficulty in swallowing.

Visual disability was detected if the person did not have the perception of light (blind) or if he was having perception about light but could not count fingers of a hand with or without glasses from a distance of 3 meters (Dilip, 2001).Partial blindness was found in 10.8 percent of elderly and 0.4 percent was completely blind. Females ($p<0.01$) and institutionalized elderly ($p<0.001$) were found to have significantly higher proportion of visual disabilities ($p<0.01$). The proportion of visual disabilities were found to increase with age, though the association was not statistically significant.

The findings on visual and hearing problems among the elderly are much lesser than reported by Bhosale and Devi (2008). They reported a prevalence of vision and hearing impairment in 61.6 percent and 38.4 percent of elderly respectively but the present results are consistent with reports by Goswami et al., of AIIMS, New Delhi (2005) wherein vision problems were found in only 3.3 percent of elderly. It may be that these inabilities are inversely related to the support extended to the elderly or their economic independence in procuring visual / hearing aids. Hearing ability was rated as poor in 15.0 percent of elders and 0.4 percent were deaf. But contrary to visual disability, free living elderly ($p<0.05$) and elderly men ($p<0.05$) reported a significantly higher prevalence rate of hearing disability.

Smell and taste perception loss was found in 2.6 percent of elderly. Smell and taste perception loss was significantly associated with increase in age ($p < 0.001$). Regarding mobility, a majority (84.6%) had no difficulty in walking a distance. Restricted mobility was higher for institutionalized elderly (6.7%) and also for females (6.4%) though chi square analysis did not reveal any significant difference. However, loss of mobility with increasing age was at statistically significant levels ($p<0.001$).

The incidence of stiff back was also higher among the institutionalized elderly (39.3%), elderly females (25.3%) and increased with age. All the above associations were highly significant ($p < 0.001$). For comparing the mean number of physical inabilities, Mann Whitney U test was used for category wise and gender wise comparison. The U values were however not significant indicating no significant association of inability prevalence with living arrangement or gender. For comparing the same with increasing age Kruskal-Wallis test was performed. The H test statistic was significant at 0.05 level, indicating an association of increasing inabilities with age.

4.1.3.4 Minor morbidities

Frequency of incidence of acute health problems of the elderly over the previous month was ascertained. Results are depicted in Table 10.

Table 10

Minor Morbidities among elderly

Illness profile	Living arrangement		Gender		Age Group (Years)			Pooled (n=500) %
	Free Living (n=350) %	Institution (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
Cough	54.6	56	52.2	56.8	58.1	50.9	54.5	55
Cold	40.2	54.7	45.2	44.2	43.5	43.2	54.5	44.6
Diarrhea	10.6	5.4	9.0	9.0	9.9	7.1	10.9	9.0
Fever	32.9	26.7	38.2	32.6	36.3	23.5	30.9	31.0
Stomach pain	21.7	12.0	20.2	17.9	19.4	16.9	21.8	18.8
Constipation	17.7	13.3	16.0	16.6	12.2	23.0	14.5	16.4
Head ache	45.7	37.3	37.3	46.8	46.5	37.2	47.3	43.2
Backpain	56	55.3	44.1	62.8	59.6	50.3	56.3	56
Joint pain	67.9	78.0	55.8	78.9	68.3	72.7	70.9	70.2
None of the morbidities	8	2	9.6	4.2	5	7.1	9.1	6.2
Chi-square	6.5**		5.88**		1.738^{NS}			-
Mean number of morbidities per person	5.54±3.1	5.68±2.7	5.42±3.19	5.69±2.83	5.69±2.95	5.48±3	5.41±2.97	5.59±2.97
Test of Significance	Mann Whitney 'U' Test Z value = 3.339^{NS}		Mann Whitney 'U' Test Z value = 0.816^{NS}		Kruskal Waalis Test H = 0.812^{NS}			

Geriatric subjects presented complaints of simultaneous occurance of minor morbidities. The mean number of minor morbidities reported by the elderly was 5.59±2.97. This figure is much higher than the average number of acute health problems reported by Goswami et al., (2005) in a rural population in Haryana (average number 2.3) and even among a tribal elderly population as reported by Kerketta et al., (2009) (average number 3.1).

The most common health problem reported was leg pain (70.2%) which was significantly ($p<0.001$) higher among the institutionalized (78%) and among females (78.9%). This was followed by back pain (56%) cough (55%), cold (44.67), head ache (43.2%) and fever (31%). Other complaints presented were giddiness, palpitation, skin

ailments, weakness, nocturia and heart burn in less than one percent of the elderly. Similar findings have been reported by Bhosale and Devi (2008); and NSSO 60th round (2004).

Only 6.2 percent of elderly reported no minor health problem during the previous month .A higher percentage of free living elders (8%) were free from any minor health problem than institutionalized elderly(2%). More men (9.6%) were free from minor health problems than women (4.2%).These differences were also statistically significant as per chi-square test. A reduction in the mean number of morbidities was observed with age, which may be an indication of the better immunity status of those who survive into the oldest old group. However, when mean number of morbidities per person were compared, no significant differences between groups could be found by tests of significance.

4.1.3.5 Major Health problems

Data on chronic health problems of the elderly during the past one year was procured and the details are furnished in Table 11.

Table 11 Major health problems of elderly

Illness Profile	Living arrangement			Gender			Age Group (years)				Pooled (n=500)
	Free Living (n=350) %	Institutionalised (n=150) %	Chi-square test	Male (n=188) %	Female (n=312) %	Chi-square test	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	Chi-square test	%
Diabetes	27.4	20.7	2.53^{NS}	23.4	26.6	0.6^{NS}	26.7	23.0	27.3	0.50^{NS}	25.4
Cardio Vascular Disease	13.1	5.3	6.65^{**}	15.4	8.0	6.69^{**}	13.4	6.6	12.7	3.8^{*}	10.8
Cancer	1.1	0.0	1.73^{NS}	0.0	1.3	2.4^{NS}	1.1	0.5	0.0	0.98^{NS}	0.8
Arthritis/joint problems	34	53	0.99^{NS}	3 7	4 2	0.06^{NS}	4 2	33	55	0.57^{NS}	4 0
Osteoporosis	2.3	6.78	5.81^{*}	3.2	3.8	0.14^{NS}	1.1	6.6	5.5	9.70^{**}	3.6
Cataract	13.7	20.0	3.15^{NS}	13.8	16.7	0.71^{NS}	11.1	20.2	21.8	8.66^{*}	15.6
Asthma	10.6	10.0	0.04^{NS}	13.3	8.7	2.71^{NS}	10.7	10.4	9.1	0.12^{NS}	10.4
Hypertension	32.6	34.0	0.10^{NS}	29.3	35.3	1.91^{NS}	34.0	31.1	34.5	0.45^{NS}	33.0
Peptic Ulcer	2.9	1.3	1.04^{NS}	1.6	2.9	0.83^{NS}	2.3	2.7	1.8	0.17^{NS}	2.4
Renal diseases	1.7	0.0	2.6^{NS}	0.5	1.6	1.13^{NS}	0.8	1.6	1.8	0.89^{NS}	1.2
Liver diseases	0.3	0.0	0.43^{NS}	0.5	0.0	1.66^{NS}	0.0	0.5	0.0	1.73^{NS}	0.2
Bone fractures	5.1	1.3	4.0^{*}	1.6	5.4	4.53^{*}	2.3	4.4	10.9	8.89^{**}	4.0
No major health problem	36.3	39.3	-	36.2	37.8	-	38.2	37.2	32.7	-	37.2
Chi-Square	0.417^{NS}		-	0.136^{NS}		-	0.576^{NS}			-	-
Mean number of major morbidities per person	1.14±1.18	1.05±1.08	-	1.06±1.08	1.14±1.19	-	1.08±1.14	1.10±1.11	1.30±1.32	-	1.11±1.15
Test of signficance	Mann Whitney 'U' Test Z value $=0.65^{NS}$		-	Mann Whitney 'U' Test Zvalue $=0.45^{NS}$		-	Kruskal Waalis Test $H = 1.12^{NS}$			-	-

Ns – Not significant * $p<0.05$ **$p< 0.001$

Highest incidence was found regarding the problem of hypertension (33%). This is comparable to reports by Joshi et al., (2006) in Mumbai whereby hypertension incidence of 31 – 42 percent was found among elderly. Reports by Goswami et al., (2005) indicated a prevalence rate of 15.2 percent. Similar figures were indicated by Dilip (2001)also. All India statistics on cause -profile of old age mortality for urban areas showed that diseases of circulatory system (Cerebrovascular and hypertensive diseases) remain the most prominent cause of death among the elderly (Health information of India ,1996). Kalavathy et al., (2000) found a hypertension prevalence of 51.8 percent in an elderly population in Kerala by direct assessment. They also found that the prevalence rates fell to 38 percent when self reporting as per intake of anti hypertensives was relied upon.

The next prominent health problem was diabetes (25.4%), the incidence being higher among free living elders, the female elderly and the oldest old, though these associations were not significant. Reports on prevalence of diabetes in Indian elderly are few and far between. Joshi et al., (2006) in a study on an elderly Mumbai population reported the prevalence of diabetes to be 41.6 percent in lower middle class compared to other income strata. However comparative figures from Chennai (Ashabai et al.,2001), was 10.5 percent which is much lower. Goswami et al., (2005) in a rural area of Haryana found still lower figures (1.2%). These differences may be attributed to different life styles, stress levels and dietary habits.

The prevalence rates of Cataract (15.6%) was much lower than other reports. (Bhosale and Devi , 2008 and Goswami et al., 2005) The discrepancies in rates of prevalence may be due to variation in tool, methodology and nature of population as suggested by Swaddiwudhipong et al., (1996). The subjects already having availed surgical treatment for cataract also cannot be ruled out.

Incidence of bone fracture was higher among the free living(5.1%) and among older women (5.4%) and these associations were statistically significant. Age wise comparison also projected significantly higher incidence ($p<0.01$)of bone fracture among oldest age group(10.9%) when compared to young old (2.3%) and old (4.4%).

Arthritis or 'joint problems' were reported by as many as 40 percent of elderly .More institutionalized (53%) than free living (34%);women (42%)than men (37%) and older elders (55%) than younger elders were found to be affected, though the differences between groups were not significant. NSSO 2nd round (1998) found that 48.9 percent of elderly in Kerala to have complaints of Arthritis. Kerala was ranked only behind Andhra Pradesh (51.8%) regarding this problem.

Absence of major health problems were observed among 37.2 percent of elderly in the present study, as against 20 percent which was reported by ICMR in a community survey conducted among geriatric clinics in India. Further analysis to identify subjects relatively free from major health problems revealed that institutionalized elderly (39.3%) more than free living (36.3%) and females (37.8%) than males (36.2%) enjoyed slightly better status. With advancing age, the incidence of major health problems increased. However, none of the above associations were statistically significant. The mean number of major morbidities per person was also assessed. But no statistically significant differences could be established between any of the groups studied.

4.1.3.6 Medication use by the Elderly

Medication use by the elderly is an important quality care issue. Multiple and inaccurate drug use among elderly has been reported (Walia, 2003). To investigate this aspect, medications regularly consumed by the subjects within a week prior to the interview was enquired about. Table 12 presents the details.

Table 12

Type and number of drugs used by elderly

Type of drugs used	Living arrangement		Gender		Age Group (Years)			Pooled (n=500) %
	Free Living (n=350) %	Institutionalized (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
Analgesics	4.1	4.9	4	4.5	4.9	4	3.2	4.2
Antacids	13.3	1.3	12.4	8.1	11	8.8	6.5	8.8
Antibiotics	7.7	0.9	4.9	4	8.3	2.9	0.9	4.2
Anti coagulants	8.8	3.6	7.7	7	9.5	3.8	6.5	6.7
Anti hypertensives	46.8	36.5	44.3	31.5	35.6	42.3	49.1	40.9
Cardiac glycosides	11.9	1.3	11.5	6.8	11.7	3.8	9.9	8.1
Diurectics	3.1	4.9	3.8	3.4	3.4	4.9	0.4	3.4
Hypoglycemics	30.4	20.4	25.7	28.3	28.3	26.6	26.1	26.5
Laxatives	0.5	2.3	0.9	1.1	0.9	2.9	0.2	1.3
Steroids	0.5	4.9	0.9	2.3	2.2	2.2	0.2	1.9
Lipid Lowering drugs	9.2	1.3	12.4	3.4	8.8	5.8	0.2	5.9
Vitamin supplements	19.4	19.3	18.3	20.2	18	25.6	6.5	18.2
Miscellaneous (OTC)	14	5.9	14.4	9.9	10.3	13.7	9.9	11.2
Average number of drugs per day	**3.5±2**	**2.6±1.13**	**3.3±1.8**	**3.2±1.7**	**3.4±1.92**	**3.2±1.8**	**2.8±1.4**	**3.1±1.82**

OTC – Over the counter

Average number of drugs taken per day by the elderly was 3.1±1.82. The most frequently used drugs were anti-hypertensives (40.9%) , hypoglycemic agents (26.5%) and vitamin supplements (18.2%). Although some variation was observed in the drug intake with free living elderly taking more drugs (3.5±2) than institutionalized (2.6±1.13) and males (3.3±1.8) more than females(3.2±1.7) . A progressive reduction in drug intake was observed with age also, but the differences in all the above cases were found to be statistically insignificant.

Jorgensen et al., (2001) have also documented extensive multiple drug use among the elderly (up to 78%), the most commonly used drugs being cardiovascular, nervous system and gastrointestinal medications. Elderly women using more drugs per day than men (av.4.8 vs 3.8) was also reported in the above study. However, in the present study medication use was comparatively less and there was no significant gender difference in this aspect also. Institutionalized sample included in the present study with poor purchasing power may partly explain reduced medication use by the elders.

It has been estimated that older people may under report the number of drugs they take daily by 20 to 30 percent due to inaccurate recall (Jackson et al.,1989).This may also be a significant reason in the present context. Previous studies (Zhan et al., 2001) indicate that the proportion who reported taking medications generally increased with age, and in most age groups, a higher proportion of women reported taking multiple medications. However the present findings do not agree to the above reports.

4.1.4 *Quality of Life Index of the Elderly*

To interpret meaningfully the psychosocial and physiologic risk factors affecting the Quality of Life of elderly, five major domains as given below , were identified based on their relevance in this context as reported by various researchers.

1 Economic Dependency (Mehta and Shrirangpure,2000 and Robinson ,2001)
2 Depression (German et al., 2008;Wilson et al., 2007 and Pawaskar ,2007)
3 Age related inabilities – Poor dental status, blindness, deafness, poor taste and odour perception, stiff back and lack of mobility. (Kimura et al., 2009, Marchi et al., 2008; Pawaskar 2007 and Jongenelis et al., 2004)
4 Incidence of minor morbidities (Hengsterman et al., 2008 and Johanson et al., 2008)
5 Incidence of Major morbidities (WHO, 2002 and Hanna et al., 2000)

Each factor was scored on a two point scale and weighted average for each factor was computed. The total of the mean weighted average for each factor for the

elderly indicated as percentage, was assumed to be indicative of the quality of life of elderly.

$$\text{Quality of life Index} = \frac{\sum x_i w_i}{\sum w_i} x\,100$$

Where, x_i is scores for no problem (0) and having a problem (1)

w_i is number of subjects in each class.

Grading was done after computing the mean values and standard deviations of the quality of life index of the subjects (n=500). Subjects who obtained a score greater than or equal to the sum of mean and standard deviation (≥ Mean + Standard Deviation) was categorized as having poor quality of life. Those who obtained the score less than or equal to the difference of mean and standard deviation (≤ Mean – Standard Deviation) were categorized as having excellent quality of life and those who obtained scores between the above two values were categorized as having average quality of life. Results of the above classification are presented in the following tables.

Table 13

Percent distribution of elderly based on Quality of Life index

Variables	Quality of life index			Chi-square
	Excellent (≤ Mean – S D) %	Average (Mean ±1SD) %	Poor (≥ Mean + S D) %	
Living arrangement				
Free living (n=350)	17.4	59.7	22.9	19.018***
Institutionalized (n=150)	3.3	66	30.7	
Gender				
Male(n=188)	19.7	61.7	18.6	14.768***
Female(n=312)	9.3	61.5	29.2	
Age group (Years)				
60-70(n=262)	17.2	60.5	22.2	18.101**
70-80 (n=183)	8.7	67.4	23.9	
80+ (n=55)	9.1	47.3	43.6	
Pooled (n=500)	**13.2**	**61.6**	**25.2**	**-**

*** p<0.001 ** p< 0.05 S.D – Standard Deviation

As the table depicts there was a significant difference in the quality of life index of elderly. Majority (61.6%) had a quality of life index rated average. The rating as excellent was secured by only 13.2 percent of elderly. When two living arrangements were compared, a significantly ($p<0.001$) higher percentage of free living elders had excellent quality of life than institutionalized elderly. The above findings are similar to reports by Varma et al.,(2009)in which emotional and physical quality of life scores were higher for free living elders than those in institutions.

Quality of life was significantly ($p<0.001$)associated with gender also with men having better quality of life than women. Age factor of elderly was negatively associated with quality of life index scores to a significant extent ($p<0.01$). It was seen that age tend to reduce the quality of life of elderly to a significant extent. The findings are illustrated in figure 9.

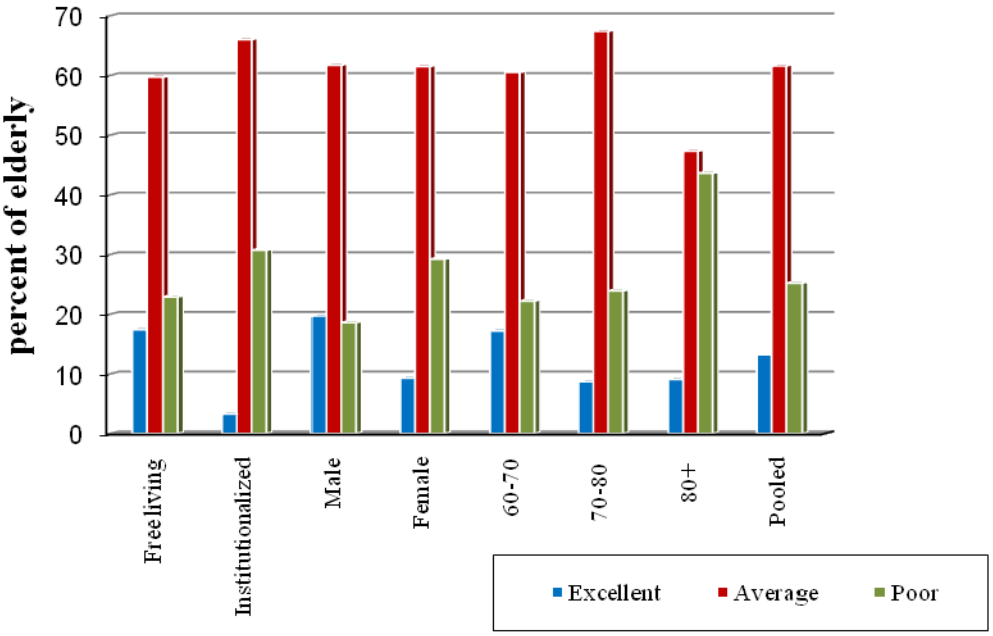


Figure 9 - Quality of Life Index of Elderly

As evident from the figure, a higher percentage of elderly in all categories were classified as having average 'quality of life'. Proportion of elderly with excellent quality of life was lowest among institutionalized elderly, whereas highest proportion of the same was noted among elderly men. The Comparative contribution of each factor in predicting poor quality of life of elderly is presented in Figure 10.

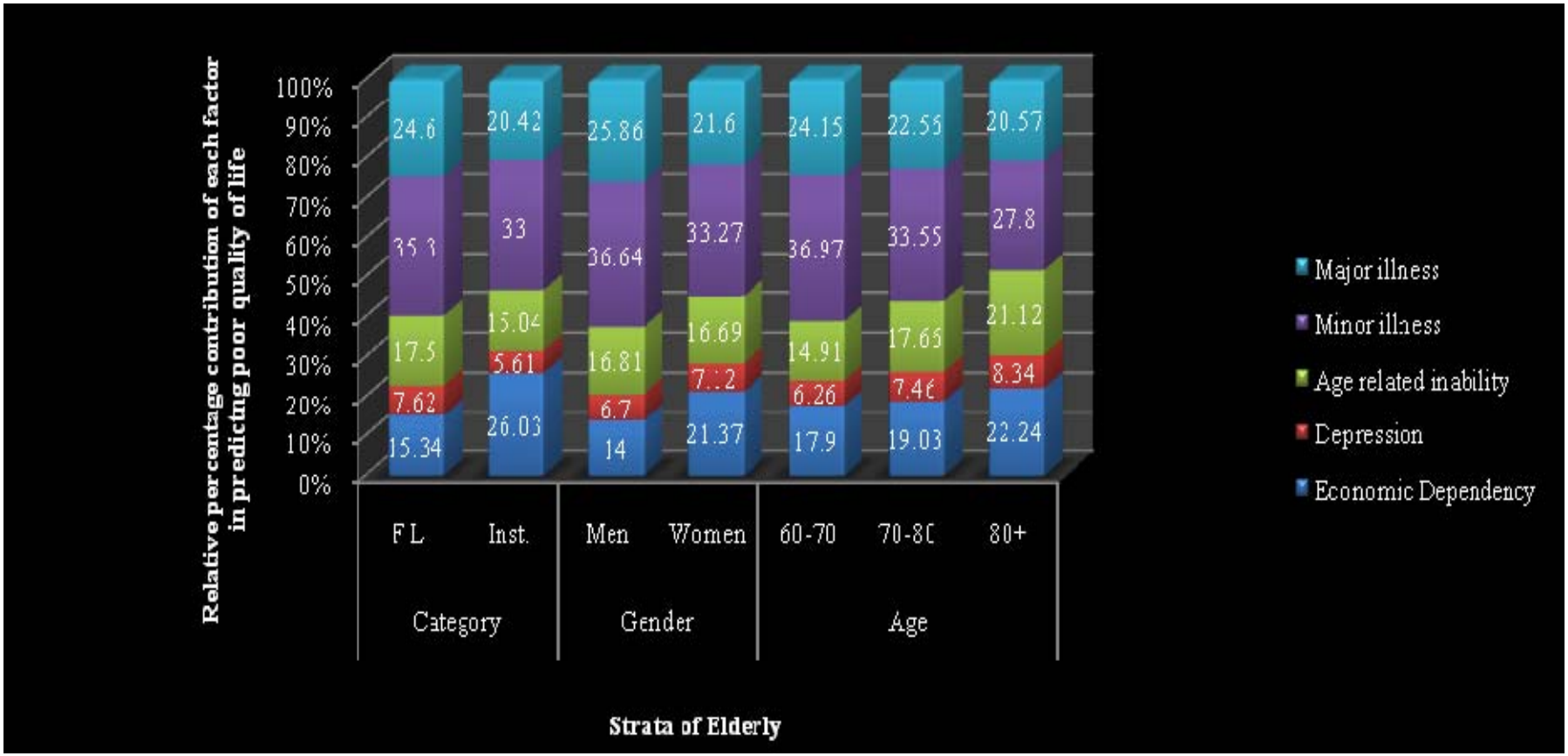


Figure 10 Comparative contribution of risk factors in predicting poor quality of life of Elderly

As evident from the above figure, minor (27.8% to 36.97%) and major illnesses (20.4% to 26.86%) were the most important risk factors affecting the quality of life of elderly. This was followed by economic dependency (14% to 26.03%) and age related inabilities (14.9% to 21.12%). The relative contribution of depression was more or less similar(5.61% to 8.34%) across various strata of elderly.

4.2 Assessment of Nutritional Status of the Elderly

Nutritional assessment is a process of several evaluations which when combined defines an individuals nutritional status. Combinations of standard measurements of anthropometric, biochemical, clinical and dietary indices have been suggested by WHO (2002) to assess nutritional status of elderly.

4.2.1 *Anthropometric Measurements*

Anthropometric characteristics of individuals and populations are simple and strong predictors of future ill-health, functional impairment and mortality. Anthropometry has been suggested to be extremely useful in identifying changes in body composition and size that occur with old age. (Perisssinotto et al., 2002).Anthropometric evaluation of elderly population is complex since a number of factors such as age related biological changes, illnesses, secular changes, diseases, lifelong practices (smoking, diet, exercise) and socio – economic variables affect its predictive power.

Many studies worldwide have reported the effect of age on anthropometry (Kikafunda and Lukwago, 2005).However only a few studies on elderly in India have dealt with age related variations in anthropometric characteristics. (Ghosh, 2006). Moreover no detailed investigations have been undertaken to study the variations in anthropometry of elderly in Kerala.

To compare the anthropometry of older persons, WHO (1995) has recommended the following :

- Use of NHANES III data for comparison between population groups and

- Use of available local reference data of each country, though with limitations, to provide early indications of future problems. None of the references are suggested to be used as standards, since different populations show large geographical and ethnic variations in height, weight and BMI, much of which reflects differences in lifestyle and environment throughout life.

4.2.1.1 Height, Weight and Body Mass Index

The mean height, weight and Body Mass Index of elderly according to gender and age is presented in table14.

Table 14

Mean Height , Weight and Body Mass Index of the elderly by age and gender

Age in years	Elderly men (Mean ±SD)				Elderly women(Mean±SD)			
	n	Height (cm)	Weight(kg)	BMI	n	Height	Weight	BMI
60-70	48	162.59±7.75	60.33±14.49	22.77±5.12	77	149.69±6.92	55.23±10.27	24.57±4.0
70-80	43	161.28±9.52	59.22±10.11	22.70±2.88	77	146.66±8.73	51.79±11.53	24.08±5.0
80+	24	161.13±12.4	48.03±10.56	18.41±2.94	27	139.46±8.45	43.30±8.87	22.26±3.7
F value		0.28^{NS}	3.37*	4.03*		17.054^{***}	12.585^{***}	2.719^{NS}
Pooled	115	161.91±8.89	58.85±12.77	22.38±4.26	181	146.85±8.63	51.98±11.31	24.02±4.4

Ns – Not significant * $p<0.05$ *** $p<0.001$

Though height and weight of the elderly does not, per se, indicate their nutritional status, a decline in both indices with age was noted. The decline in height of both female and male elderly, though progressive with age, was not significant for males. But the reduction was highly significant ($p<0.001$) among elderly females. Several studies have documented height loss ranging from 1.2 cm – 4.2 cm/20 years, due to thinning of vertebrae with age. (Pieterse, 1999; WHO, 1995; Kwok and White law, 1991).

As far as body weight of elderly is concerned the progressive reduction with age in both men ($p<0.05$) and women ($p<0.001$) was found to be statistically significant whereas the decline in BMI of the subjects with age showed statistical significance ($p<0.05$) in elderly men and failed to show any statistical significance in elderly

women. The concomitant decrease in body weight of the elderly with age is also supported by previous findings. WHO (1995) indicated that body weight gain in men plateaus at around 65 years and declines thereafter and though the weight increase in women are frequently greater, it plateaus about 10 years later than in men. Decrease in body mass index with age is also well documented (Seidell and Visscher, 2000).

Another perspective of the body weight change with age or gender data is its comparison with percentile reference values of NHANES – III data as given in the following figure

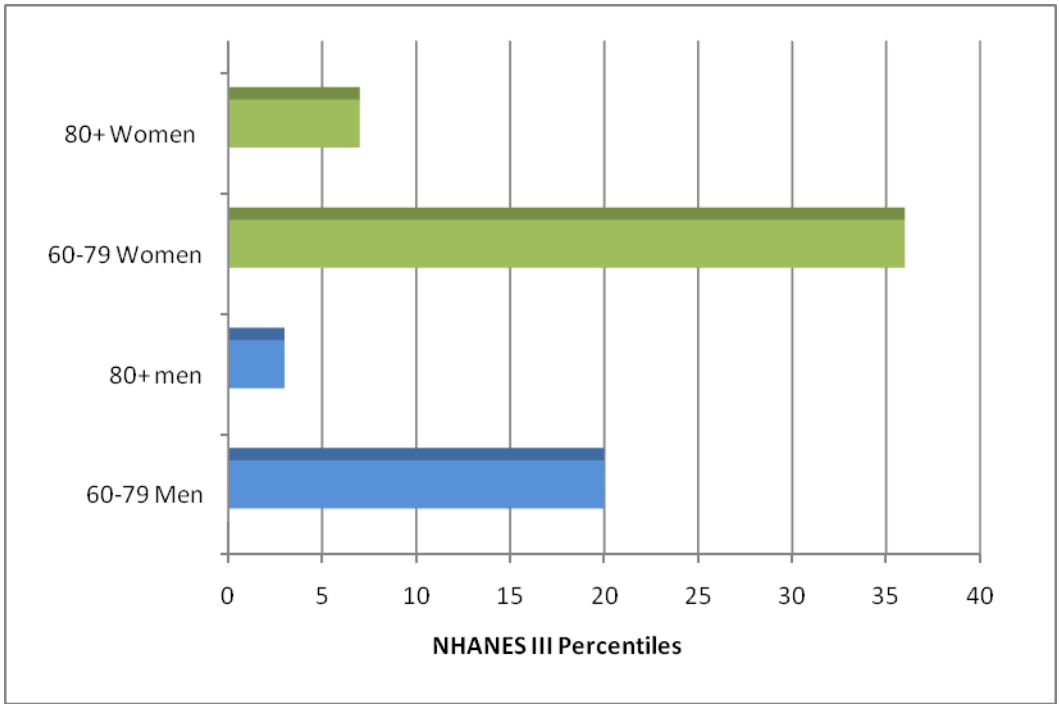


Figure 11 – Comparison of Mean Body Weights of Elderly with NHANES III Percentiles values

A comparison with the NHANES – III data indicated that the mean body weights of 60 to 79 year old men was between the 15th and 25th percentile of NHANES III data whereas mean body weight of 80 plus men was below the 5th percentile values which was indicative of chronic energy deficiency. Women of 60 to 79 years had their mean body weights between 25th and 50th percentile values of NHANES III data and body weight of oldest old women (>80 years) was between 5th and 10th percentile of

the same reference. This indicated that loss of body weight affected the oldest old (> 80 years) of men and women in this study population.

BMI classification of elderly is presented in table 15.

Table 15
Percentage Distribution of elderly based on BMI classification

Gender	Age group (years)	n	Body Mass Index classification ✱				χ^2
			<18.5	18.5-24.9	25-29.9	>30	
Men	60-70	48	22.9	41.7	31.3	4.2	10.74* (When BMI>25 treated as one cell)
	70-80	43	9.3	72.1	18.6	0	
	80+	24	25.0	70.8	4.2	0	
		115	17.2	55.6	25.3	2.0	
Women	60-70	77	6.5	54.5	29.9	9.1	3.288^{ns}
	70-80	77	9.1	55.8	25.7	10.4	
	80+	27	14.8	59.3	22.2	3.7	
		181	8.8	55.8	26.5	8.8	

* $p<0.05$, ns – not significant, ✱ - Shetty and James 1994.; James et al.,1988

As obtained from the table the majority of elderly males (55.6%) and females (55.8%) had a BMI between 18.5 to 24.9. Overweight was observed among 25.3 percent of males and 26.5 percent female elderly. An obvious difference was observed in the overall prevalence of obesity (BMI>30) among males (2%) and female (8.8%) elderly and also in chronic energy deficiency (BMI<18.5) among male (17.2%) and female (8.8%) elderly.

NNMB reports (2005-2006) indicated an overall prevalence of CED in Kerala to be 27.7 percent in elderly men and 21.1 percent in women which was the lowest among other Indian States. The present study also indicated a lower prevalence of CED among elderly women compared to men. Similarly overweight /obesity prevalence rates in Kerala as per NNMB reports(2005-06) was 14.5 percent in men and 24 percent in women .The national survey also revealed that though food and nutrient intakes were relatively lower in Kerala, the prevalence of overweight and obesity was high, a disparity which was complex.

Age wise distribution of elderly with respect to their Body Mass Index revealed concomitant decrease in overweight (25 – 29.9 BMI) and obesity (>30 BMI) with age among men which was statistically significant ($p < 0.05$). However no such association has been observed between low BMI and age of elderly women. NNMB (1997) survey on elderly also could not establish any significant relationship between age and BMI.

Singh et al., (2004) reported a prevalence rate of overweight and obesity among elderly in Delhi as 26.7 percent and 9.7 percent respectively. They also found that 28.7 percent of men were overweight and 5.4 percent were obese, whereas 23.4 percent and 16.9 percent of women were overweight and obese respectively. The increased prevalence of obesity among elderly women than men was also observed in the present study. A comparison of the prevalence of overweight and obesity among elderly in Kochi and Delhi is given in figure 12.

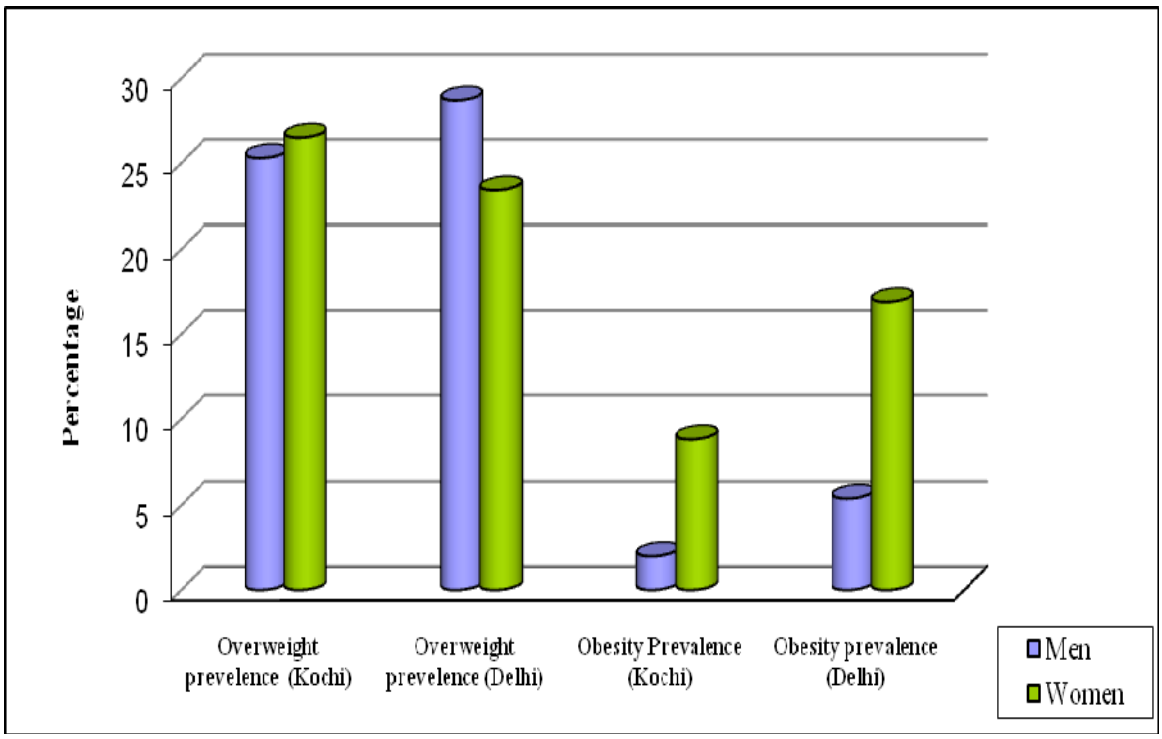


Figure 12 - Prevalence of overweight and obesity among Elderly in Kochi and Delhi

Though obesity prevalence was much lower in present study, the overall results of the present study are comparable with the Delhi study in that prevalence of obesity was more among females than males. It is also notable that the proportion of overweight elderly females (BMI>25) were higher in the present study (26.5% compared to 23.4% of Delhi study.) The co-existence of CED (BMI<18.5) and overweight / obesity (BMI>25) among the elderly is a clear indication of the dual burden of malnutrition among the elderly population also. NFHS-III (2005-06) had also clearly brought out the same trend among adults of Kerala. Thus the BMI data analysis indicated that overweight and obesity among elderly coexist with underweight, the trend being more marked among the elderly women than men.

An attempt was made to compare the BMI status of elderly with their living arrangements and it is given in Table 16.

Table 16

BMI status of elderly based on gender and living arrangements

Gender	Living arrangement	n	BMI classification*				χ^2
			<18.5 %	18.5-25.0 %	25-29.9 %	>30 %	
Men	Free living	79	14.1	51.6	31.3	3.1	5.2^{ns}
	Institutionalized	36	22.9	62.9	14.3	0	
	Total	115	17.2	55.6	25.3	2.0	
Women	Free living	113	0.00	55.9	35.3	8.8	12.8^{*}
	Institutionalized	68	14.2	55.8	21.2	8.8	
	Total	181	8.8	55.8	26.5	8.8	

ns – Not significant $p<0.05$ * Ref: WHO (1998)

As observed from the table, chronic energy deficiency was more common among institutionalized males (22.9%) than free living males (14.1%). Prevalence of overweight (31.3%) and obesity (3.1%) was more among free living elderly men than institutionalized men. Among elderly women also the institutionalized were affected by chronic energy deficiency (14.2%) whereas none of the free living women were affected.

An interesting paradox was the equal prevalence of obesity among elderly women who were free living (8.8%) and institutionalized (8.8%). However, the association between living arrangement and BMI was statistically significant in the case of women ($p<0.05$) but not in men.

4.2.1.2 Mid Upper Arm Circumference and Calf Circumference

Mid Upper Arm Circumference (MUAC) has been reported to be a potential screening tool for poor nutritional status in the elderly. (Ismail,1999; Webb and Copemann, 1999). But some studies also showed that the use of MUAC may be affected by the redistribution of sub cutaneous fat towards central areas of body during ageing. (Collin et al., 2000). Calf circumference however is widely reported to be the most sensitive measure of muscle mass in the elderly, superior than mid upper arm circumference. The following table presents the mean mid upper arm circumference and calf circumference of elderly.

Table 17

Mean values of MUAC and CC of the elderly

Age group (Years)	Elderly men (Mean ±SD)			Elderly women(Mean ±SD)		
	n	MUAC	CC	n	MUAC	CC
60-70	46	27.23±3.43	31.1±5.1	77	27.33±3.89	32.3±5.9
70-80	41	26.61±2.71	30.7±3.9	76	26.07±2.97	29.5±3.1
>80	28	24.50±0.71	26.8±3.0	28	23.86±2.18	27.6±3.9
Pooled	115	26.79±3.09	30.6±4.6	181	26.46±3.54	30.4±4.9
F value	1.870^{ns}		3.14*	6.650**		12.9***

MUAC – Mid Upper Arm Circumference CC- Calf circumference

The mean values of Mid Upper Arm circumference and calf circumference of both elderly men and women showed a declining trend with age. This has been well documented by Ismail (1990). These differences with age, in the case of Mid Upper Arm Circumference of elderly males was not statistically significant whereas Mid

Upper Arm Circumference ($p<0.01$) and Calf Circumference ($p<0.001$) of females and Calf Circumference ($p<0.05$) of elderly males showed statistically significant reduction with age.

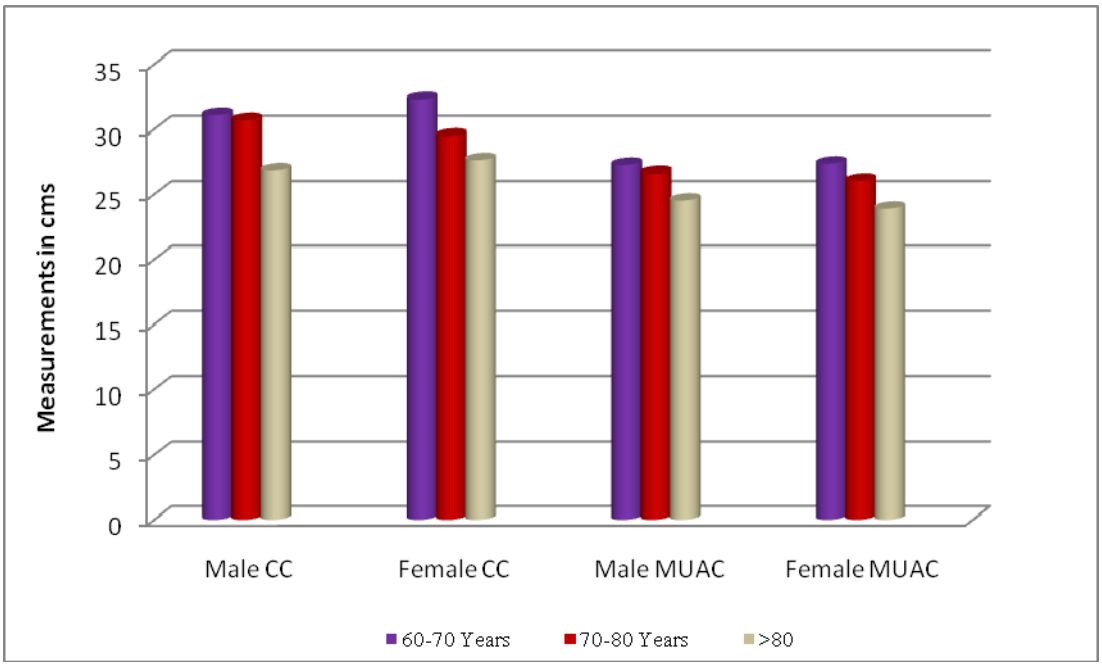


Figure 13 -Mean values of MUAC and CC of the elderly

The decline in circumference measurements with age may be due to the general loss of muscle in response to reduction in physical activity of elderly with age. Strong age related decline in circumference measurements in elderly women than men has been documented by Manandhar et al., (1997) in a study among the poor elderly in Mumbai, India.

Table 18

MUAC and CC of the elderly based on living arrangement

Gender	Parameters	Free living		Institutionalized		t value
		n	Mean ±S.D	n	Mean ±S.D	
Men	MUAC(cm) CC(cm)	79	26.814±3.23 31.3±4.5	36	26.72±2.63 29.4±4.5	0.109ns 1.9ns
Women	MUAC(cm) CC(cm)	113	27.15+3.24 32.2±5.7	68	25.76±3.71 29.3±4.0	2.317* 3.8***

A comparison of mid upper arm circumference and calf circumference of elderly in two different living arrangements such as free living and institutionalized, revealed that, irrespective of gender the institutionalized elderly had lower mean values of MUAC and CC than the free living. But statistically significant differences due to living arrangements were found only for elderly women. The difference was highly significant ($p<0.001$) with respect to calf circumference and significant at 5 percent level in the case of mid upper arm circumference .

The association of selected variables to MUAC of elderly was studied and is presented in table 19

Table 19

Association of selected variables to MUAC of elderly

Variables	n	Mid Upper Arm Circumference (cm)		χ^2
		<22 cm	≥22 cm*	
Age in Years				
60-70	123	10.28	89.72	
70-80	117	10.34	89.66	1.998^{ns}
80-90	56	21.05	78.95	
Total	296	11.27	88.73	
Sex				
Male	115	9.09	90.91	
Female	181	12.50	87.50	0.507^{ns}
Total	296	11.27	88.73	
Category				
Free-living	192	8.59	91.41	
Institutionalized	104	15.29	84.71	0.183^{ns}
Total	296	11.27	88.73	
BMI				
CED(<85)	36	56.52	43.48	
Normal(18.5-25)	159	6.78	93.22	53.12***
Over weight(>25)	101	4.17	95.83	
Total	296	11.27	88.73	

* Reference – Ismail (1999) Webb and Copemann (1996)

The usefulness of MUAC in detecting elderly with poor BMI has been reported by Ismail (1999) and MUAC has been proposed as an alternative to BMI as a screening tool in the acute phase of an emergency.

The association of MUAC with age, gender, living arrangement and BMI of the subjects were studied. Low Body Mass Index was found to be significantly associated with low MUAC ($p<0.001$). This is indicative of the usefulness of MUAC as a measurement to be used in conjunction with BMI to detect Chronic Energy Deficiency.

Association of selected variable with Calf Circumference of the elderly was also analyzed and is given in table 20.

Table 20
Association of selected variables to Calf Circumference of the elderly

Variables	n	Calf Circumference (cm)		χ^2
		<31	≥31*	
Age in Years				
60-70	123	57.0	43.0	
70-80	117	60	40.1	9.671**
80-90	56	87.1	12.9	
Total	296	62.0	38.0	
Sex				
Male	115	53.8	46.2	3.953 *
Female	181	66.5	33.5	
Total	296	62.0	38.0	
Category				
Free-living	192	62.50	37.50	
Institutionalized	104	61.5	39.8	0.006 *
Total	296	62	38	
BMI				
CED(<18.5)	36	88.5	11.5	
Normal (18.5-25)	159	67.6	32.4	19.050***
Over weight(>25)	101	45.2	54.8	
Total	296	62.3	37.7	

*Reference Bonnefoy et al., (2002), Ismail (1999)

Lower calf circumference was significantly associated with advancing age ($p<0.01$); being female ($p<0.05$) and low BMI ($p<0.001$). Chumlea et al., (1998) recommended calf circumference as a sensitive measure of the loss of total body mass. The present findings also revealed the value of calf circumference in geriatric nutritional assessment. It is probably a better indicator of nutritional status of elderly than MUAC, since the variations of calf circumference across age, living arrangement and gender showed significant difference.

4.2.1.3 Body Fat Measurements

Although Body Mass Index (BMI) is used as a clinical measure to identify overweight and obese persons, it does not account for body fat distribution. Fat accumulated in visceral tissues is an independent risk factor for hypertension, diabetics, dyslipidemia and cardiovascular disease (Shirai, 2004 and Elisat, 2001). Yet little

information exists on the body fat measurements of Indian elderly. Also because of its relation to functional ability, several studies have emphasized the need to measure body fat in older people. (Ghosh et al., 2006 and Oguntona and Kuku, 2000).

A cause and effect paradigm of high body fat and propensity for disease in Indians has also been demonstrated. Also higher body fat for a given BMI than other ethnic groups, both within and outside Asia have been found for Indians (Kurpad, 2004). Therefore parameters of overall obesity and body fat was studied on a sub sample of 90 elderly. The results are presented in Table 21.

Table 21

Mean body fat measurements and other parameters of obesity

Parameters	Reference values	Elderly Men (n=45) Mean age 71.9 yrs.		Elderly Women (n=45) Mean age 72 yrs	
		Free living	Institutionalized	Free living	Institutionalized
Waist-Hip ratio	M-0.89** F-0.81	0.97±.04	0.90±0.1	0.95±0.06	0.90±0.1
Triceps fatfold (mm)	M-13.4** F-22.3	16.4±0.8	11.89±5.0	37±4.9	24.38±6.6
Subscapular fatfold (mm)	M-19.50** F-19.80	27.4±2.85	18.1±5.2	26.7±2.1	25.1±3.4
Body fat Percentage	M-26.2* F-34	34.1±8.0	33.9±5.3	44.3±5.6	43.4±2.5

**-NHANES III(1994) mean values *WHO,(2002)

M=Male F=Female

Mean age of the selected elderly was 71.9 years for men and 72 years for women. All of them irrespective of gender and living arrangement had a waist hip ratio higher than the mean value of NHANES III(1994). This implied a higher risk for chronic degenerative diseases. Kaur and Radhakrishnan(2008) reported that Waist Hip

ratio was the best predictor for type II Diabetes in elderly .Hypertension has also been reported to be significantly higher in elderly individuals having a higher Waist Hip ratio.(Deshmukh et al., 2005)

Skinfold thickness provides reasonable estimates of subcutaneous fat reserves which serve as a major energy source during prolonged starvation (Meguid and Laviano, 1999). The NHANES III data (1988-1994) were used for comparison as it has been recommended by WHO (2002) for use in different population groups to compare their means and standard deviations, if reliable local data was unavailable.

A comparison with the percentile values of NHANES III (figure 12) showed that the free living elderly men had mean fatfold measures above the 85th percentile of NHANES III values, whereas institutionalized men had measurements just above the 50th percentile. The mean triceps and subscapular measurements of all elderly except institutionalized men were also found to be higher than the reference mean value of NHANES III data (1994), which implies slightly higher vulnerability of institutionalized men with regard to undernutrition.

The fat folds of women in general were within higher percentile brackets. Free living women had their triceps fat folds above 95th percentile whereas institutionalised elderly women had triceps fat fold values just above the 75th percentile value of NHANES III, as given in figure 12.

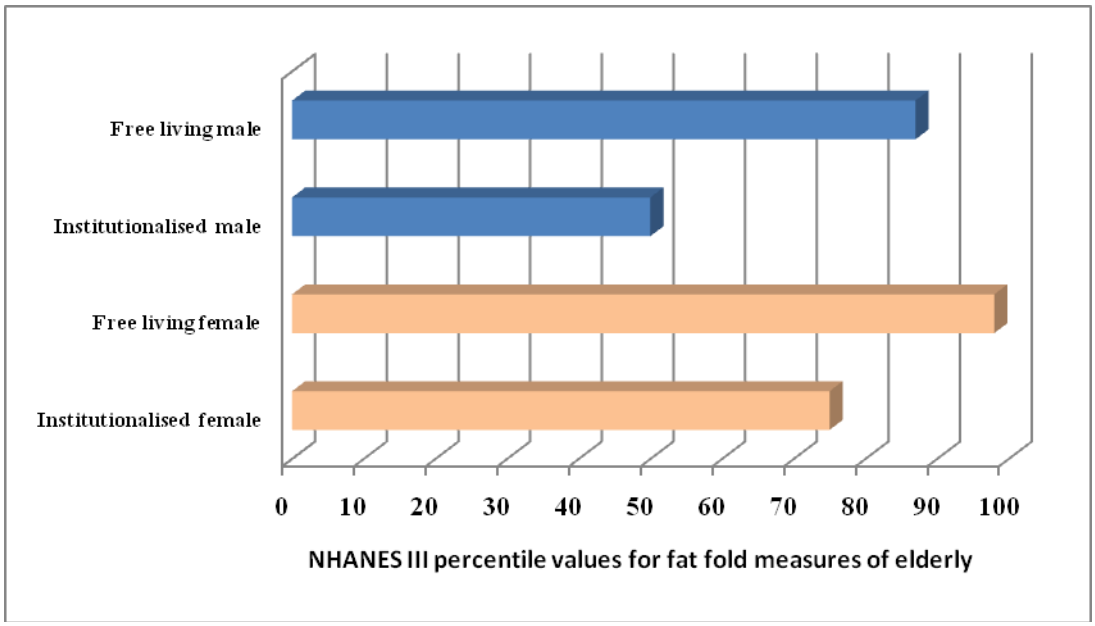


Figure 14 - Comparison of mean Triceps fat fold measures of elderly with NHANES III percentile values

Even though Wilson and Morley (1999) reported that altered compressibility of body fat occurs with ageing rendering absolute skinfold thickness measurements unreliable for use in older adults, the above results do imply raised body fat content in majority of the elderly. High body fat even with relatively low BMI in Asian Indians have been reported by Kurpad (2004) and Dudeja et al., (2000). Confirming the above findings, body fat impedence scale measurements of both men and women implied a higher body fat than the 50th percentile value for all groups of elderly.

The present findings are also in concordance with studies pertaining to elderly individuals from other parts of the world (Guo et al., 1999; Chilima and Ismail, 1998). Significant sex differences in skinfold and circumference measures have been reported by Ghosh (2006); Alhamdan (2008). Raguso et al., (2006) also reported that body fat increased significantly in elderly participants since fat replaces lean mass as a physiological consequence of aging.

4.2.1.4 Armspan measurements of elderly.

Many studies have reported the limited utility of height measurements in computing BMI of elderly due to spinal curvature (kyphosis); vertebral compressions and alterations in height and shape of vertebral discs (Wahlqvist and Flint, 1988) Postural changes such as bowing of legs and bent knees due to decreased muscle strength might also lead to inaccurate height measurements in elderly (Pieterse, 1999). A number of studies (Ismail, 2002; WHO,1998 and Reeves et al.,1996)] have demonstrated that armspan measurements approximate to height at maturity and is independent of ageing, suggesting that it may offer an alternative to height in calculating BMI in older populations. However, most of the studies that looked at the association between armspan and height have focused on Caucasians, and large ethnic differences in the association have been noted (Reeves et al., 1996). Such efforts have not been reported in India. Therefore armspan measurements were assessed on 106 non-kyphotic elderly and regression equations between armspan and height have been established. Table 22 gives a comparison of means of heights, armspan, BMI computed using height and BMI calculated as weight / armspan^2.

Table 22
Height and Armspan measurements of the elderly

Parameters	Men		Women	
	(n=50)	't' value	(n=56)	't' value
Mean Height (cm) Mean armspan (cm) BMI – Height BMI – Armspan	161.9 ±8.9 170.02±3.7 21.16 ± 3.7 22.38 ± 4.3	Ht vs As 9.126*** BMI Ht vs BMI As 0.009^{NS}	146.85 ± 8.63 157.03 ± 8.40 24.0 ± 4.48 22.22 ± 3.7	Ht vs As 15.96*** BMI Ht vs BMI As 5.39***
Correlation coefficient Height and Armspan	0.735***		0.675***	
BMI-height and BMI armspan	0.89***		0.88**	
BMI-height and BMI-armspan **Regression equation**	Men BMI-height = 0.2+(0.8 x BMI – as) Women BMI-height = 1.94+(0.89 x BMI - as)			
Height – Armspan **Regression equation**	Men Height (cm) = 72.44 + (0.54 x armspan in cm) Women Height (cm) = 66.3 + (0.53 x armspan in cm)			

Ns – Not Significant **p<0.01 ***p<0.001 BMI – Ht : BMI computed using standing height

BMI – As : BMI computer using arm span measurement

In the present study, mean heights of elderly was found to be significantly lower than mean armspan (p<0.001) for both older men and women. Mean armspan exceeding height measurements as in the present study has been reported by Reeves et al., (1996) in blacks whereas no significant difference between the two indices were found in Caucasians. (Kwok and Whitelow, 1991). Arm span exceeding height by 5 to 6 percent has been previously reported (Chhabra, 2008). 't' test indicated that mean BMI based on height and BMI based on armspan were not significantly different in elderly men whereas there was significant difference between the same measurements

among elderly women. However, highly significant ($p<0.001$) correlation between height and armspan and BMI – height and BMI – armspan for both men and women were found. Similar correlation between height and arm span was also reported in black and white women of the age group of 39 to 89 years (Steele and Chenier, 1990).

Linear regression model was deemed appropriate to arrive at gender specific regression equations for computing BMI using armspan measurements. These could be used, after further validation, for estimation of height in elderly subjects with conditions limiting their ability to stand straight. In a similar on use of arm span as a predictor of height in South Indian Women (Mohanty et al., 2001), the regression equation derived was Women Height (cm) = 49.57 + (0.674 x armspan (cm)).

Sensitive and specific cut off points for BMI – armspan need to be derived which corresponds to BMI – height used to classify grades of chronic energy deficiency (Shetty and James, 1994). A similar set of measurements in young adults of this region need to be estimated so that any inaccuracy due to postural changes of elderly in the above data can be corrected and the results be more accurate.

A comparison of anthropometric values of elderly in the present study with other published reports on the same lines are presented in the table below.

Table 23

Comparison of Anthropometry of Elderly in Kochi to other published reports.

Particulars	Lower than Kochi	Greater than Kochi
Height	• NNMB – 1997 – except for very old (80+) females[1] • Mumbai slum(1997)[2]	• Only for 80+ females (NNMB,1997) • Delhi – lower middle class (2007)[3]
Weight	• NNMB - 1997- for all age groups and genders[1] • Mumbai slum(1997)[2]	• NHANES III mean[4] • Delhi – lower middle class[3]
BMI	• NNMB - 1997[1]	• Delhi Lower Middle Class[3]
Mid Upper Arm Circumference	• NNMB, 1991[1] • Mumbai slum,1997[2]	• NHANES III mean [4] • U.S Ref. data (1990)[5] • US Asians(1991)[6] • Rural Malaysia (1991)[7]
Calf Circumference	• Mumbai slum,1997[2]	• NHANES III mean[4]
Triceps Fatfold	• Mumbai slum,1997[2] • NNMB, 1997[1]	• NHANES III mean[4] • US ref. data (1990) [5] • Boston (1992)[8] • Urban China, (1991)[9] • Rural Malaysia (1991)[7]
Subscapular fatfold	• Mumbai slum, 1997[2]	• NHANES III mean[4]

Source:

1- NNMB, 1997. Vijayaraghavan et al.,2000. 2-Manandhar and Ismail,1997

3-Tyagi, 2007 4- NHANES-III Plan and operations 1988-94. 5-Frisancho,1990 6-Kim et al.,1993

7-Yassin and Terry,1991 8-Nelson and Evans,1992 9-Side et al.,1991

It is obvious from the table that the anthropometric measurements of the elderly in Kochi were higher than the values reported by NNMB among elderly in other parts of India except for the elderly in Delhi. However all international reports (including NHANES III) presented higher values for anthropometric measurements.

4.2.2 *Biochemical Assessment*

Biochemical assessment is an useful objective method of estimating the prevalence of nutrient deficiencies in the elderly (Chandra, 1991). According to Bamji (2003), for complete nutritional assessment, biochemical tests should be used in conjunction with the history of dietary intake and physical examination. In the development of any deficiency disease, biochemical changes are expected to occur prior to clinical manifestations which facilitates early detection and correction (Mahan and Stump, 2000).

The nutritional status of the elderly subjects as assessed by the relevant biochemical parameters are discussed below:

4.2.2.1 Blood Haemoglobin

Blood haemoglobin levels are suggested as an useful index of the overall nutritional status of a population (Smith, 2000) irrespective of its significant role in anemia. Table 24 presents the blood haemoglobin status of the sample using the cut-offs suggested by WHO (1999).

Table 24

Blood Haemoglobin status of the elderly

Particulars	**Haemoglobin status♦**				
Elderly Men	**n**	**≥13(g/dl) (Normal) %**	**12-12.9(g/dl) (Marginal) %**	**10-11.9(g/dl) (Mild) %**	**7-9.9(g/dl) (Mod.) %**
60-70 Years	26	18.8	25.0	56.3	0
70-80 Years	25	26.7	26.7	40.0	6.7
80+ Years	21	27.3	18.2	27.3	27.3
Pooled	72	23.8	23.8	42.9	9.5
Total Anemic Men (Hb<13 g/dl)	76.2%				
Elderly Women	n	≥12(g/dl) %	11-11.9(g/dl) %	10-10.9(g/dl) %	7-9.9(g/dl) %
60-70 Years	62	53.2	27.4	14.5	4.8
70-80 Years	26	46.2	23.1	7.7	23.1
80+ Years	20	15.0	25.0	40.0	20.0
Pooled	108	44.4	24.9	17.6	2.0
Total Anemic Women (Hb<12 g/dl)	55.6%				
Overall prevalence of Anemia – 65.4% **Chi square between** Gender and Anemia Prevalence 6.430* Age and Anemia Prevelance 9.623**					

* $p < 0.05$ ** $p < 0.01$ ♦ WHO, 1999

The overall prevalence of anemia among elderly was found to be 65.4 percent. Gender wise analysis showed that anaemia was more prevalent among elderly men (76.2%) than elderly women (55.6%). The higher prevalence of anemia in men is supported by the NHANES III data (1994) across different races and ethnicities which indicated a greater overall anemia prevalence in older men than women.

The age of the elderly was found to have a significant impact ($p<0.01$) on anaemia prevalence. As the age advanced there was observed a progressive increase in

the percentage of elderly men with normal haemoglobin status, accompanied by a reduction in mild anaemia and exorbitant increase in moderate anaemia. But for females, a progressive decline in normal haemoglobin status with age was noted. However severe anaemia with haemoglobin level less than 7g/dl was totally absent among the elderly population studied.

The following figure depicts the details of the haemoglobin values of subjects according to gender and age.

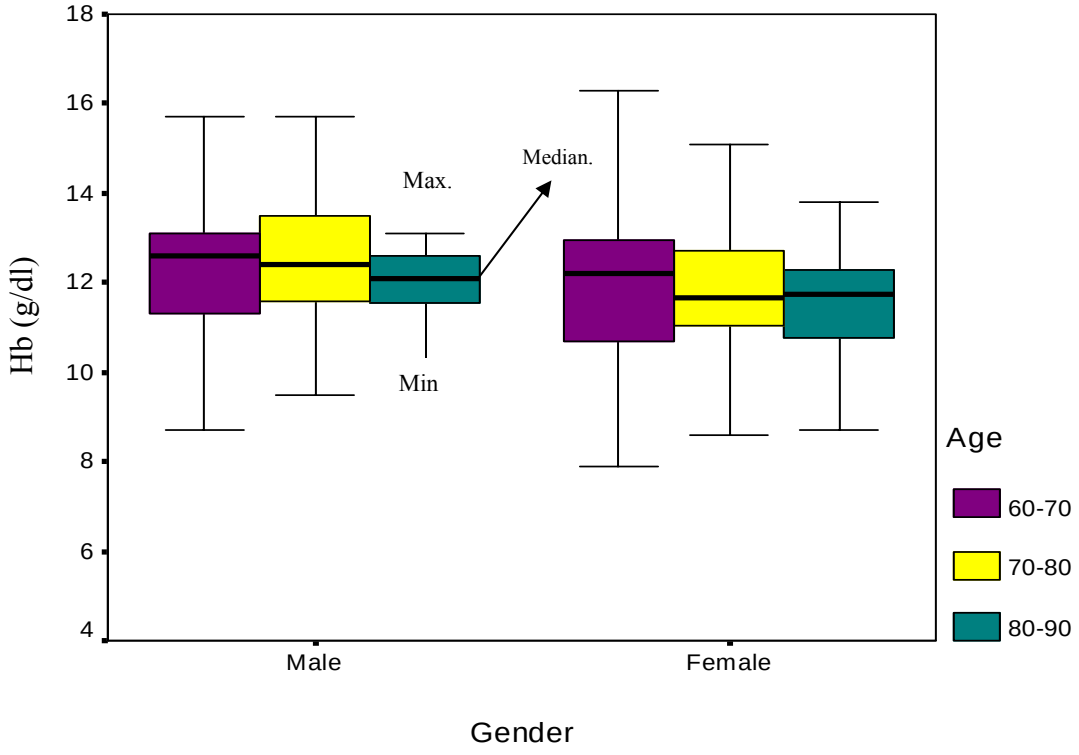


Figure 15

Haemoglobin levels of elderly according to gender and age

The NHANES reports (1994) also indicated that though anemia is more prevalent in younger women, male prevalence surpasses female prevalence in old age, a disparity that continues into upper age brackets.

Ramachandra and Kasthuri (2009) reported an anemia prevalence rate of 17.7 percent in a rural, South Indian elderly population. Swami and Bhatia (2002) indicated a prevalence of 68 percent among an elderly population in Chandigarh, India. Severe anemia among tribal elderly of Orissa was as high as 70-76 percent whereas in other groups it was 15-33 percent (Kerketta et al., 2009). The overall prevalence in the present study was 65.4 percent, which is indicative of high anemia prevalence.

The significant increase in anemia prevalence with age as observed in the present study is in line with the findings of Mallick (2003) wherein he observed a declining haemoglobin level with increasing age. Chatta and Lipschitz (1999) attributed the age related changes in haemoglobin levels to the blunted response to haematopoietic stress like iron deficiency or chronic disease states.

The following figure presents the prevalence of anaemia in different strata of elderly.

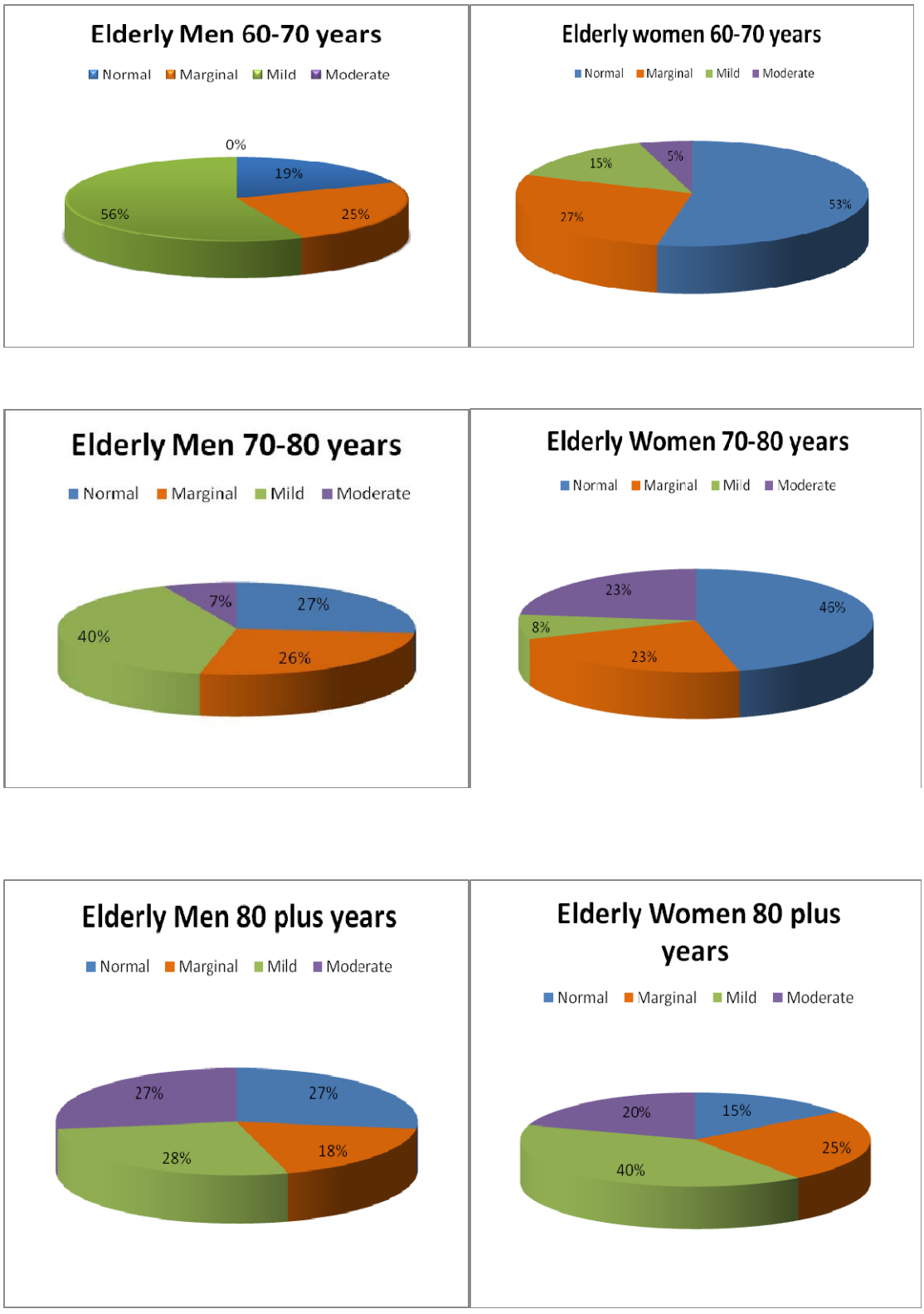


Figure 16 - Haemoglobin Status of elderly

Mean Haemoglobin values of the elderly are presented in Table 25.

Table 25

Mean Haemoglobin levels of the elderly

Particulars	Mean Hb level			Ref value ♦ (g/dl)	't' value Reference vs observed	
	Free Living (g/dl)	Institution-alized (g/dl)	Pooled (g/dl)		Free Living	Institution-alized
Elderly men (n=72)	12.4±1.7	11.7±1.4	12.3±1.7	13	4.6***	4.1***
't' value Free living vs. Institutionalized	0.96^{NS}					
Elderly women (n=108)	12.5±1.5	11.3±1.5	11.86±1.6	12	2.5*	3.38***
't' value Free living vs. Institutionalized	4.58***					

ns-not significant * p <0.05 ***-p<0.001 ♦WHO, 1999

The mean haemoglobin levels of elderly men and women in both the living arrangements were significantly (p<0.001) lower than the reference values. It was also inferred that institutionalized elderly have significantly lower mean haemoglobin levels than free living counter parts. But no significant difference in blood haemoglobin levels were found between elderly men in institutions and homes. Whereas there was significant difference (p<0.001) between elderly women in the two living arrangements, which is indicative of lower haemoglobin status of institutionalized elderly. This is similar to observations by Patel (2008) on lower haemoglobin levels among elderly in old age homes.

4.2.2.2 Complete Blood count

Of the various biochemical tests, Complete Blood Count (CBC) is suggested to having value in screening elderly when poor nutrition is suspected (Simmons,1997;Shapiro and Greenfeild, 1987). Complete blood count includes haemoglobin, hematocrit (PCV), MCV, MCHC, MCH, RBC count, ESR, and differential count (Polymorphs, lymphocytes and Eosinophils). The mean values of Complete Blood Count and Serum Iron levels are presented in the following table .

Table 26

Complete Blood Count and Serum Iron values of elderly

Sl No	Parameters	N	Reference range*		Elderly Men(n=60)			Elderly women (n=65)		
			Men	Women	% below normal (▼)or above normal (▲)	Mean ±SD	't' (ref. vs. mean)	% below normal (▼) or above normal (▲)	Mean ±SD	't'(ref. vs. mean)
1	Haematocrit (PCV) (%)	125	40-54%	37-47%	87%▼	35.11±3.7	4.9***	70▼	34.3±3.8	5.3***
2	MCV(μm^3)	125	82.5-98μm^3		33.3▼	83.6±8.8	0.5^{ns}	41.7▼	84.5±6.9	2.3^{ns}
3	MCHC(%)	125	30-35.9%		nil	32.9±1.8	0.12^{ns}	6.7▼	32.3±1.2	0.45^{ns}
4	RBC count (ml/cumm)	125	3.71-5.52ml/cumm		13.3▼	4.13±0.6	0.34^{ns}	16.7▼	4.2±0.4	1.24^{ns}
5	MCH(pg)	125	26.1-32.8pg		13.3▼	27.3±1.6	0.42^{ns}	33.3▼	26.9±2.8	2.44^{ns}
6	ESR	125	0-10mm/hr	0-20mm/hr	Institutionalised 86.7▲ Free living 78.9▲	17.31± 4.7	2.1^{*}	Institutionalised 93.3▲ Freeliving 50▲	35.1±2.7	1.1^{*}
7	Eosinophils	125	1-6%		▲ 21.4%	6.6±3.74	na	▲18.2%	4.8±2.1	na
8	Total lymphocyte count	125	2000-3000 cells/mm^3		<2000cells/mm^3-43% >3000cells/mm^3-14.3%	2414.3±940	Within range	<2000-21.4% >3000-17.9%	2525±657	Within range
9	Total WBC count	125	5000-10000 cells/mm^3		>10000-7%	7536±1879	Within range	>10000-9%	8107±2050	Within range
10	Serum iron (µg/dl)	60 M-30 W-30	35-150(µg/dl)		<60g/dl with Hb<13-83.3% >60g/dl with Hb<13-16.7%	80 ± 24.57	na	<60g/dl with Hb<12-44.1 >60g/dl with Hb<12-55.56	63 ± 39.17	na

***p<0.001 *p<0.05 ns – Not significant na-tests of significance not applicable. * - Simmons, 1997

None of the CBC values except haemotocrit ($p<0.001$) and ESR ($p<0.05$) showed significant deviation from the normal range. Mean haematocrit values were significantly ($p<0.001$) lower than the normal values for both male and female elderly. It was found that 87 percent and 70 percent of elderly men and women had low haematocrit values.

More elderly women than men had below normal values for MCV (41.7%), MCHC (6.7%), RBC count (16.7%) and MCH (33.3%) than elderly men.

ESR was raised in majority of elderly. When living arrangements were compared regarding ESR levels, it was found that higher percentage of institutionalized elderly had raised ESR (86.7% of men and 93.3% of women who were institutionalised compared to 78.9 % men and and 50% women who were free living). Natarajan et al., (1993) also reported low haemoglobin and raised ESR among elderly subjects, which may be due to infections and undetected malignancies. Other diagnosis for raised ESR range from rheumatological disease, chronic bronchitis, anemia, macrocytosis or hypoalbuminemia. (Reinhart, 2006)

Abnormal Serum Iron is suggested as a marker of poor health in elderly (Corti et al.,1997). Mean Serum iron values did not differ from the normal range. However when mean serum iron of 60 anemic elderly were checked, it was found that 83.3 percent and 44.1 percent of elderly men and women respectively had serum iron less than 60g/dl implying anemia due to chronic disease. (Simmons, 1997). However further confirmation by peripheral smear, ferritin or transferrin saturation is implied.

4.2.2.3 Markers of protein status and metabolic disorders among elderly

Serum albumin, Random blood sugar and Serum cholesterol levels were studied as markers of protein status and metabolic disorders among a sub sample of 125 elderly. The details are given in table 27.

Table 27

Markers of protein status and metabolic disorders among elderly

Sl No	Parameters	n	Reference range*	Elderly Men			Elderly women		
				% below normal(▼) or above normal (▲)	Mean±SD	't'	% below (▼) normal or above normal (▲)	Mean±SD	't'
1	Serum albumin (g/dl)	125	3.5g/l	Institutionalised 6.7[@] Free living – Nil	4.0 ± 0.19	29.42***	Institutionalized 8.3[@] Free living Nil	4.0 ± 0.3	39.67***
2	Random Blood Sugar (mg/dl)	125	80-120 mg/dl	Institutionalized <80-21.4 Normal-50 >120-28.6 Free living <80-6.7 Normal-80 >120-13.3	95.25 ± 25.9	na	Institutionalized <80-5 Normal-55.9 >120-39 Free living <80-3.7 Normal-66.7 >120-29.6	141.4 ± 58.24	na
3	Serum cholesterol (mg/dl	125	<200 mg/dl	Institutionalized 40[#] Free living 40[#]	189 ± 35.8	3.435**	Institutionalized 51.7[#] Free living 70.4[#]	199.4 ± 41.6	4.65***

***p<0.001 **p<0.01 ns–Not significant na- tests of significance not applicable

a) Serum Albumin

Serum albumin is suggested to be the simplest and best single predictor of mortality in elderly. Also as it is simple to prepare, stable, soluble and easily purified, serum albumin was chosen as a marker of protein status in elderly. Low serum albumin is associated with reduced muscle mass and hence is a good indicator of malnutrition (Satyanarayana and Chakrapani, 2006). The mean values of serum albumin of the elderly were higher than the reference values. However 6.7 percent of institutionalised men and 8.3 percent of institutionalized women had lower values than the reference value of 3.5g/dl. None of the free living elders had lower mean values of albumin.

b) *Random Blood Sugar*

With increasing age there is reduced tissue sensitivity to insulin and thus increased risk of impaired glucose tolerance (Colledge, 2002). For diagnosis of diabetes mellitus, blood glucose levels of subjects were assessed. Mean blood sugar levels of elderly women were generally higher than the normal range; whereas mean RBS levels of elderly men were within normal range.

It was also found that elderly living in institutions (both men and women) had greater incidence of elevated blood sugar (>120g/dl) than their free living counterparts.

c) *Serum Total Cholesterol*

Serum total cholesterol is a direct indicator of chronic diseases like coronary heart disease, obesity etc. and is routinely used for screening primary and secondary hyperlipidemias. The mean total cholesterol levels were significantly higher($p<0.05$) than normal range for men and women.

However, distribution within living arrangements showed that 40 percent of both free living and institutionalized men had total cholesterol levels higher than 200mg/dl whereas 51.7 percent and 70.4 percent of institutionalized and free living women had high cholesterol levels. This points at free living elderly women to be the 'risk group' with regard to total cholesterol levels.

High risk for coronary heart diseases have been found among Keralites (Joseph et al., 2000). Nearly 70 percent of adults of the age group 30-70 years have serum cholesterol above 200mg/dl in Kerala as per reports by Soman (2007). Joseph et al., (2000) also suggested that the prevalence of hypercholesterolemia (>240mg/dl) among Keralites were double than U.S adults (3.2% vs. 1.8%).

The prevalence of high total cholesterol in a considerable proportion of elderly could be attributed at least in part to the imbalance in their diet pattern which may be high in dietary saturated fats with little inclusion of fruits and vegetables group.

4.2.3 *Clinical assessment of the elderly*

Clinical examination provides a practical and direct method of assessing the nutritional status of an individual (Copemann et al.,1996) and provides direct information on signs and symptoms of dietary deficiencies prevalent among the population. Clinical assessment in the present study consisted of external examination of the body for changes in superficial epithelial tissues especially skin, eyes, hair, mouth etc. Joshi (2002) recommended clinical examination as an effective tool to screen severe malnutrition. Clinical examination attempts to identify the interplay of factors influencing the progression or regression of nutritional abnormalities and provides a picture of current nutritional status (Jeejeebhoy and Keith, 2005). Clinical examination was done on 166 elderly by qualified physicians using the clinical assessment schedule (N.A.C - I.C.M.R) and the findings are given in table 28.

Table 28

Findings of Clinical examination of the elderly

Clinical Symptoms	Free Living (n=85) %	Institutionalised (n=81) %	Pooled (n=166) %
GENERAL APPEARANCE			
Poor	10	24	19.2
Eyes			
Conjunctiva – Xerosis			
Dry and wrinkled	0	9.9	4.8
Very dry and bitot's spots	0	2.4	1.2
Conjunctiva – Discharge			
Watery discharge, excessive lachrymation	2.4	12.34	7.2
Conjunctiva – Pigmentation			
Severe earthly discoloration	2.3	2.4	2.4
Slight discoloration	1.23	11.1	6.0
Cornea – Xerosis			
Slight dryness and diminished sensibility	1.8	13.6	7.2
Cornea – Vascularisation	0	2.4	1.2
Lids – excoriation			
Slight excoriation	0	8.6	4.2
Blepharitis	0	1.23	0.6
Folliculosis – a few granules	0	1.23	0.6
Angular conjunctivitis	3.6	3.7	3.0
Night Blindness	0	2.5	1.2
Mouth			
Lips – Angular Stomatitis – Mild	24	37	30
Tongue			
Pale but coated tongue	24.7	39.5	31.9
Glazed, atrophic tongue	2.3	14.8	8.4
Ulcered tongue	2.3	4.9	3.6
Fissured tongue surface	16.4	19.7	18

(Contd…)

Clinical Symptoms	**Free Living (n=85) %**	**Institutionalised (n=81) %**	**Pooled (n=166) %**
Buccal Mucosa			
Stomatitis	16.5	20.9	18.6
Gums			
Bleeding	1.23	24.7	13.2
Gingivitis	2.3	9.9	6
Pyorrhoea	4.7	7.4	6
Retracted	2.3	4.8	3.6
Teeth – Fluorosis			
Chalky teeth	9.4	1.2	5.4
Pitting of teeth	8.2	3.6	6.0
Mottled & discoloured	5.8	9.8	7.8
Dental Caries	20	29.6	24.6
Hair			
Loss of lustre	17.6	25.9	21.6
Skin			
Dry, Rough, Crazy pavements	15.6	25.8	21.0
Diminished elasticity	25.8	29.6	27.7
Wrinkled Skin	35.2	41.9	38.5
Face			
Nasolabeal dyssebacea	5.8	13.5	9.6
Adipose Tissue			
Deficient	2.3	19.7	10.8
Oedema			
Oedema on dependent parts	5.9	17.3	11.4
Alimentary System			
Anorexia	42.3	58.0	50
Nervous System			
Calf Tenderness	3.5	8.6	6
Parasthesia	4.7	12.3	8.4
Neck			
Goitre	4.7	14.8	9.6

The general appearance of elderly was rated as poor for19.2 percent of elderly. The clinical symptoms observed in eyes were bitots spots (1.2%), night blindness (1.2%), folliculosis and blepharitis (0.6% each) and corneal vascularisation (1.2%). More prevalent problems were conjunctival xerosis (4.8%), watery discharge (7.2%) and slightly diminished corneal sensibility (7.2%). Higher percentage of institutionalised elderly were found to have clinical deficiency symptoms than the free living counterparts. These symptoms indicate deficiency of vitamin A intake as established by several studies. (Meguid and Laviano, 1999).

Clinical examination of mouth revealed prevalence of Vitamin B complex and Vit.C deficiency symptoms like angular stomatitis (30%), pale but coated tongue (31.9%), stomatitis of buccal mucosa(18.6%)and bleeding gums(13.2%). Dental caries was found among 24.6 percent of elderly. Clinical symptoms in mouth were also more prevalent among the institutionalized elderly than their free living counterparts.

Natarajan et al.,(1991) also reported prevalence of Vitamin B complex deficiency to be very common in elderly. Lack of skin and hair luster and crazy pavements were present in 35 percent of elderly. Diminished elasticity and wrinkled skin was also a common finding in 27 percent and 38 percent elderly respectively. Calf tenderness (6%) and parasthesia (8.4%) were also detected which is attributed to Pyridoxine, biotin and thiamine deficiencies.

Goitre was detected among 9.6 percent elders, pointing to iodine nutriture to be a problem of sufficient magnitude in this group. State wide survey on IDD in 2001 as well as re surveys by NIDDCP had brought out IDD levels in Kerala to be 16.6 percent (The Hindu, 2008). Consumption of iodized salt by Keralites were found to be only 48.9 percent by NIDDCP surveys, which may partly explain the above findings.

The elderly subjected to clinical examination (n=166) were rated as having excellent, average or poor clinical status based on scores worked out as follows: those who had equal to or lower than the mean - Standard Deviation number of symptoms(excellent); those with symptoms within Mean ±SD and those having symptoms more than the mean +Standard Deviation (Poor).The results are given in table 29.

Table 29

Percentage distribution of elderly according to clinical Status

Variable	Excellent ≤Mean-SD	Average Mean±SD	Poor ≥Mean –SD	χ^2
Living arrangement				
Free living (n=85)	67.36	8	24.7	34.5***
Institutionalized (n=81)	9.3	10.3	80.4	
Gender				
Male (n=61)	68.85	9.95	21.2	0.124^{NS}
Female (n=105)	60	9.7	30.3	
Age (Years)				
60-70 (n=79)	29.7	9.0	61.3	0.168^{NS}
70-80 (n=52)	36.5	10.1	53.4	
80+ (n=35)	19.3	9.6	71.1	

As seen from the table, majority (67.36%) of the free living elderly were rated as having excellent clinical status, whereas 80.4 percent of institutionalized elderly had poor scores indicating that free living elderly had a better nutritional profile, which was statistically significant also ($p<0.001$).

Age and gender wise analysis in this respect did not show any significant difference. However, there was observed a slightly better nutritional profile among elderly men (68.85%) than women (60%) and young old (29.7%) than oldest old (19.3%).

4.2.4 *Dietary Assessment of the elderly*

Both qualitative and quantitative aspects of the diets of elderly were ascertained. The qualitative aspects included meal pattern and preferences, diet related health behaviours, Food variety and Phytochemical density of diets. The quantitative data as collected by food weighment survey included food and nutrient intake of the elders.

4.2.4.1 Meal pattern and preferences

Concerns with the nutritional status and well being of older adults have generated much interest in their food intake pattern. Meal pattern and food preferences of the elderly were assessed to know the actual determinants of food and nutrient consumption of elderly. Table 30 presents the details.

Table 30 : Percentage distribution of elderly according to meal pattern and preferences

Meal pattern profile	Living arrangement			Gender			Age(Years)				Pooled
	Free Living (n=350)	Institut-ionalised (n=150)	Chi square	Male (n=188)	Female (n=312)	Chi square	60-70 (n=262)	70-80 (n=183)	80+ (n=55)	Chi square	(n=500)
Type of Meal											
Vegetarian	16.9	17.3		14.4	18.6		12.6	21.3	23.6		17.0
Non-Veg	81.1	82.0	1.190^{NS}	82.4	80.8	6.044*	85.9	78.1	70.9	14.42**	81.4
Ovo-Veg	2.0	0.7		3.2	0.6		1.5	0.5	5.5		1.6
Planning of menu											
Often	33.1	0.0		17.6	26.6		30.5	16.4	10.9		23.2
Sometimes	34.6	2.7	208.02***	35.1	18.9	21.54***	28.6	24.0	10.9	40.20***	25.0
Rarely	15.4	18.0		18.6	14.7		13.7	20.2	14.5		16.2
Never	16.9	79.3		28.7	39.7		27.1	39.3	63.6		35.6
Food shopping											
Self	20.6	0.7		22.9	9.6		17.9	11.5	9.1		14.6
Others	69.4	99.3	55.47***	70.7	83.0	16.54***	71.4	84.7	90.9	19.62***	78.4
Self with assistance	10.0	0.0		6.4	7.4		10.7	3.8	0.0		7.0
Form preferences											
No Preference	4.3	6.7		6.9	3.8		4.6	6.6	1.8		5.0
Liquid	3.1	1.3		1.1	3.5		1.9	2.2	7.3		2.6
Semi solid	23.4	5.3	36.49***	18.6	17.6	5.66^{NS}	19.1	17.5	14.5	11.63^{NS}	18.0
Soft	32.0	30.7		29.3	33.0		29.0	34.4	34.5		31.6
Solid	34.9	56.0		42.6	40.4		43.1	38.3	41.8		41.2
Crunchy	2.3	0.0		1.6	1.6		2.3	1.1	0.0		1.6
Food taste preference											
Bland foods	46.3	32.7		43.1	41.7		43.5	40.4	41.8		42.2
Salty foods	6.0	8.0	9.08*	5.3	7.4	2.64^{NS}	5.3	6.6	12.7	8.74^{NS}	6.6
Sweet foods	6.3	5.3		4.3	7.1		4.6	6.6	10.9		6.0
Hot, Spicy food	41.4	54.0		47.3	43.9		46.6	46.4	34.5		45.2

*p<0.01 ***p<0.001 ns- Not Significant

Majority of elders were non – vegetarians (81.4%). Preference for vegetarianism increased with age and this was statistically significant ($p<0.001$). Non–involvement in menu planning and food shopping was seen mostly among the institutionalized ($p<0.001$), men ($p<0.001$) and the very old ($p<0.001$) elders.

Lack of involvement in menu planning and food shopping may have implications on being predictors of reduced dietary intake. Several studies (Shahar et al., 2001; Wylie et al., 1999; Payette, 1995) indicated loss of autonomy in meal planning and shopping to be negatively affecting the dietary intake of elderly. The food consistency preferred was solid (41.2%) followed by soft (31.6%) and semi solid (18%). Least preference was reported for liquid and crunchy foods. The preference for soft and semi – solid foods may be due to loss of teeth, use of dentures and chewing / swallowing difficulties. Almost equal preference was recorded for bland foods (42.2%) as well as hot, spicy foods (45.2%)

Natarajan et al., (1991) also reported that more than 30 percent of elderly preferred soft and bland foods due to edentulousness and denture use. Preference for bland foods may be due to the high prevalence of hypertension, diabetes and other diet related disorders .It is of interest to note that 45.2 percent preferred hot spicy food. This might be attributed to age associated diminished taste perception which results in preference for flavor enhanced foods (Schiffman,1997). But individual differences among elderly regarding this aspect has been reported which reflect differential rates of physiological ageing (Hetherington,1998). Reports by Drewenowski (1997) also indicated that taste preferences are influenced by a range of genetic, physiologic and metabolic variables.

4.2.4.2 Diet related health behaviours among the Elderly

Modification of diet in terms of food avoidance, inclusion and nutrient modifications to suit the disease pattern are unavoidable during old age. So an attempt was made to study the diet related behaviours among the elderly and the results are presented in Table 31.

Table 31
Dietary modifications adopted by the elderly

Particulars	Living arrangement		Gender		Age (years)			Pooled (n=500) %
	Free Living (n=350) %	Institution (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
1)Dietary modifications adopted	19.3	16.9	16.5	18.3	16.4	20.8	12.7	17.6
Fat restricted	36.9	29.3	36.7	33.3	32.4	38.3	32.7	34.6
Low salt diet	50.9	44.8	44.8	50.9	43.9	57.9	42.9	50.0
Bland	3.5	6.9	3.4	5.3	4.9	2.6	14.3	4.7
Natural food	3.5	6.9	13.8	0.0	4.9	5.3	0.0	4.7
Low sugar	35.1	20.7	27.6	31.6	36.6	23.7	28.6	30.2
Low salt and sugar	5.3	13.8	10.3	7.0	9.8	7.9	0.0	8.1
2) Inclusion of health foods								
Green leaves	59.7	55.3	56.4	59.6	61.8	51.9	63.6	58.4
Yellow Vegetables	41.7	46.0	41.5	43.9	43.9	39.9	49.1	43.0
Vit. C Fruits	34.9	2.7	29.3	22.8	29.8	21.3	16.4	25.2
Other Fruits	36.9	3.4	31.9	23.8	29.9	26.2	14.5	26.9
Unrefined Cereals	30.0	6.0	24.5	21.9	25.3	19.1	23.6	22.8
Ragi	18.3	0.7	11.7	13.9	13.8	12.6	10.9	13.1
Sea Foods	41.4	1.3	31.4	28.2	36.6	20.8	23.6	29.4
Garlic	67.7	72.5	66.5	70.7	70.5	65.6	74.5	69.1
Tea	90.3	85.3	89.9	88.1	90.1	86.9	89.1	88.8
3)Foods totally avoided by the Elderly								
Meat	33.1	24	29.3	31.1	27.1	33.3	36.4	30.4
Egg	23.4	28.7	21.3	27.2	21.4	28.4	30.9	25.0
Dairy products	11.4	11.3	9.6	12.5	9.9	15.3	5.5	11.4
Sea foods	16.6	26.0	14.9	22.1	17.2	21.3	23.6	19.4
Pickles	17.7	16.7	14.4	19.2	17.6	18.0	14.5	17.4
Beverages (Soft drinks etc)	56.3	54.7	48.9	59.9	58.8	55.7	41.8	55.8
Tea/Coffee	6.9	14.7	10.1	8.7	6.9	12.6	9.1	9.2

As the table depicts dietary modification was done by the subjects as part of management of chronic health problems. On an average, 17.6 percent of subjects adopted some form of dietary modification. Low salt (50%), low sugar (30.2%) and the restricted fat (34.6%) were the major modifications. Generally elderly women adopted more dietary modifications than men and free living elderly than those in old age homes.

The foods included daily or often in diets by elderly for health reasons were green leafy vegetables (58.4%); yellow vegetables (43%) and fruits (26%); unrefined cereals (22.8%); ragi (13.1%); sea foods (29.4%), garlic (69.1%) and tea (88.8%). The percentage of elders able to include these foods daily or often were more or less same across the various categories. But institutionalized elderly reported low levels of inclusion of yellow fruits, vitamin C fruits, other fruits, unrefined cereals, ragi and sea foods on a regular basis than their free living counter parts. This pattern coincided with the food avoidance pattern of the elderly, in that, lower percentage of institutionalized elderly reported totally avoiding specific foods for health reasons. This may be due to the lack of autonomy of institutionalized elderly regarding their diet.

4.2.4.3 Food Variety and Phytochemical density of the diets of Elderly

According to WHO (2002) the main nutritional factors to be considered in formulating food based dietary guidelines for healthy ageing include variety, nutrient density and phytochemical density. Studies suggest that the diet of a population group needs to be considered in totality as the sum of the diet is greater than it's individual parts.Also adherence to the traditional cuisine peculiar to each region is almost always associated with lower mortality and longer survival as found in Greece(Trichopoulo et al.,1995),urban Australia (Kouris-Blazos et al.,1999) and Denmark(Osler and Schroll,1997).

However, all over the world traditional cuisines are becoming submerged to contemporary cuisines which are mostly high fat western foods. Thus a qualitative assessment of foods included by the elderly, the variety in their diet and phytochemical density of their diets assumed significance.

Studies reveal the highly beneficial health effects to consumption of certain foods rich in specific compounds called phytochemicals (Wahlqvist et al., 2002; Stevinson et al., 2000, Worsley et al., 2002). WHO (2002) published the phytochemical dense food checklist which is recommended to rate the inclusion of such foods in the daily dietaries of the elderly. By excluding totally unfamiliar foods from the above checklist, the same was used to assess the phytochemical dense food intake of the elderly.

Food variety checklist proposed by WHO (2002) was used to score the food variety of diets of elderly which is expressed as the number of biologically distinct foods eaten over a designated period of time. Research suggests that over 30 different foods a week ensures a wide range of nutrient combinations that may have potential health benefits that particular foods alone cannot offer. Thus food variety enables a qualitative evaluation of the diet of elderly. Table 32 presents the findings on phytochemical density and food variety scores of the elderly.

Table 32

Phytochemical density and food variety of the diets of elderly.

Particulars	Living arrangement		Gender		Age (Years)			Pooled (n=500) %
	Free Living (n=350) %	Institutionalised (n=150) %	Male (n=188) %	Female (n=312) %	60-70 (n=262) %	70-80 (n=183) %	80+ (n=55) %	
Phytochemical density Scores*								
Poor(<10)	13.4	13.3	9.0	16.0	12.2	13.7	18.2	13.4
Fair(10-20)	35.4	38.7	27.7	41.7	35.9	37.7	34.5	36.4
Good(20-30)	45.1	47.3	57.4	38.8	48.1	43.7	41.8	45.8
Excellent(>30)	6.0	0.7	5.9	3.5	3.8	4.9	5.5	4.4
Phytochemical density between groups , chi square	5.776^{NS}		20.957***		2.495^{NS}			---
Food variety Scores*								
Marginal(<16)	19.7	19.3	10.6	25.0	17.9	20.2	25.5	19.6
Fair(16-20)	20.3	24.0	18.1	23.4	25.2	18.0	14.5	21.4
Good(20-24)	22.3	49.3	32.4	29.2	22.1	37.7	45.5	30.4
Very Good(>24)	37.7	7.3	38.8	22.4	34.7	24	14.5	28.6
Food variety-between groups , chi square	25.3***		59.8***		27.0***			----

ns – Not significant . ***p<0.001 * WHO(2002)

The phytochemical density of the diets of almost half (45.8%) of older persons were rated as good to excellent(4.4%) probably an indication of adherence to traditional dietary pattern by them. Age and living arrangement were not significantly influencing the phytochemical density of the diets of elderly. However gender had a highly significant ($p<0.001$) association with the phytochemical density of the diet.

The phytochemical dense foods included in the checklist were unrefined cereals, fruits, vegetables, pulses, nuts, herbs, spices and beverages. Cereal intake was restricted to rice and wheat with a few reporting intake of oats, ragi and corn. Inclusion of almost 3 types of pulses per week was indicated. As phytochemical dense spices (pepper, ginger, cumin, turmeric and coriander) were used in the traditional cookery of

Kerala, they contributed to the improved score with regard to phytochemical density. Figure 17 illustrates the findings.

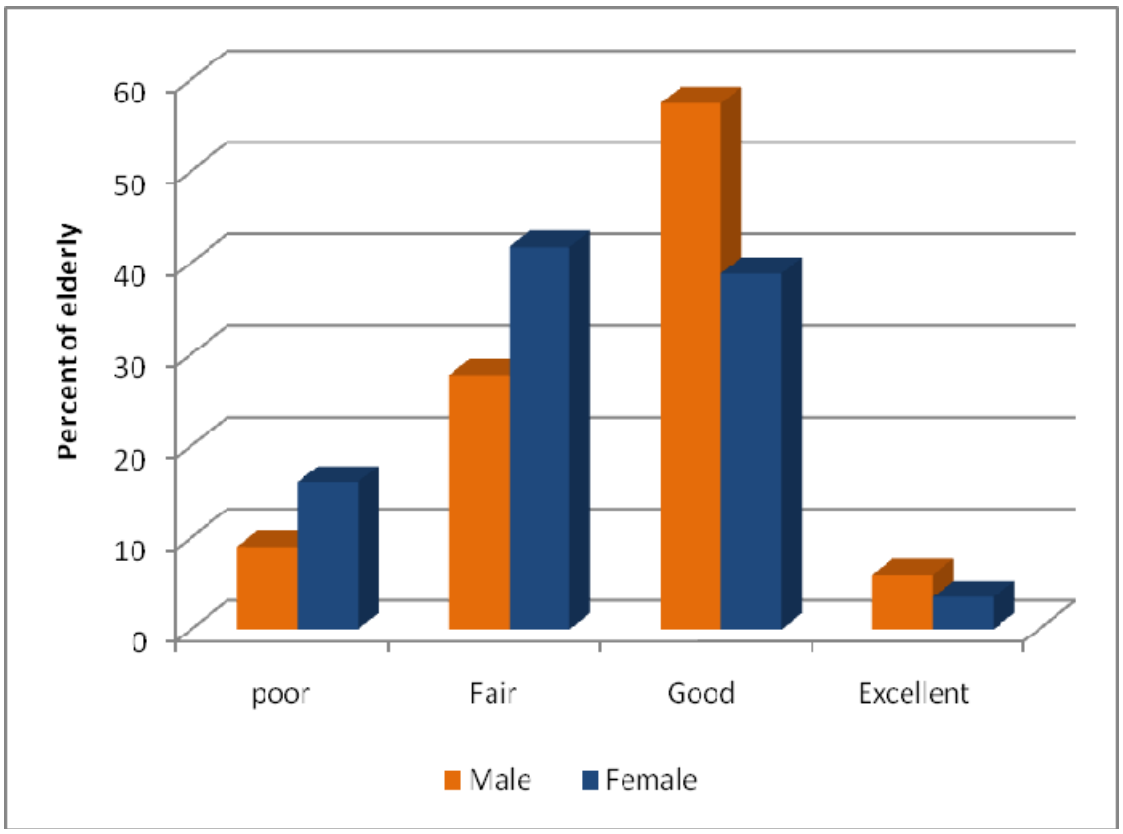


Figure 17 -Distribution of elderly according to Phytochemical density of diets

When the food variety of the elderly's diets were analyzed, distinct differences emerged between institutionalized and free living subjects. Also elderly men had significantly better food variety than elderly women($p<0.001$).Increasing age ,at the same time, tend to reduce the food variety score to a significant extent($p<0.001$).

A similar attempt on comparing diet quality of young old, old and very old in Germany (Volkert et al., 2004)also observed an age related decline of the food variety scores. Donkin et al.,(1998) found that factors negatively influencing food variety and phytochemical density of diets of elderly were economic dependency of elderly and being single. He had also observed that elderly who were less educated ate less vegetables and those with lower income ate less fruit.

Figure 18 depicts the comparative food variety scores of elderly men and women.

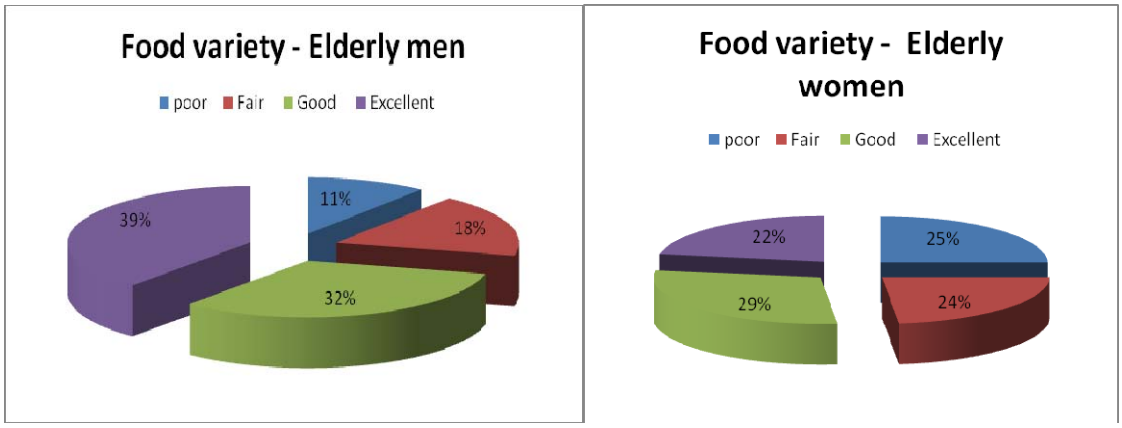


Figure 18 - Comparative food variety scores of Elderly Men and Women

4.2.4.4 Food intake of the Elderly

One day food weighment (Bamji, 2003) on a subsample of 60 elders yielded data regarding the actual food intake of the elderly. Further the nutrient intakes were computed using food composition tables (Gopalan et al., 1989). The reference standards for RDA of elderly chosen by various investigators seem to vary widely due to lack of consensus. But generally the RDA recommended by Pasricha and Thimmayamma (2000) have taken into account the 25 percent reduction in calorie and other modifications in RDA of older adults suggested by ICMR (1989). Therefore the RDA suggested for sedentary Indian elderly by Pasricha and Thimmayamma (2000) has been adopted to compare the food and nutrient intake of the elderly in the present study. The results are shown in Table 33.

Table 33

Mean food intake of elderly in comparison with RDA

Food groups	Elderly Men (n=30)						Elderly women (n=30)					
	RDA* (gms/ day)	Institiona-lised (n=15)	t value	Free-living (n=15)	t value	Pooled	RDA* (gms)	Institutiona-lised (n=15)	t value	Free-living (n=15)	't' value	Pooled
Cereals	325	255±40.9	14.98***	279.8±25.9	21.72***	267.5±33.4	270	178.9±27.7	15.57***	210.6±47.0	7.92***	194.7±37.3
Pulses	40	17.06±2.7	33.1***	20.6±4.0	12.73**	18.8±3.35	40	15.2±3.5	26.4***	20.53±3.53	12.7***	17.9±3.5
Vegetables(GLV/OV/R&T)*	200	79.5±5.1	121.9***	76.0±13.9	124.8***	87.7±9.5	200	75.5±5.6	108.8***	88±12.5	27.3***	81.8±9.05
Fruits	200	22.5±1.59	132.3***	41.7±16.7	36.82***	32.1±9.14	200	20.0±8.0	87.5***	43.57±16.3	35.8***	31.8±12.15
Milk and milk products	300	242.5±72.0	1.982NS	298.2±78.5	0.362NS	270.4±75.3	300	239.2±73.8	2.14NS	296.3±140.8	0.9NS	278.3±107.3
Fats and Oils	20	14.13±4.7	3 .395NS	25.4±10.4	5.785**	19.7±7.55	20	13.17±5.0	2.44*	22.7±11.1	4.3**	17.9±8.05
Meat / Fish/Eggs	30	38.3±19.0	3.37**	49.1±21.2	3.4**	43.7±20.1	30	32.9±18.8	2.7**	42.0±17.0	2.8**	37.45±17.9
Sugars	20	21.0±5.1	0.764NS	24.4±5.8	2.936*	22.7±5.45	20	22.8±8.4	1.67NS	28.95±7.5	4.2*	25.8±7.95

* p<0.05 **p<0.01 ***p<0.001 ns-Not significant

*Ref: RDA (Pasricha and Thimmayamma,2000)

GLV – Green Leafy Vegetables, OV – Other vegetables, R & T – Roots and Tubers

In general the mean intake of food groups except milk and milk products, flesh foods, fats and oils and sugars were significantly ($p<0.001$) lower than the recommended dietary allowance (RDA) .Irrespective of gender, the free living elderly population were on an advantage with respect to food intake. Within the same living arrangement , males reported a comparatively better food intake than female elderly.

The main cereals consumed were rice and wheat. There was no inclusion of jowar (Sorghum vulgare), pearl millet (Pennisetum typhoideum), finger millet (Eleusine coracana), maize (Zea mays) etc in the daily dietaries. NNMB special survey (2005 – 06) indicated inclusion of a variety of cereals and millets by the Indian population in general. The mean consumption of cereals in the NNMB survey met 70 percent of RDA, whereas the present results indicate a higher deficiency. Lack of variety of cereals and millets in Kerala dietaries may be a contributory factor to the low level of cereal intake by the elderly.

Mean consumption of pulses were also significantly lower than RDA by all groups but free living elders reported slightly higher consumption than their institutionalized counterparts. Gastric problems were generally perceived to be associated with pulse intake by the elderly and many exercised caution in consuming pulses.

Fruit and vegetables consumption was significantly lower than the recommended levels by both groups of elders. Slightly higher intakes were noted among the free living elderly. The low intake of fruits and vegetables by Indians are well documented (Beegom and Singh, 1997 and NNMB Survey, 1997). The mean daily intake of vegetables (Green leafy vegetables, other vegetables and roots and tubers) hardly met 100g in any of the groups in the present study.

It was also observed that a considerable number of households as well as old age homes totally eliminated green leafy vegetables in their meal plan. NNMB (2004-2005) reports indicated a daily intake of only 7 gms of GLV in Kerala, which is the lowest in India. For South Indian States the mean vegetable intake was 106 g/day.

The intake of fruit was restricted to banana with few reporting an intake of more than one fruit per day. These findings have to be viewed in the light of the new findings with regard to the wholesome effects of fruits and vegetables especially related to ageing. This envisages the need for a more focused approach to make sure the availability of low cost , locally available green leafy vegetables, yellow vegetables and fruits. Simple dehydration technologies to preserve green leafy vegetables could also effectively improve GLV consumption among elderly.

The consumption of milk and milk products however did not differ significantly from the RDA. According to NNMB (2004-2005) surveys ,the average milk intake of Indian adults ranged from 66 g in Kerala to 170 g in Gujarat. The present study revealed a still better picture (270-278 g/day).Excessive intake of tea and coffee by the elderly may account for this.

Flesh food intake, sugar and fat intake exceeded the RDA in all groups the highest figures being found among free living males and females. Flesh food intake exceeded the RDA at highly significant levels ($p<.01$). There was consistent gender difference in the consumption of all food groups with men having slightly better food intake than of women.

The generally poor food intake of elderly with respect to cereal, pulse, fruit and vegetables has been reported by many researchers. NNMB(2005-06) also reinstated that food and nutrient intakes were lowest among Keralites than all other Indian states surveyed. Chandrasekhar and Bhooma (2000) have also reported that the intake of food groups by elderly were low when compared to the RDA. Natarajan et al (1999) in a study on rural elderly found that 93.2 percent of elders subsisted on low calorie diets and grossly inadequate consumption of various food groups. Bhooma and Chitra (2005), John and Arulmani (2004) and Mehta and Thakore(1996) have also found that Indian elderly consume grossly inadequate diets.

However the higher consumption of fats, sugars and non-vegetarian foods by the elderly clearly demonstrated that the dietary transition underway in the adult population of Kerala (NFHS III, 2005-06) is also reflected among the elderly.

4.2.4.5 Nutrient intake of the Elderly

Using the one day food weighment data on sixty elderly the mean intake of nutrients were computed using the food composition tables (Gopalan et al., 1999). A comparison of the same with the RDA for Sedentary elderly as recommended by Pasricha and Thimmayamma (2000) was done and is presented in the following table.

Table 34

Mean nutrient intake of elderly in comparison with RDA.

Nutrients	Elderly Men (n=30)						Elderly women (n=30)					
	RDA♦	Institution-alised (n=15)	't' value	Free-living (n=15)	't' value	Pooled (n=30)	RDA♦	Institution-alised (n=15)	't' value	Free-living (n=15)	't' value	Pooled (n=30)
Energy(Kcal)	1973	1472±150.	24.5***	1556±189	24.5***	1514.5±169.5	1704	1393.3±147.	19.7***	1461.4±186	15.9***	1427.3±166.2
Protein(gm)	55	36.0±3.9	28.7***	38.9±6.3	14.3***	37.45±5.1	45	34.2±4.8	16.7***	41.7±7.9	6.1***	37.95±6.35
Fat(gm)	40	34.3±4.7	13.0^{ns}	41.4±10.3	1.73^{NS}	37.85±7.5	40	33.3±5.0	2.4^{NS}	42.7±11.1	4.3^{NS}	38±8.0
Calcium(mg)	880	360.8±16.0	118.4***	390.8±89.0	16.8***	375.8±52.5	865	353.5±17.5	106.3***	360.6±44.5	40.0***	357.05±31
Iron(mg)	42	12.0±1.4	89.78***	17.72±1.15	115.8***	14.86±1.45	38	11.1±1.24	92.4***	12.3±1.4	83.5***	11.7±1.32
Thiamine (mg)	1.2	0.94±0.06	49.6ns	1.1±0.1	18.9^{NS}	1.02±0.08	1.2	1.0±0.03	73.1ns	1.0±0.10	19.8^{NS}	1.0±0.06
Riboflavin (mg)	1.1	0.75±0.24	5.34**	0.44±0.23	11.12**	0.59±0.23	1.1	0.68±0.21	6.1**	0.42±0.11	21.51**	0.55±0.16
Vitamin A (µg)	998	244.0±19.7	148.0***	179.6±111.9	26.34***	211.8±154.5	996	241.7±20.7	141.1***	147.1±95.0	26.8***	194.4±57.8
Vitamin C (mg)	40	21.9±2.4	28.93***	25.8±6.5	8.42***	23.85±4.5	40	20.9±3.4	21.8***	27.5±7.2	6.5**	24.2±5.3

* p<0.05 **p<0.01 ***p<0.001 ns-Not significant ♦Ref: RDA (Pasricha and Thimmayamma,2000)

It was found that there was gross deficit in the intake of all nutrients except thiamine and fat, when compared to the RDA and these deficits were at highly significant levels ($p<.001$).

The low energy intake found among elderly in the present study is supported by evidences from many large scale studies. The NSSO household consumption expenditure data for 1999-2000 evidenced that the calorie intake in Kerala was the lowest among the Indian States with rural Kerala reporting an average consumption of 1389 Kcals/day and urban Kerala consuming 1602 Kcals/day meeting only 58 percent and 76 percent of RDA(Sen, 2004).Lower energy intake values among the elderly must also be considered in view of their lowered physical activity levels and metabolic rates.

NNMB surveys (2005-2006) also found a mean energy intake of 1547 Kcals/cu/day by Keralite adults which was about 74 percent of RDA. The mean energy intake of Kerala was estimated to be 1547 Kcals which was the least in the Indian states surveyed.

The protein intake was also lower than the RDA at a significant level in the present study .NNMB (2005-2006) also reported lowest protein intakes were reported in Kerala(38 g/day)among all other Indian states surveyed. The present study results are comparable to the above findings.

The micronutrient intake levels of the elderly were also found to be very low, as a consequence of the meagre inclusion of fruits and vegetables in the diet. According to WHO(2008), micronutrient deficiencies are very common in the elderly due to a number of factors like reduced food intake and lack of variety in the diet. Several Indian studies support this result. In Tamil Nadu, studies by and Chandrasekhar and Bhooma(1998) and Natarajan et al.,(1991) found low intakes of calories, protein, iron, Vit.A, thiamine, riboflavin and Vit.C among elderly. Brahmam (2005) based on all India data by NNMB surveys, reported that average intake of all nutrients except thiamine and niacin was less than the RDA. Bamji (2003) also reported that the intake of micronutrients particularly iron and Vitamin A was below the RDA for elderly.

Arlappa et al., (2004 and 2003) also consistently observed low nutrient intakes among Indian elderly.

The intake of fat was assessed to be high. The fat intake of free living elderly exceeded the RDA but not at significant levels. The mean fat intake of institutionalized elderly however did not exceed the RDA. The major sources of fat were fried foods, coconut and ready made snacks. The food preparation methods adopted also had a significant role in fat intake. Higher levels of fat intake in Kerala has been reported (NNMB, 2005-06 and NFHS, 2005-06) to which the present results are comparable.

Thiamine was obtained from the intake of parboiled rice and flesh foods .So the intake was not significantly lower than the RDA. Calcium intake met the RDA for Indian adults owing to the intake of milk, but the additional allowance for elderly was not attained due to non inclusion of vegetarian sources of calcium.

Iron intake showed gross inadequacy in all categories of elders due to low intake of green leafy vegetables , iron rich millets etc. Moreover low Vitamin C intake coupled with high consumption of tea and coffee, which are the known inhibitors of iron absorption place the elderly in a highly vulnerable position with regard to their iron nutriture. NNMB(2005-2006) surveys also found the median iron intake of Indian elderly to be 12.3 mg which was much below the RDA. The Vitamin C intake of 24 mg/day by the elderly of the present study is comparable to the corresponding figure of 28 mg/day reported by NNMB survey (2005-2006).

4.2.4.6 Percentage adequacy of food and nutrient intake by the Elderly.

The percentage adequacy of food and nutrient intake by the elderly were computed and is presented as figures 19 and 20.

Percentage adequacy of food intake

Figure 19 illustrates the percentage adequacy of food intake of the elderly.

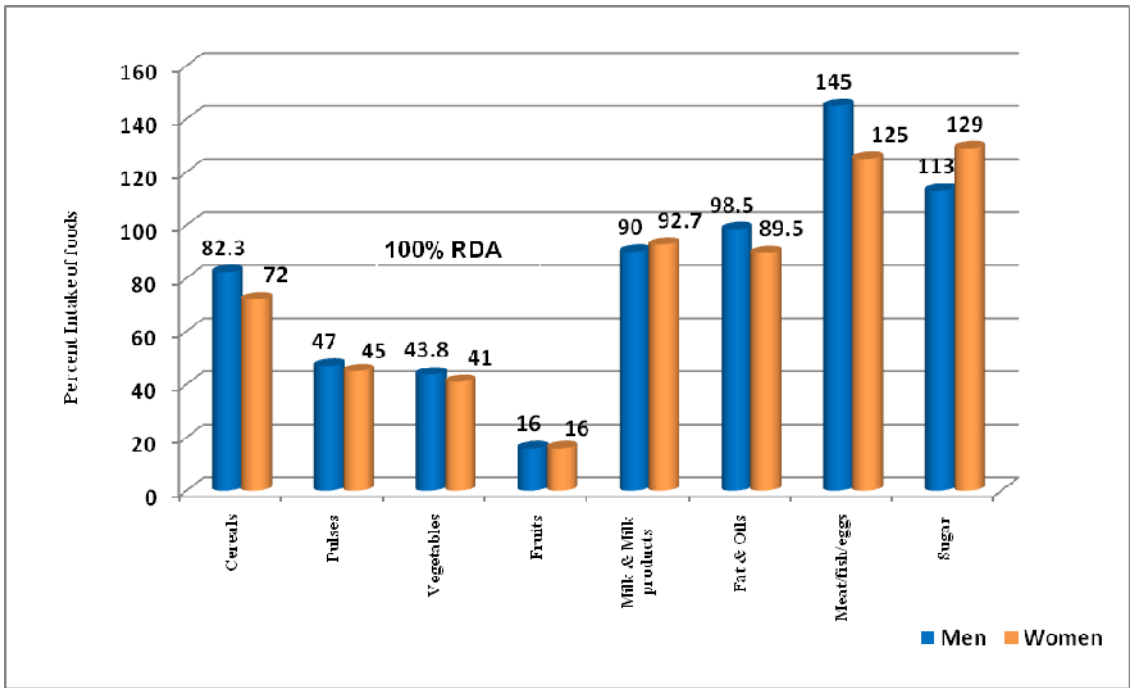


Figure 19: Percentage adequacy of food intake by elderly

As the figure depicts the lowest adequacy (16% of RDA) was seen in the intake of fruits .Intake of pulses and vegetables, the protective foods, was also found to be less than 50 percent of RDA. Cereal intake was found to be 70 to 80 percent of the RDA and milk and milk products and fat intake adequacy was above 90 percent of RDA. The percentage adequacy exceeded only in the intake of flesh foods (125 to 145%) and sugar (113 to 129%). Gender difference in percentage adequacy to a notable extent was for flesh foods (145% for males and 125% for females) and sugar (113% for males and 129% for females).

Percentage adequacy of nutrient intake

Figure 20 presents the details regarding percentage adequacy of nutrient intake of the elderly.

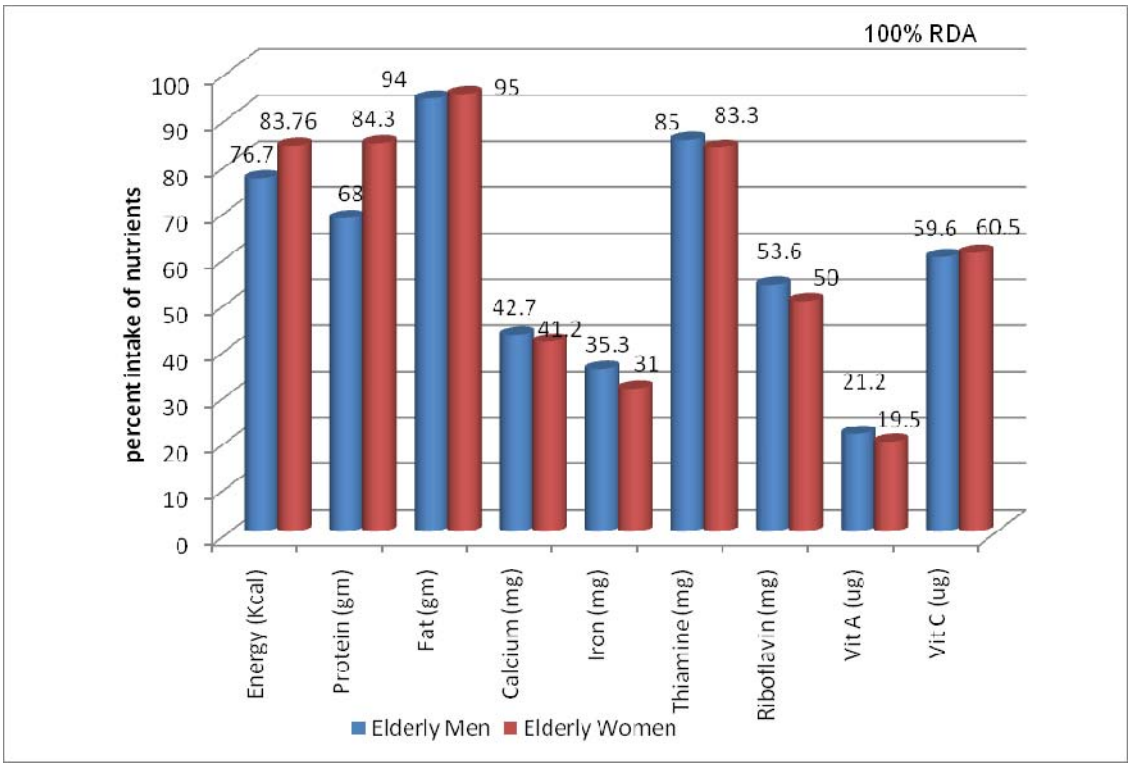


Figure 20 - Percentage adequacy of nutrient intake by elderly

The figure clearly presents the total inadequacy of all nutrients at varying levels. Above 90 percent adequacy was reported only for fat intake. 80 percent and above intake was noted for thiamine. Inadequacy in energy (76.7%) and protein (68%) was more obvious in elderly males and females for whom the percentage adequacy was above 80 percent. Gross inadequacy was noted in the case of vitamin A intake followed by iron and calcium .

4.2.4.7 Proportion of elderly and percentage adequacy of nutrients.

The details regarding proportion of elderly and percent adequacy of nutrients are shown in table 35.

Table 35

Proportion of elderly and percentage adequacy of nutrients

Nutrients	Gender	RDA*	% of RDA			
			≥100%	70-99%	50-69%	<50%
Energy(Kcal)	Male	1973	3.3	60.0	36.6	0
	Female	1704	10.0	66.7	23.3	0
Protein(g)	Male	55	6.7	63.3	26.7	3.3
	Female	45	16.7	56.6	20	6.7
Fat(g)	Male	40	20.0	56.7	20	3.3
	Female	40	33.3	50.0	16.7	0
Calcium(mg)	Male	880	3.3	6.7	66.6	23.3
	Female	865	3.3	13.3	80.0	3.3
Iron(mg)	Male	42	0	0	60	40
	Female	38	0	3.3	53.3	43.3
Thiamin(mg)	Male	1.2	20	53.3	20.0	6.7
	Female	1.2	13.3	63.3	16.7	6.7
Riboflavin (mg)	Male	1.1	16.7	26.7	53.3	3.3
	Female	1.1	13.3	23.3	60	3.3
Vit A (μg)	Male	998	0	43.3	33.3	23.3
	Female	996	0	53.3	33.3	13.3
Vit C(mg)	Male	40	10.0	30.0	33.3	26.7
	Female	40	6.7	36.7	40	16.7

*RDA by Pasricha and Thimmayamma,2000

The proportion of elderly consuming nutrients greater than or equal to the RDA was comparatively smaller except in the case of fat and thiamin. NNMB survey (Arlappa et al., 2004) also found that only 2.8 percent elders consumed nutrients at par with RDA. As far as energy intake was concerned 36.6 percent of elderly men and 23.3 percent of women reported having less than 70 percent of RDA. Generally, consumption levels less than 70 percent of RDA is considered as inadequacy. The

incidence of overweight among the subjects despite moderate energy consumption may be due to the lack of physical activity and sedentary lifestyle resulting in a reduction in energy expenditure.

Energy consumption less than 50 percent of RDA which corresponds to one BMR (Basal Metabolic Rate) representing subsistence diet was not found in the present sample of elderly. In NNMB survey (Arlappa et al., 2004) this figure was 1.5 percent. The intake of fat exceeded RDA in 20 percent of men and 33 percent of women. This is comparable to the recent NFHS III (2005-06) survey where an increasing trend of fat consumption in Kerala especially among women was reported. These findings also explain in part the increasing prevalence of overweight and obesity among the subjects.

However the pattern of consumption of micronutrients presented a dismal picture. Majority of subjects had intake levels below 70 percent of RDA for calcium (about 90%), iron (almost100 %), vitamin A (56%) and vitamin C(60%).

Quantitative insufficiency of diets of Indian geriatric population is well documented. Natarajan (1999) in detailed clinical studies on a South Indian Elderly population found multiple vitamin deficiencies to be common among the elderly. Marginal and pre-clinical vitamin deficiencies may result in non-specific symptoms such as malaise, irritability, frequent colds, insomnia and loss of appetite. The problem of wide spread osteoporosis among Indian elderly as a result of calcium deficiency has been pointed out by Brahmam (1999). He further recommended vitamin and mineral supplementation for meeting the RDA for elders.

It is also notable that elderly women generally did not have much lower food intake than as some previous reports indicate (NNMB 1997; Natarajan, 1991). The present findings are in congruence with the latest NNMB survey reports (2005-2006) as it indicated a pattern of diminishing gender bias with regard to food intake. Kerala being a leading state in India with regard to several social development indicators resulting in greater access of women to food, education and health care has been previously reported (Sen, 1994).Regarding the gender differences in food intake, free

living women were found to have higher consumption of fruits, milk group and flesh foods though lower than the recommended levels. A study by Bates et al.,(1999) in U.K on gender differences in food and nutrient intakes of elderly found the most significant differences in food intakes were that elderly women ate more butter, fat, milk and fruits and men had higher intakes of meat and alcoholic drinks. The study pointed out that the relationship between food choices, nutrient intakes and actual nutrients consumed were complex.

4.2.5 *MNA- Non invasive Assessment of the nutritional status of elderly*.

Mini nutritional assessment (MNA) is a screening tool designed to provide rapid assessment of nutritional risk (Guigoz et al.,2002) and is composed of four domains ; anthropometry, dietary ,global and subjective assessments .The MNA has been widely used in assessing nutritional vulnerability of older adults. Published studies report screening of 35,000 elderly subjects in different settings (community, hospitals and institutions) from different countries.

Detailed validation studies have been undertaken on the MNA and it has high sensitivity and specificity as reported by Kuzuya et al., (2005), Delacorte et al., (2004) Visvanathan et al., (2004), Guigoz and Vellas,(1995) and reproducibility (Bela et al.,2002) .It fulfilled the criteria of a tool for nutritional evaluation like sensitivity, specificity , cost and targeting a specific group (Rush,2004). It has been translated by specialists into more than 15 languages and is freely available.

There are few published studies describing the status of Indian elderly as per the MNA. Therefore the MNA was used to define nutritional status of elderly in the present study. Before using MNA for objective evaluation of nutritional status, an assessment of its applicability in the study locale was also carried out. Assessing applicability of a tool in nutritional studies is to define precisely whether the screening tool is able to identify malnutrition.

The following markers were chosen as recommended by Guigoz et al.,(2006) and Thorsdottir et al.,(2005) to test the applicability of the MNA in the present study population.

- On the basis of clinical evaluation without knowledge of MNA results, two clinicians, trained in nutrition, classified the patients as well nourished or under nourished. This classification was used as 'Gold standard' to evaluate the MNA and is further named as Clinical status.
- Comprehensive nutrition assessment which included BMI, Mid upper arm circumference, Calf circumference, serum albumin, total cholesterol, Haemoglobin and Haematocrit evaluations.

4.2.5.1 Clinical Status

Due to lack of reference standards to classify the elderly according to their nutritional status, clinical status – a nutritional assessment done independently by two physicians was used as the 'Gold standard'. Using clinical status as the standard, the elderly (n=166) were classified as well nourished (51%) and under nourished (49%). The Mean Body Mass Index of elderly classified so is given below

Table 36

Mean BMI of Elderly subjected to Clinical evaluation

Particulars		***Clinical status*** *(n=166)*	
		Well nourished 51% (n=84)	***Mal nourished 49% (n=82)***
Mean BMI (n=166)	Men (n=61)	23.4± 3.54	*18.4± 2.94*
	Women (n=105)	*24.8 ±3.70*	*19.8 ±3.83*

The above results indicate that the Body Mass Index (an indicator of long term mal nutrition) varied within the subjects classified as well nourished or under nourished. This indicates that clinical status is of value in testing the applicability of

MNA. The following table shows the classification matrix of MNA vs. clinical status, taken as 'Gold standard'.

Table 37

Classification Matrix: MNA vs Clinical Status

Nutritional Status as per MNA (n=166)	**"Gold Standard" Clinical Status (n=166)**	
	Well nourished (n=84)	**Mal nourished (n=82)**
Well nourished (n=89) MNA score ≥ 24	81	***8***
Mal nourished (n=77) MNA score ≤ 23.5	***3***	74
Sensitivity – 90.2% Specificity – 96.4%		

Out of 166 subjects only twelve subjects (indicated in italics) were misclassified by MNA scores, indicating that the MNA is able to classify the nutritional status of subjects with accuracy. The sensitivity ie., the ability to identify all actual positives (in this case malnourished) by the tool, with respect to their clinical evaluation by physicians was 90.2%, which is excellent. The specificity ie., the ability to recognize all actual negatives (in this case well nourished) was 96.4%, which indicates that the MNA is able to identify well nourished elderly with slightly better accuracy than it is able to identify malnourished older persons.

Guigoz et al., (1999) reported that MNA could classify elderly subjects with accuracy and hence it could be used as a practical assessment tool for grading the nutritional state of elderly. Kuzuya et al., (2005) evaluated and recommended applicability of MNA as a screening tool for nutritional assessment of Japanese home care elderly population in a similar way and found comparable results. Thorsdottir et al., (2005) also reported that MNA test could be used as a fast and simple screening tool for nutritional assessment in elderly with significant specificity and sensitivity.

4.2.5.2 Body Mass Index

The agreement between Body Mass Index and MNA in classifying the nutritional status of the elderly was also tested by sensitivity- specificity analysis as given below.

Table 38

Classification Matrix: MNA vs Body Mass Index

Nutritional status as per MNA (n=296)	**Body Mass Index (n=296)**	
	Well nourished BMI ≥20 (n=163)	**Mal nourished BMI≤ 20 (n=133)**
Well nourished (n=159) MNA score ≥ 24	153	***6***
Mal nourished (n=137) MNA score ≤ 23.5	***10***	127
Sensitivity – 95.4% Specificity – 93.9%		

Body Mass Index less than 20 is suggested as a cut off point indicating low body weight further leading to several grades of chronic energy deficiency (BMI <18.5) among vulnerable groups in developing countries (Expert consultation of WHO,2004). Therefore, a Body Mass Index less than 20 was used as the cut off for classifying the elderly as well nourished or malnourished. In this analysis only 16 elderly (given in italics) out of 296 subjects were misclassified by MNA scores. The sensitivity (95.4%) and specificity (93.9%) co-efficients were excellent, indicating the applicability of MNA in identifying malnutrition among the elderly in Kochi.

Similar relationship between nutritional status and BMI was also found by Vellas et al., (2000) and Persson et al., (2002).Significant association of BMI and MNA scores proved the good predictability of MNA in relation to BMI measure. Yet another study by Henken et al., (2005) to determine the association between BMI and standard indicators of nutritional status also showed significant association between BMI and MNA scores . A Study by Lopez (2003) exclusively on institutionalized elderly women

also demonstrated a significant association between MNA scores and BMI at five percent level.

4.2.5.3 Mid Upper Arm Circumference

Mid upper arm circumference has emerged as a potential screening tool for poor nutritional status. Equivalent cut offs in relation to and chronic energy deficiency using a range of data sets from developing countries have been developed by James et al., (1994). Ismail (1990) reported cut off value of 21.7cm in relation to BMI cut off of 16kg/m^2 for elderly. Webb and Copemann (1996) suggested a Mid Upper Arm cut off value of less than 22cm to indicate increased risk of malnutrition . Using the MUAC cut of value 22 cms, the applicability of MNA was assessed as given below.

Table 39

Classification Matrix : MNA vs. Mid Upper Arm Circumference

Nutritional status as per MNA (n=296)	**Mid Upper Arm Circumference (n=296)**	
	Well nourished (>22 cm) (n=263)	**Mal nourished (<22 cm) (n=33)**
Well nourished (n=159)	156	***3***
Mal nourished (n=137)	***107***	30
Sensitivity – 90.9% Specificity – 59.3%		

On using Mid Upper Arm Circumference as per standard, the MNA was quite accurate in predicting mal nutrition and therefore showed high sensitivity coefficient (90.9%).However, the MNA misclassified 107 subjects with MUAC above 22cm as malnourished and therefore its specificity (power of identifying true well nourished subjects) was found to be 59.3 percent only.

4.2.5.4 Calf Circumference measurements

Calf circumference is considered to provide the most sensitive measure of muscle mass in the elderly and is superior to mid upper arm circumference (Bonney et al., 2002). Cuervo et al., (2009) reported calf circumference as an indicator of risk of hyponutrition in the elderly, and found that elders with lower calf circumference showed higher undernutrition risk in every age range, in both men and women.

Association of MNA scores to calf circumference cut off values as proposed by Bonnefoy et al., (2002) and Ismail (1999) were studied and is presented in the following table.

Table 40

Classification Matrix: MNA vs Calf Circumference

Nutritional status as per MNA (n=296)	**Calf circumference** (n=296)	
	Well nourished (>31 cm) (n=112)	**Mal nourished (<31 cm) (n=184)**
Well nourished (n=159)	110	***49***
Mal nourished (n=137)	***2***	135
Sensitivity – 73.4% Specificity –98.21%		

The MNA showed average sensitivity (73.4%) in recognizing malnutrition in conjunction with calf circumference measurements. But the specificity (ie. power of identification of well nourished elderly) of the tool was found to remarkably high (98.21%) on comparing with calf circumference measurements. This means that the elderly who were having low calf circumference values (< 31 cm) were misclassified as well nourished by the MNA.

The conclusions derived from the above analyses may be summarized as below:

Table 41

Summary of sensitivity and specificity tests of MNA

Standards to which compared	Sensitivity of MNA (power to identify true malnourished*)	Specificity of MNA (power to identify true well nourished**)
Clinical Status as per physicians	90.2%-Good	96.4%-excellent
Body Mass Index	95.4% - -excellent	93.9%-excellent
Mid Upper Arm Circumference	90.9%-excellent	59.3%-average
Calf Circumference	73.4%-fair	98.21%-excellent

*True malnourished -malnourished as per the standards used.

**True well nourished -well nourished as per the standards used

It is clear from the above table that the MNA is able to classify the elderly as well nourished and malnourished with reasonable accuracy. Therefore the feasibility of use of the MNA tool in routine geriatric assessments in the study region is acceptable.

4.2.5.5 Biochemical indices vs MNA

According to Mahan and Stump (2000), biochemical tests are the most subjective and sensitive measure of nutritional status and helps to diagnose disease at the subclinical stage (Bamji, 2003).Association of selected biochemical markers with the MNA scores are presented in the following table.

Table-42

Mean biochemical values of MNA classified elderly

Biochemical parameters	MNA Assessment (n=125)	Mean ± S.D	ANOVA- F value
Serum Albumin (g/lt)(n=125)	Well Nourished At Risk Malnourished	4.1 ± 0.26 3.87 ± 0.26 3.79 ± 0.22	6.196**
Haemoglobin (g/dl)(n=125)	Well Nourished At Risk Malnourished	11.83 ± 1.4 11.75 ± 1.3 10.94 ± 1.4	4.138*
Haematocrit(%) (n=125)	Well Nourished At Risk Malnourished	34.5 ± 4.12 34.2 ± 3.1 32.9 ± 3.7	3.472*
Total cholesterol(mg/dl) (n=125)	Well Nourished At Risk Malnourished	204.7 ± 47.8 204.2 ± 37.6 189.54 ± 47.6	0.997^{ns}

** $p<0.01$ * $p<0.05$

The mean values of Serum albumin progressively declined with reduction in MNA scores. MNA status was found to be significantly associated ($p<0.01$) with serum albumin. Likewise there was a progressive decline of mean haemoglobin as well as haematocrit values with decline in MNA status. Chi square analysis revealed that MNA and haemoglobin levels were also highly associated ($p<0.05$). Haematocrit measurements also declined with low MNA scores and this was also found to be associated at 5 percent level. Although there was a decline in the mean total cholesterol levels of elderly in concordance with the MNA, the association was not statistically significant.

Rezende (2005) reported a positive correlation of MNA values with haemoglobin and haematocrit measurements and concluded that MNA predicts undernourishment. The present findings also fall in line with it.

4.2.5.6 *Association of MNA scores and selected variables*

The MNA scores of the elderly population was computed and association of the same was checked with selected variables. Results are presented in table 43.

Table 43

Association of MNA and selected variables

Variables	MNA Assessment(n=296)			Chi square
	Well nourished Score ≥24 points	**At -risk** Score 17 to 23.5 points	**Malnourished** Score <17 points	
Age				
60-70yrs	62.7	33.33	3.9	22.85***
70-80 yrs	55.8	36.5	7.7	
80 + yrs	13.8	72.4	13.8	
Sex				
Male	62.9	31.5	5.6	4.99^{ns}
Female	47.9	44.5	7.5	
Living arrangement				
Freeliving	71.1	24	5.0	
Institutionalised	35.1	56.1	8.8	30.78***
Religion				
Hindu	38.1	56.2	5.7	23.31***
Christian	65.0	28.2	6.8	
Muslim	70.4	18.5	11.1	
Economic independence	57.5	56.2	5.7	
Independent	55.7	28.2	6.8	9.7*
Partially independent	35.2	18.5	11.1	
Fully dependent				
Marital status				38.94***
Married	69.0	19.0	12.1	
Widowed	59.8	35.4	4.7	
Single	20..0	74.0	6.0	
Education				30.181***
Illiterate	24.1	72.4	3.4	
School level	45.5	48.5	5.9	
Above school level	69.5	21.9	8.6	
Pooled MNA Assessment	**53.6**	**39.6**	**6.8**	

Nutritional status assessment by MNA score revealed that more than half of elderly (53.6%) were well nourished, followed by 'at risk' elders (39.6%) and malnourished (6.8%). (Figure 21)

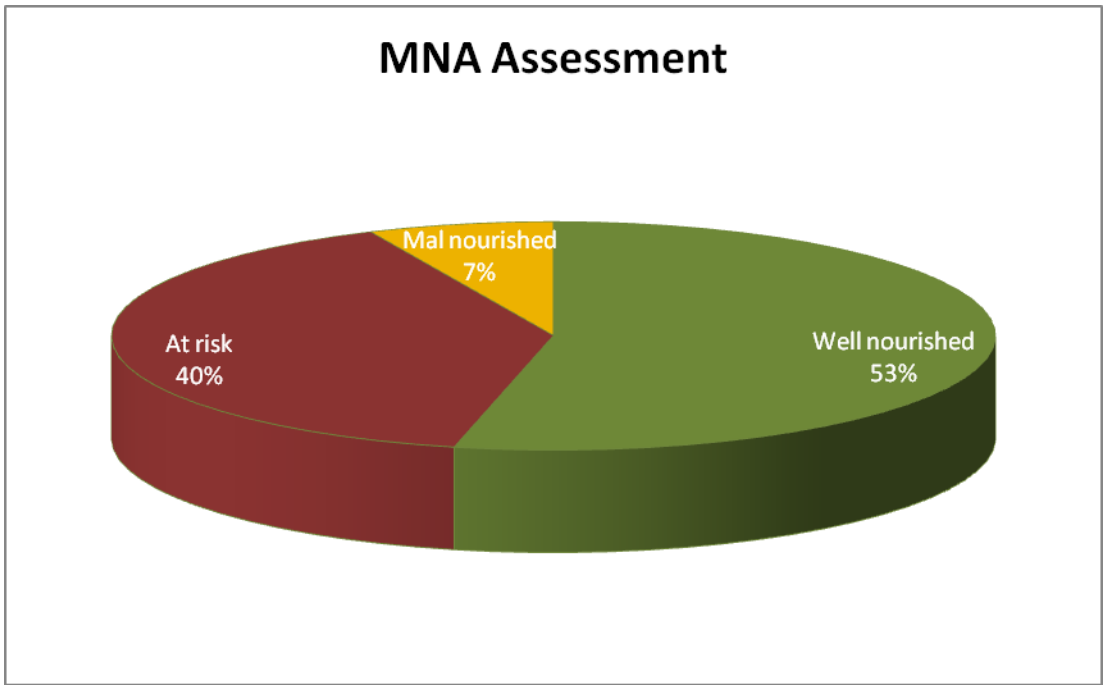


Figure 21 - Distribution of elderly according to Grades of Nutritional Status as per MNA

The present study is fairly consistent with the reports of Christensson et al., (2002) and Guigoz et al., (2003) that on using MNA scores, a considerable proportion of elderly were at risk of malnutrition. On using MNA assessment, 48 percent and 45 percent of elderly to be 'at risk' of malnutrition were reported by Soini et al (2004) and Visvanathan and Mcintosh (2003) respectively. The percentage of elderly who were malnourished ranged from 3 to 3.8 percent in the above studies.

Higher percentage of elderly being at risk of malnutrition has been reported by De Groot et al., (2004) in Denmark in a study on 1161 elderly men. Ferdous et al., (2009) in Bangladesh applied the MNA and found 26 percent to be malnourished and 62 percent to be at risk. In Spain (Cuervo, 2009), 4.3 percent were undernourished as per the MNA.

While considering each one of the variables studied and their relation to MNA scores, it was found that age has got a highly significant association with MNA status.

There was a decrease in well nourished subjects with increasing age and a concomitant increase in percentage of malnourished elderly with age ($p < 0.001$). Soini et al., (2004) has also established age related decline in nutritional status of elderly. A study by Baweja et al., (2008) using MNA on an elderly population in Rajasthan reported 7.24 percent malnutrition among 80+ group. But in the present study the prevalence rate was much higher.

Gender did not show any significant association with the nutritional status of elderly in the present study although elderly women were more at risk of malnutrition (44.5%) or malnourished (7.5%) than elderly men. Non-bias of elderly as per gender in terms of Body Mass India in Kerala have been reported in NNMB Survey (2006). The present results affirm the above findings on lack of gender bias in health issues in Kerala. But studies of Cuervo (2009) in Spain have shown significant association of female gender to malnutrition by MNA Assessment.

The living arrangement did have a significant role in the incidence of malnutrition. The elderly living in old age homes had increased risk of malnutrition (56.1%) than the free living elders (24.0%).Data from large scale studies also showed a similar trend of undernutrition being at significantly higher levels in institutions (Cederholm, 1992; Hoffman (1993). As per Hollis and Henry (2007) those residing permanently in institutions are at increased risk of developing undernutrition party due to lack of dietary variety.

The proportion of well nourished elderly presented a decreasing trend with increasing economic dependency ($p<0.05$). The highest proportion of elderly who were at risk (56.9%) and malnourished (7.9%) were economically fully dependent in others and this association was found to be significant at 5 percent level. Feldblum (2007) also reported economic dependence to be significantly associated to poor nutritional status.

There was observed a significance difference ($p<0.001$) in the incidence of malnutrition among different religious groups. Highest percentage of well nourished (70.4%) and mal nourished (11.1%) elderly were among Muslims followed Christians. However, 'at risk' elderly were highest among Hindus.

Marital status also showed a significant association to nutritional status ($p<0.001$) with highest percentage of well nourished (69%) and lowest percentage of 'at risk' (19%) among married elderly. At the same time the most affected group was single elderly who have never married.

Educational level was also significantly associated ($p<0.001$) with the nutritional status of elderly with illiterates having the lowest percentage of well nourished (24.1%)and highest proportion (72.4%) of at risk elders. School level education was found to improve the nutritional profile of elderly.

4.3 Risk factors associated with Nutritional Status of the Elderly.

Stepwise multiple logistic regression analysis was performed to determine risk factors related to Chronic Energy Deficiency (BMI<18.5), Malnutrition (as per MNA), Depression (as per Geratric Depression Scale) and overweight/ obesity (BMI ≥25) among the elderly.

4.3.1 *Relative Risk of Independent Variables to Chronic Energy Deficiency (Body Mass Index <18.5)*

Poor nutritional status is generally considered as a consequence of imbalance between dietary intake and nutritional needs. Being underweight, particularly in elderly persons is associated with physical, functional and psychological impairments and delay in recovery from illnesses. Although criticized because of the limits of its meaning, BMI is widely applied in nutritional assessment. It's known association with disease and death makes it a useful tool to detect persons at risk both in screening and clinical interventions.

In adults, being overweight is associated with higher mortality risk (Calle et al., 1999 and Dorn et al., 1997) whereas in elderly persons being underweight seems to be a better predictor of negative outcomes than does obesity (Dey et al., 2001 and Grabowsky et al., 2001). Seiddel and Visscher (2000) considered BMI as an appropriate measure of low lean body mass in elderly persons.

The BMI has been widely used as a practical measure of Chronic Energy Deficiency (Khongsdier, 2005). Although adult nutritional status can be evaluated in many ways, the BMI is most widely used because this technique is being economic, non invasive and very practical (Ferro Luzzi et al., 1992; James et al, 1988).

Chronic Energy Deficiency (CED) was defined as BMI less than 18.5 (WHO,2002) and relative risk of 16 independent variables to Chronic Energy Deficiency (CED) were tested by step wise logistic regression. The following table presents the results.

Table 44

Relative risk of various factors to Chronic Energy Deficiency (BMI<18.5) in elderly by step wise logistic regression.

Variable	Univariate regression		Stepwise multivariate	
	Rel. Risk	95% CI	R.R	95% CI
Gender				
Female	1	1.09-6.8	- ns -	
Male	2.74			
Age (yrs)				
60-75	1	0.329-3.448	- ns -	
> 75 yrs	1.677			
Living arrangement				
Free living	1	1.573-	1	1.832-
Institutionalised	8.98	51.359**	5.595	17.088***
Religion				
Muslims	1			
Christians	4.125	1.28-13.321*	4.431	1.5-12.96**
Hindus	8.658	1.59-47.11	8.60	2.05-36.09**

(Contd..)

Variable	Univariate regression		Stepwise multivariate	
	Rel. Risk	95% CI	R.R	95% CI
Marital Status				
Married	1		1	
Widowed	0.740	0.183-2.98ns	0.453	0.132-1.55^{ns}
Single	4.547	1.292-15.99*	3.667	1.142-11.78*
Type of family				
Living With children	1			
With Spouse only Or alone	4.54	1.29-15.99*	- ns -	
Education				
< 5 yrs schooling	1			
5-10 yrs schooling	0.607	0.69-5.36^{ns}	- ns -	
>10 yrs education	0.504	0.164-1.55^{ns}		
Economic independence				
Fully independent	1			
Partially independent	2.167	0.315-14.913^{ns}	- ns -	
Fully dependent	3.6	0.765-14.735^{ns}		
Depression				
No depression	1		1	
Depression	5.233	1.78 – 15.39**	4.85	1.77-13.288**
Life satisfaction				
High	1		- ns -	
Low/Average	1.321	0.79-0.668^{ns}		
Social Activities				
Good	1		- ns -	
Poor	2.571	0.641-10.314^{ns}		
Dental Problems				
No dental problem	1		1	
Dental Problems	3.3	1.2-10.1*	3.0	1.2-9.2*
Major morbidities				
No major disease	1		- ns -	
Any major disease	0.631	0.175-2.270^{ns}		
Minor illness				
No minor illness	1			
Incidence of minor illness	1.530	0.068-9.855^{ns}	- ns -	
Food variety				
Good	1			
Poor	2.05	0.215-1.222^{ns}	- ns -	
Food habit				
Vegetarian	1		1	
Non Vegetarian	5.414	0.55-53.3ns	7.9	1.1-69.7*

ns - Not Significant * p<0.05 ** p<0.01 ***p<0.001

Gender

Gender was not found to be a significant risk factor for chronic energy deficiency. The risk for CED was found to be lower for older women (1) compared to older men (2.74), though not statistically significant. BMI can reflect intra household inequality in food intake both in quantity and quality. The NNMB (2000) data have shown that the extent of CED was marginally higher among males (53.5%) than females (49.4%) at all India level. The 2005-2006 NNMB surveys also found CED prevalence in Kerala to be higher among men (27.7%) compared to 21.1 percent of women.

Age

There was a slightly higher risk for older elderly (>75 years) to have a low BMI but the risk was not statistically significant.

Living Arrangements

Being in an old age home increased the risk for chronic energy deficiency by 5.6 times than living in a home environment. This was found to be highly significantly also ($p<0.01$). This may be interpreted by considering the fact that majority in old age homes may be victims of long duration malnutrition throughout their life course.

Jain and Purohit (2007) in a study on living status and general health of senior citizens found that the senior citizens living in old age homes exhibited poor general health than the free living counterparts. Payette et al., (2000) has also reported that institutionalisation is significantly associated with weight loss among elderly. Sibai et al., (2003) has described institutionalised elders to have lower BMI than free living counterparts, though no evidence of poor nutritional status was found.

Rudman et al., (1990) hypothesised that higher prevalence of malnutrition in institutionalised elderly resulted from an increased energy requirement secondary to multiple infection and other chronic illness in the institutionalised population. In institutions, lack of supervision and assistance at meal times may also be an important

factor resulting in poor food intake. Lack of dietary variety in institutions have also been pointed out by Henry (2007).

Religion

Religion was significantly associated with BMI. Christians were 4.4 times at risk and Hindus were 8.6 times at risk for underweight than Muslims. This is likely to be related to the dietary variation and socio economic status.

Marital Status

There was a higher risk for single elderly to have CED compared to ever married (including widowed) elderly. The risk for single elderly was 3.7 times of the ever married group ($P<0.05$).

Goldman et al (1994) in a study on marital status and health among elderly found that single elderly had poorer health and risk of dying than married elderly. Also since single elderly was more likely to be isolated and on a low income or disabled, socio economic factors and disease together are likely to have more influence on their energy intake than 'marital status' alone.

Family Type

The variable family type was found to be a significant ($p<0.05$) risk factor for CED. Living alone (either by themselves or with spouse only) increased risk by 4.54 times than living with family members though the risk was not statistically significant on multivariate analysis. Coleman and Krondal (1993) also observed malnutrition among elderly in isolated households.

Murphy et al., (1990) assessed the impact of social factors and found that companionship is positively related to appetite and nutrient intake. The findings on more number of family members slightly but favourably influencing nutritional status of elderly may be due to the positive effect of companionship.

Education

Educational status of the elderly was not found to be a risk factor for chronic energy deficiency. As reported by Frauenrath et al., (1999) and nutrient intakes of the study population also seems to be largely independent of factors like sex, age and educational status.

Economic Independence

Being economically dependent increased the risk of CED by 3.6 times but this was not at statistically significant levels.

Depression

The elderly who were detected to have depression as per the Geriatric Depression Scale had 4.8 fold increase in developing chronic energy deficiency compared to those elderly who were not depressed, which was statistically significant.

This finding is supported by several other studies. German et al., (2008) found that after controlling for age, cognitive status, functional ability and number of illness, under nutrition was significantly associated with depression. Park and Suh (2007) also recommended focus on psychological well being of elderly as a higher depression score was found to be significantly related to a higher risk of becoming malnourished.

Life Satisfaction

Elderly with higher life satisfaction had lower risk for CED. This was however not statistically significant. Johansson et al (2008) and Hengsterman et al., (2008) analysed factors associated with malnutrition of elderly and found lower self perceived quality of life to be significantly associated to malnutrition.

Social Activities

Elderly with poor social activities and networks were found to have a risk of CED 2.5 times more than those who had good social activities, though the risk was not statistically significant.

Dental Status

Elderly with poor dental status had 3 times risk for chronic energy deficiency and this risk was statistically significant at five percent level. Supportive evidence includes reports by Shay and Ship (1995) correlating poor dental status with lower nutrient intakes and multiple dietary inadequacies. De Marchi et al (2008) also found that patients who were dissatisfied with dental status were more likely to be at risk of malnutrition.

NNMB (2000) have also found that with increasing age there was a declining trend in food and nutrient consumption which could be attributed to reduced physical activity and loss of teeth due to increasing age.

Major morbidities

Having major morbidities did not increase the risk of elderly to be chronic energy deficient, probably because major morbidities which are chronic and degenerative diseases are often associated with being overweight and obese.

Minor illness

Minor illnesses were found to increase the risk of CED by 1.5 times than those who do not have a minor illness ,but the risk was not statistically significant.

Food Variety

Elderly with good to very good food variety were taken as reference .Those with marginal/fair food variety had twice the risk for CED, though not statistically significant. Bernstein et al.,(2002) established that a highly varied diet is associated with higher BMI in elderly compared to malnourished elderly and those at nutritional risk and identified lower intake of fruits, vegetables and fluid to be sensitive and specific predictors of malnutrition.

Type of diet

Being vegetarian increased risk of CED by 7.9 times in this population though it was not statistically significant. The increased risk of Hindus to have low BMI may be partly explained by this factor.

In conclusion, the significant risk factors associated with chronic energy deficiency of elderly in the present study were living in an old age home, being single, being depressed and having dental problems. The effect of religion with more Hindus being affected by CED was also found to be significant. Risk of age, gender and educational status could not be established statistically, though slight risk levels evolved.

4.3.2 *Relative Risk of Independent Variables to Malnutrition as per the MNA.*

Malnutrition was defined as a score of less than 17 on using the Mini Nutritional Assessment tool. Relative risk of several component variables for malnutrition, was verified by step wise logistic regression. Following table presents the details.

Table 45

Relative risk of various factors on Malnutrition (as per MNA) among the elderly by stepwise logistic regression

Variables	Univariate regression		Stepwise multivariate	
	Rel. Risk	95% CI	R.R	95% CI
Gender				
Female	1	0.997-1.121^{ns}	- ns -	
Male	0.331			
Age (years)				
60-75	1			
>75	2.224	0.595-8.46^{ns}	- ns -	
Living arrangement				
Free living	1		- ns -	
Institutionalised	1.153	0.207-11.39^{ns}		
Religion				
Hindus	1			
Christians	0.601	0.198-1.825^{ns}	- ns -	
Muslims	0.615	0.137-2.763^{ns}		
Marital Status				
Married	1			
Widowed	1.5	0.450-4.715^{ns}	- ns -	
Single	3.01	0.425-21.37^{ns}		
Type of family				
Living				
With children	1		- ns -	
With Spouse or alone	1.34	0.51-2.285^{ns}		
Education				
> 5 yrs schooling	1		- ns -	
< 5 yrs schooling	1.331	0.2-8.64^{ns}		
Economic Independence	1		1	1.071-10.614**
Fully independent	3.331	0.624-17.89^{ns}	3.371	
Fully/Partially dependent				
Life Satisfaction				
High	1		1	
Low/Average	17.749	2.225-141.55**	19.11	2.7 -134.7**
Depression				
No depression	1		1	
Depression	13.300	4.936-35.836**	14.990.	6.136-36.625**
Social Activities				
Good	1	1.68-21.57^{ns}	1	
Poor	6.038		3.575	1.236-10.342**

(Contd…)

Variables	Univariate regression		Stepwise multivariate	
	Rel. Risk	95% CI	R.R	95% CI
Dental Problems				
No dental problem	1	2.178-31.906**	1	
Dental Problems	8.336		6.049	1.829-20.008**
Major disease				
No major disease	1		1	
Any major disease	16.559	2.523-108.699**	10.77	2.076-55.938**
Minor Illness				
0-3 days a month	1	0.721-6.396ns	- ns -	
>3 days a month	2.148			
Gender				
Female	1	0.997-1.121ns	- ns -	
Male	0.331			
Food variety				
Good	1		- ns -	
Poor	2.1	0.173-1.480ns		
▪ ***Food Preparation***			- ns -	
Self, no assistance	1			
Others	0.349	0.132-0.921		
▪ ***Food Shopping***				
Self	1		- ns -	
Others	2.830	0.707-11.325ns		
▪ ***Involvement in menu planning***			- ns -	
No	1			
Yes	0.468	0.219-0.998*		

Gender

Gender bias in the incidence of malnutrition could not be established, though men had slightly lower risk levels than women. Diminishing gender bias in nutritional status may partly be attributed to the greater awareness and availment of existing health facilities and lesser disparity in intra household level food distribution in Kerala as pointed out by Dreze and Sen (2002).

Age

There was higher risk for being malnourished as age advanced. The risk was 2.24 times for 75+ age group than the younger elderly. But the risk did not show any statistical significance. Baweja et al., (2008) in a similar attempt in Rajasthan found

that as age advanced, malnutrition and it's risk increased. Similar trend on declining nutritional status with age was also presented by Soini et al., (2004) also.

Living Arrangement

The elderly in old age homes had 1.5 times more risk for malnutrition compared to free living elders, though not statistically significant.

Religion

The risk for malnutrition as per the MNA was lower for Christians and Muslims than Hindus though it could not be established statistically. However, this further reinstates the vulnerability of elderly Hindus to malnutrition than other communities.

Marital Status

The risk for single elderly to be malnourished was 3 times higher than married elderly whereas widowed/separated group had 1.5 times the risk. However these were not statistically significant.

Type of family and *educational level*

Significant relationships between type of family or education level of elderly and risk for malnutrition could not be elucidated. Correa et al., (2009) elucidated a significant association between care giver's education level and nutritional status of elderly. This may imply that if autonomy in decision making is not possible for elderly,then education level of family members or authorities may affect their nutrition more than their own educational status. However education of elderly as predictor of under nutrition has been established in studies by Ferdous (2009) in rural Bangladesh

Economic Status

Elders who were fully economically dependent on others had 3.3 times risk for malnutrition compared to elderly who were fully or partially independent. This was found to be statistically significant also ($p < 0.05$).

Life satisfaction

Poor life satisfaction was also found to the highly associated to risk of being malnourished ($p<0.01$), which is a well documented finding (Johnson, 2005, Morley,1998).

Depression

Depression was found to be yet another risk factor for malnutrition. The elderly who were depressed were 13 times more at risk for malnutrition compared to elderly without depression .This association was found to be highly significant ($p<0.001$).

Smoliner et al., (2009) have also reported that malnutrition and depression in a German elderly population was highly correlated and depression (as per Geriatric Depression Scale) emerged as the only independent risk factor for prevalence of malnutrition in multiple regression analysis. Age, sex, care level, number of drugs or self caring capacity did not influence nutritional status in the above study.In a similar attempt in Israel (German et al., 2008), malnutrition as per MNA was significantly associated with depression after controlling for age, cognitive status, functional ability and number of illness.

Social Activities

Elderly with poor social activities were found to have 3.6 times higher risk of being malnourished than those with good social activities ($p<0.05$). Christensson et al., (2003) in Sweden also reported similar relationship between active involvement in social life and risk of malnutrition. In Rajasthan, Baweja et al., (2008) could clearly demonstrate a significantly higher risk of malnutrition in elderly with reduced social interactions in comparison to persons who were functionally active and partook in social activities. Similar trend was seen in a study on ulcer healing in elderly patients and influence of nutritional status and social interactions on it (Wissing et al., 2001). Patients in whom social interactions were good had higher MNA scores and healing rate was also higher among them.

Dental problems

Dental problems in elderly was a significant risk factor in developing malnutrition. Those with more tooth problems had 6 times higher risk in developing malnutrition ($p < 0.01$).Elderly persons with chewing problems having a significantly higher risk for malnutrition than those without chewing problems had been demonstrated by Baweja et al., (2009) and Feldblum (2007) . Soini et al., (2004) has also found that dental status correlated significantly to MNA score. also identified chewing problems in elderly to be significantly associated with the development of malnutrition.

Major Diseases

Elderly having no major diseases had lower risk of being malnourished. The relative risk of malnourition increased by 10.77 times in elderly with having a major morbidity ($p<0.01$) than those having no major morbidities at all.

Minor Illness

The elderly who suffered from minor illnesses for more than 2 days in a month had a higher risk of malnutrition (2.2 times), though the risk was not statistically significant.

Food variety

Elderly with poor food variety as per the food variety scores, were 2.1 times prone to be malnourished than those with better food variety scores. However this was not statistically significant. Bernstein et al., (2002) reported significant association between highly varied diet and nutritional status and found a high diet variety score to be related to high fruit and vegetable variety score.

Food Shopping, Menu planning and Food Preparation

Elderly who had to prepare food themselves with no assistance were at higher risk for malnutrition, however being involved in menu planning reduced risk for mal-nutrition. Being able to do food shopping themselves also was associated with lower

risk for malnutrition, though none of these factors were at a statistically significant level.

Thus it could be concluded that the risk factors having significant association with malnutrition in elderly were economic dependence, depression, poor social activities, having dental problems, having a major disease and poor life satisfaction.

4.3.3 Mal Nutrition Risk – Scoring and Classification

The significant risk factors related to malnutrition (as per MNA evaluation) among elderly as elucidated by multivariate logistic regression were assigned weighted scores according to their relative risk magnitude as follows:

Risk Factor	Relative Risk	Weighted risk score
Economic dependence	3.37	1
Poor social activity	3.57	2
Dental problems affecting food intake	6.05	3
Incidence of major disease	10.77	4
Depression	14.99	5
Poor life satisfaction	19.11	6

The weighted mean scores for each group of elderly were computed to indicate the risk level for malnutrition and was termed as Malnutrition Risk Index.

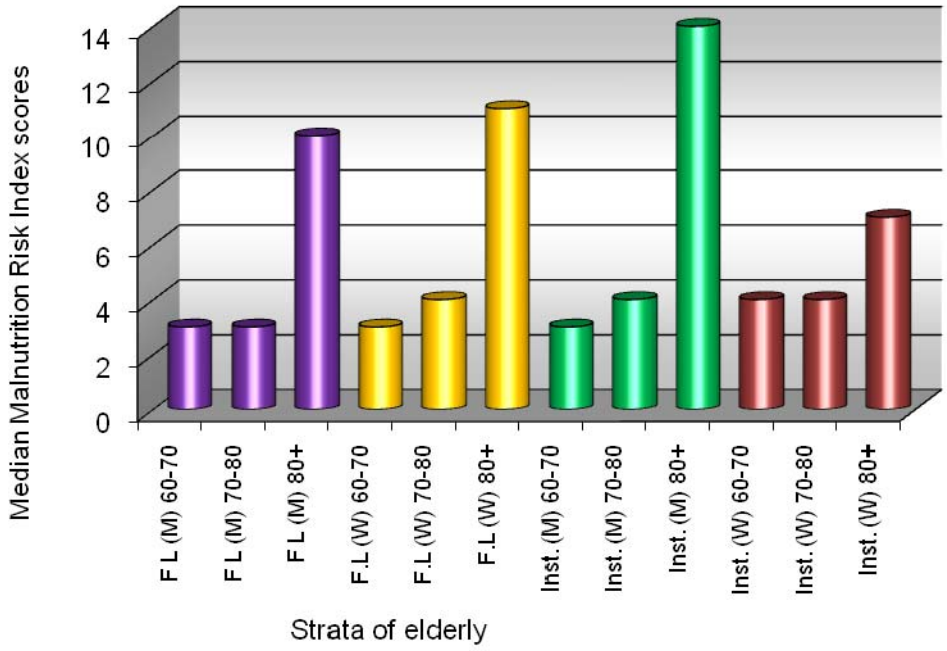
The following table presents the mean and median values of Malnutrition Risk Index scores(MRI scores) assigned to the elderly.

Table 46

Malnutrition Risk Index (MRI) scores of the elderly

Strata			N=500	MRI Scores	
Living arrangement	Age (Years)	Gender		Mean ±S.D	Median
Free living	60-70	Men	78	3.73±2.64	3.0
Free living	70-80	Men	39	4.17±3.8	3.0
Free living	80+	Men	35	7.78±3.49	10
Free living	60-70	Women	119	5.23±4	3.0
Free living	70-80	Women	64	5.78±4.3	4.0
Free living	80+	Women	15	10.63±6.31	11.0
Institution	60-70	Men	10	2.33±1.8	3.0
Institution	70-80	Men	20	5.45±4	4.0
Institution	80+	Men	6	11.0±6.55	14
Institution	60-70	Women	35	5.85±4.0	4.0
Institution	70-80	Women	52	6.1±4.3	4.0
Institution	80+	Women	27	7.17±5.13	7.0

As evident from the table, malnutrition risk generally increased with age. Specifically, the oldest age group (80 plus years) was found to be most affected irrespective of gender and living arrangement. The Malnutrition Risk Index scores in terms of mean as well as median were reported to be very high for elderly above 80 years of age. This has been illustrated in figure 22.



FL – Free Living, Inst – institutionalised,M – Men, W - Women

Figure 22 -Median Malnutrition Risk Index scores of Elderly

Similar observations has been reported by Dilip (2001), based on NSSO 52nd round Survey regarding the incidence of health problems among elderly of Kerala. The author found a significantly higher demand for medical attention by elderly in later stages of old age .The higher risk for ill health among female elderly may be attributed to the greater longevity of females.

Details regarding the comparative contribution of each risk factor in predicting the Malnutrition Risk Index scores of the elderly are presented in figure 23.

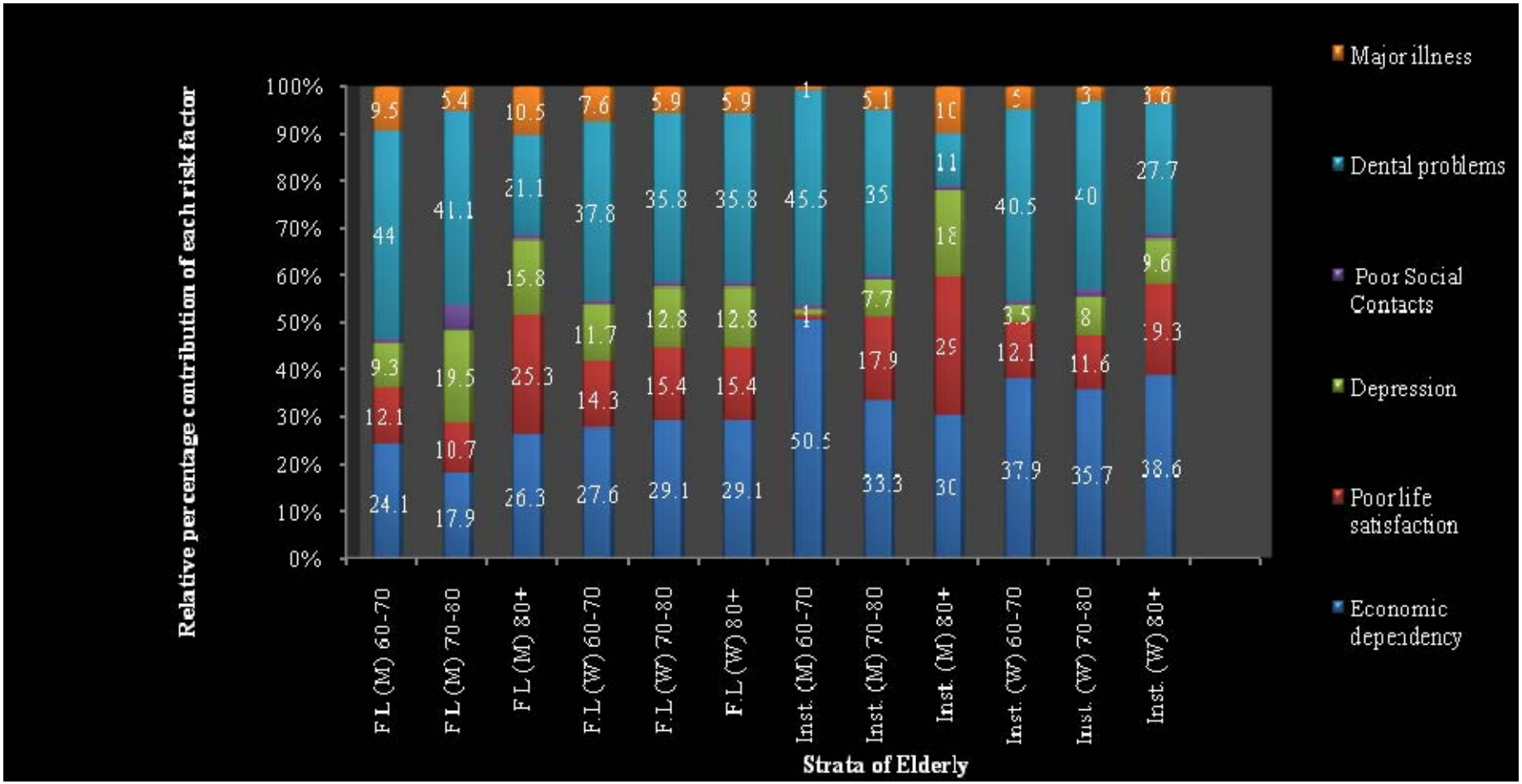


Figure 23 Comparative contribution of risk factors to Malnutrition Risk Index of Elderly

The two major risk factors for malnutrition among a majority of elderly were having a major illness, economic dependency (constituting up to 50% of MRI sores of each group) and incidence of major illness (up to 45.5%).This was followed by poor life satisfaction (up to 25.3%),depression (up to 19.5%) and dental problems(up to 18%). .Further it was seen that the magnitude of major illness as a risk factor for malnutrition has been reduced with age indicating the vulnerability of 'young old' elderly to this risk than the oldest group. At the same time psychological illnesses like depression and poor life satisfaction were stronger predictors of malnutrition in oldest age groups.

4.3.4 Relative risk of independent variables to incidence of Depression among elderly

Depression was defined as a score above five on the Geriatric Depression Scale. Relative risk of several independent factors for incidence of depression was verified by step wise logistic regression. The details are presented in table 47.

Table 47

Relative risk of various factors to incidence of depression among elderly by stepwise logistic regression

Variable	Univariate		Multivariate stepwise	
	Rel. Risk	**95% CI**	**Rel. Risk**	**95% CI**
Gender				
Male	1	0.535-2.048^{ns}	-ns-	
Female	1.07			
Living Arrangement				
Inst (Ref)	1.0	1.072-6.193*	-ns-	
Free Living	2.6			
Age (Years)				
60-70	1.0	0.94.-3.176^{ns}	-ns-	
70-80	1.73			
80+	1.6			

(contd…)

Variable	Univariate		Multivariate stepwise	
	Rel. Risk	**95% CI**	**Rel. Risk**	**95% CI**
Religion				
Christian	1			
Hindu	0.768	0.416-1.417^{ns}	-ns-	
Muslim	1.214	0.410-3.597^{ns}		
Economic Status				
Independent	1			
Dependent	1.6	0.670-3.836^{ns}	-ns-	
Social Activities				
Good	1			
Poor	2.977	0.378-1.587^{ns}	-ns-	
Life satisfaction				
Excellent	1		1	
Average	4.80	2.58-8.93***	3.86	2.3-6.7***
Poor	6.756	1.16-39.05***	7.99	1.6-40.62***
Education				
Above school level				
5-10 yrs school	3.96	1.061-14.844*	5.6	1.6-19.6*
<5 yrs school	4.11	1.036-16.327*	4.5	1.2-16.4*
Marital Status				
Married	1			
Widowed	0.95	0.514-12.967^{ns}	-ns-	
Single/Seperated	0.87	0.953-3.096^{ns}		
Type of family living				
Living with children	1			
With spouse / alone	1.3	0.142-1.780^{ns}	-ns-	
Major morbidities				
Nil	1			
Any major morbidity	1.6	0.872-3.133^{ns}	-ns-	
BMI				
Normal	1			
Underweight	3.79	1.180-12.225*	-ns-	
Overweight	1.4	0.659-2.883^{ns}		
Nutritional status as per MNA				
Well nourished	1		1	
At risk	1.334	0.641-2.77^{ns}	1.3	0.7-2.5^{ns}
Malnourished	13.6	2.967-28.54***	9.2	4.9-37.9***

Relative risk of thirteen independent variables to onset of depressive illness in elderly could be elucidated.

Gender

Elderly females had a very slight but non-significant risk for being depressed than males. Studies on gender differences in depressive symptomatology in elderly (Zunzunegui et al., 2007) have found that prevalence of depressive symptoms was higher in women than men in many countries, but was equal in a few countries like Sweden. They also elucidated that women were not particularly vulnerable due to socio cultural and health related risk factors in countries with unfavourable gender bias towards women. However, Rueda and Artazcoz (2009) have emphasized the importance of socio economic position, family characteristic and social support in understanding poorer mental health in females.

In India, women have been reported to have more psychiatric morbidity than men, the higher rate being consistent for both urban and rural areas as well as across regions, religions and socio-economic classes. Depression is the more prevalent mental health problem among women in India as it is elsewhere (Kaput and Shah, 1992; Davar, 1999) But Rodes et al., (2001) have found that though women had more mood/anxiety disorders than men, there were no gender differences in the overall prevalence of mental disorders.

In Kerala, Mohamed et al., (2002) have found men in general to have better mental health, but indicated that gender differences are converging over the generations and women seem to be changing in a positive direction regarding most of the selected indices. The non bias among female elderly for prevalence of depression may be understood in view of the following data. The Gender gap in literacy rate in Kerala is just 6 percent as against 22 percent for the country (Banthia, 2001). Kerala is the only state in India where, the sex ratio favours females (1058 as against 922 for India). In terms of reproductive behaviour, Keralite women on an average had only 1.5 deliveries (International institute for the Population Sciences and ORS Marco, 2001). The Human Development Index (HDI) prepared by the Indian Planning Commission ranks Kerala as first throughout the last 20 years. (Planning Commission, 2002). Even

the gender empowerment measure (GEM) developed by the United Nations Development Program (1995) and the alternative measures developed by Hirvay and Mahadevia (1996) also accord Kerala the leading position among all other Indian states.

Living arrangement

A significant risk ($p<0.05$) of 2.6 times more for being depressed were found for free living elderly than their institutionalized counterparts. However this relationship could not be established on multivariate analysis. Though it was observed that elderly in old age homes were dissatisfied regarding many life events, the dynamics of group living, sharing their problems with peers, regular prayer services and psychological comfort provided by authorities of homes probably went a long way in preventing many of them from being depressed. Whereas the elderly living alone or with their children / relatives may find little solace with regard to sharing their sorrows and problems and may feel 'low'.

Husaini et al., (1991) found that depression prevalence increased as level of contact with relatives and friends decreased and these relationship tended to be stronger for those living alone than for those living with others. Reports from other parts of the country (Patel, 2003 and Lakshminarayan 1999) showed that institutionalized aged experienced a poor sense of psychological well- being than non-institutionalized aged. However the present results may also be indicative of better care and privileges existing in old age homes of Kerala than other parts of India. Vasavda and Mehta (2003) concluded that elderly inmates in religious institutions were in better mental health compared to free living elders who experienced more loneliness. Fairly disciplined lifestyle in religious institutions has been reported to be beneficial to psychological health of elderly by Methilda (1998).

Age

The risk for depression increased slightly with age (1.73 times) though age was not found to be a significant risk factor for incidence of depression. Generally advanced age has been hypothesized to be a risk factor for depression as chronic medical illnesses

and cognitive impairment which occur with ageing ,adversely affects psychological well being of elderly (Alexopoulos, 2005). Roberts et al (1997) explained that age related increase in depression prevalence was attributable to physical health problems and related disability. But Steffens et al., (2000) have found that prevalence of major depression did not appreciably change with age

Religion

The risk for depression was slightly lower in Hindus (0.768) than Christians (1) and Muslims (1.2), but not to any significant extent.

Economic Dependency

Being economically dependent was found to have only a slight, but non-significant risk for incidence of depression. A slightly higher risk (1.6 times) for depression was found among economically dependent elderly than those who were independent.

However, this was found to be contradictory to other reports (Wilson et al., 2007) which have found poor satisfaction with finances was a significant risk factor for depression.

Social Activities

Depressive illness was 2.97 times higher in elderly with poor social activities than those with better levels of social activity, though not statistically significant.

Life Satisfaction

Poor life satisfaction exhibited 6.75 times more risk to depression than elderly with average (4.8) or excellent life satisfaction(1.0).This risk was found to be statistically significant ($p<0.001$)

Education

Educational status had an inverse risk with incidence of depression. Those elderly with less than 5 years of schooling had 3.9 times risk for being depressed ($p<0.05$) than more educated elderly(>5 years of schooling). Rajan et al., (2007) also

noted that mental distress comes down as the level of education goes up for both men and women in Kerala.

Marital Status

No statistically significant relationships were found in depression prevalence between elderly in different marital status.

Type of family living

Elderly living alone or with spouse only showed slightly higher risk of depression but this was found to be statistically insignificant.

Major Morbidity

Major morbidity among elderly was not found to be a risk factor to develop depression.

BMI

Elderly with BMI less than 18.5 had 3.79 times more risk to develop depression than those with normal BMI ($p<0.05$). Overweight elderly(BMI >24.9) also had slightly increased risk (1.4) than normal, but this was not significant statistically.

Nutritional Status as per MNA

Elderly who were malnourished as per the MNA reported a risk for depressive illness,which was 9.2 times higher than well nourished subjects and this association was found to be highly significant ($p<0.001$). Rezende et al., (2009) have found a significant negative correlation of depression to nutritional status of elderly. The present study also strongly suggests a strong inverse relationship between depression and nutritional status.

Thus the risk factors significantly associated with incidence of depression in this group of elderly were poor life satisfaction, lower educational status and malnutrition.

4.3.5 Relative risk of independent variables to incidence of overweight (high BMI) among elderly

Overweight is defined as BMI of 24.9-29.9 and obesity as BMI above 29 (WHO,2005).Various possible risk factors were considered for the logistic regression to elucidate their association with a Body Mass Index above 24.9 among elderly. Table 48 presents the results.

Table 48

Relative risk of various factors to incidence of overweight (BMI >24.9) among elderly by stepwise logistic regression

Variable	Univariate		Multivariate stepwise	
	Rel.risk	95% CU	Rel. risk	95% CI
Gender				
Male	1		- ns -	
female	1.573	0.877-2.82^{ns}		
Living arrangement				
Free living	1			
Institutionalized	0.63	0.457-2.628^{ns}	- ns -	
Type of family living				
With children	1.0			
With spouse only	1.353	0.534-3.432^{ns}	1.45	0.593-3.53^{ns}
Alone	2.716	1.161-6.352*	2.43	1.487-3.95***
Depression				
No depression	1		1	
Depressed	3.328	1.413-7.835***	2.030	1.2-4.13*
Food habits				
Vegetarian	1		1	
Non-Vegetarian	1.785	1.3-4.095*	2.355	1.12-4.95*

(Contd..)

Variable	Univariate		Multivariate stepwise	
	Rel.risk	**95% CU**	**Rel. risk**	**95% CI**
Religion				
Christian	1			
Hindu	0.645	0.360-1.156^{ns}	- ns -	
Muslim	1.102	0.393-2.559^{ns}		
Marital Status				
Married	1			
Widowed/single	0.92	0.63-2.1ns	-ns-	
Age (years)				
60-75	1			
>75	0.83	0.183-2.059^{ns}	-ns-	
Education				
> 5 years schooling	1		-ns-	
< 5 years schooling	0.74	0.134-1.141^{ns}		
Economic independence				
Fully independent	1			
Fully/partially dependent	0.86	0.908-60.71^{ns}	-ns-	

Gender

It was found that females posed 1.6 times risk of having a high BMI but the risk was not found to be statistically significant.

Living arrangement

Institutionalied elderly had slightly lower risk than free living elders to have a high BMI, but this was also not found to be statistically significant.

Type of family

It was found that those elders living alone had a significantly high risk ($p<0.001$) of having a high BMI. A slight but non-significant risk was not found

significant was reported for elders living with only spouse. However the risk was lowest in those living with their children.

Depression

Depression emerged as a significant risk factor ($p<0.05$) with those elderly who were depressed revealing almost twice the risk of having a high BMI.

Type of meal

Non-vegetarian diet was also found to be a significant ($p<0.05$) risk factor associated with overweight.

Religion

There was no significant risk associated with any one religion, though Hindus showed a slightly lower risk for having a high Body Mass Index and Muslims had a slightly higher risk.

Marital Status

No statistically significant relationship were found between over weight prevalence and marital status.

Age

The risk of overweight reduced with age, but this was also not found to be statistically significant.

Education

A direct association which was not statistically significant was observed between education and overweight. As the years of schooling increased the risk for overweight also increased.

Economic Independence

No statistically significant risk levels could be elucidated for elderly who were economically independent to have risk for being overweight.

Thus logistic regression revealed a similar set of factors to be relevant in both underweight and overweight among elderly of Kochi. The risk factors identified to have some significant association to Chronic Energy Deficiency were living arrangement, depression, religion, type of meal and dental status, whereas risk factors for overweight were elucidated to be depression, living alone and non vegetarian diet .

Hence it could be inferred that the risk for poor nutritional and health status of elderly could be due to a combined effect of several risk factors which may directly or indirectly influence the food intake and well being of elderly. These findings illustrate that there is no single most important risk factor, but a combination of lifestyle factors to be responsible for malnutrition among elderly.

Epidemiological, demographic and nutritional transitions are taking place in many developing countries. In India also there is some evidence of an emerging nutrition transition (Radhakrishna and Ravi, 2004; Shetty, 2002; Shukla et al., 2002; Griffiths and Bently, 2001) with co-existence underweight (BMI<18.5kg/m^2) and overweight or obesity (BMI ≥25kg/m^2) as revealed among the adult population by NNMB and NFHS-2 surveys. The present findings reveal that nutritional transition is underway among the elderly also.

4.3.6 Interrelation of risk factors to nutritional well being of elderly

Figure 24 depicts the interrelationships evolved between the risk factors significantly associated with the important health parameters of elderly viz. Chronic energy Deficiency, Overweight/ Obesity, malnutrition as per MNA and incidence of depression, by logistic regression analysis.

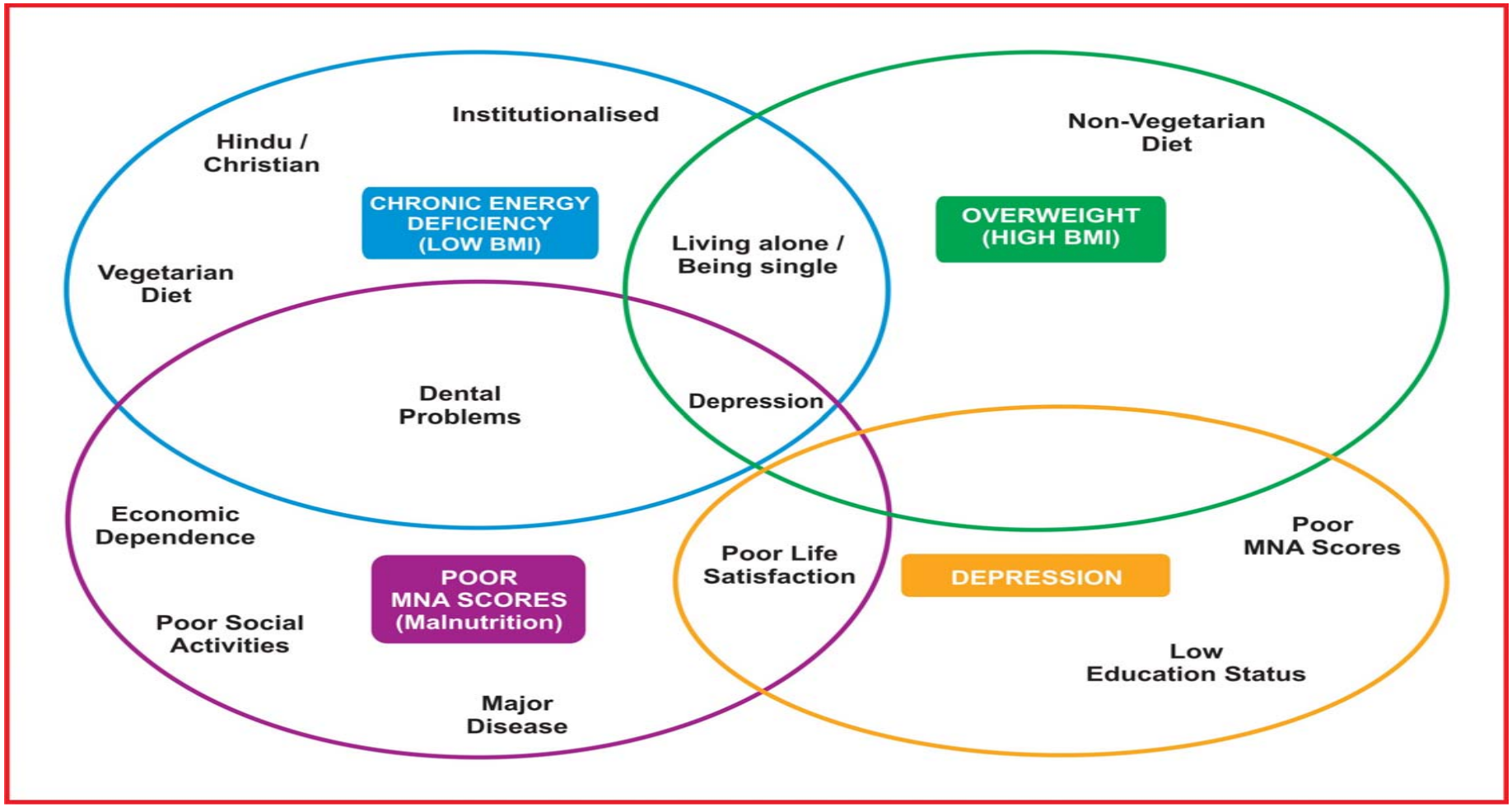


Figure 24 - Interrelation of risk factors to nutritional well being of elderly.

To sum up, the comparative effect of various risk factors of poor nutrition among elderly as studied using logistic regression analysis revealed psychological depression to be the most common risk factor leading to nutritional problems among elderly. Multiple risks were also associated with being single, living along and having poor life satisfaction. This clearly points to psychosocial variables among elderly to be important determinants of their health and nutritional status. Hence any attempt to improve the nutritional status of elderly should give due weightage on providing them with adequate psychological support.

It is apparent that there are common factors contributing to each of the conditions affecting the health of the elderly. It follows that broad based strategies which addresses these common causes will have widespread and beneficial outcomes than specific nutrition or disease focused strategies. In addition there is an urgent need to provide more information to older people about normal ageing, and about primary health care and self care approaches. Initiatives which form close links between existing family health services and geriatric care would be able to address many of the social, economic, psychological and nutritional issues simultaneously.

V. SUMMARY AND CONCLUSION

The present study entitled "Nutritional profile of elderly in Kochi, Kerala" was undertaken with the following specific objectives - to elicit information on socio-economic background, psychological status and quality of life of the elderly; to appraise their functionality and morbidity profile; to ascertain the nutritional profile of elderly with respect to their anthropometry, biochemical status, clinical profile and dietary intake; to test the applicability of the non-invasive tool, Mini Nutritional Assessment (MNA) in the study region, use MNA to further define the nutritional status of selected population and to elucidate factors associated with nutritional status of the elderly subjects.

The locale for the conduct of the study was Kochi, which is the largest urban agglomeration in the state of Kerala, India. Kerala has the highest proportion of elderly in India and among the districts of Kerala, Ernakulam district has the highest number of elderly. The largest number of old age homes in India has also been reported to be in Ernakulam. Kochi comes under the administrative purview of Ernakulam district. The peculiar demographic profile of the study area is indicative of the rapid urbanization and industrialization underway and therefore the present investigation was undertaken with the broad aim to bring out the general health and nutritional status of the first 'urban' generation of Kerala.

Inclusion criteria for selecting elderly were deemed to be persons above 60 years of age, free from apparent terminal illness or psychological abnormalities. The study covered 500 elderly subjects two stage cluster sampling was adopted to select subjects belonging to both free living and institutionalized living arrangements.

In the first stage,13 areas/wards belonging to CDP area of Kochi were randomly selected. In the second stage sampling, 25 households with elderly members were selected from a complete voter's list of the selected wards. By interviewing all elderly subjects in the selected households, 350 free living elderly were selected. Five old age homes from the total list of 49 old age homes in the study area were selected

taking care to include two paid homes, two government aided homes and one government old age home, so that the selected institutionalized sample be representative of the actual institutionalized elderly population of the study area. On an average 30 subjects from each home were selected, thus comprising 150 institutionalized elders. Thus, the total sample size was 500 elderly subjects, the sample size pre-determined by suitable statistical derivations.

The tool developed for data collection pertaining to socio-economic background, psychological status, functional abilities, medical factors and dietary habits was a detailed interview schedule entitled CHASE (Comprehensive Health Assessment Schedule for Elderly). The techniques adopted for assessment of nutritional status of elderly were anthropometry, biochemical assessment, clinical examination, dietary assessment and MNA (Mini Nutriitonal Assessment). Anthropometric assessment included height, weight, mid upper arm circumference, calf circumference, skin fold thickness, body fat impedance and waist hip ratio.

Biochemical assessment included estimation of serum albumin, complete blood count (Haemoglobin, total lymphocyte count, total WBC count, mean corpuscular volume, Mean corpuscular haemoglobin concentration, Mean corpuscular Haemoglobin, ESR, Eosinophils and Haemotocrit) Random Blood Glucose, Serum Iron and Total cholesterol. Clinical examination was conducted by qualified physicians using ICMR clinical assessment proforma on a subsample of elderly. The elderly were approached for clinical and biochemical assessment through medical camps organized in the study area and old age homes. Anthropometric and MNA assessments were extended to a few more elderly already contacted for personal interviews. Quantitative dietary assessment by one day weighment was done on subsample of 60 elderly who volunteered for the same.

The collected data was compiled and further analysed by SPSS (Vesion 11.5). The following are the major findings of the study.

Regarding the socio-economic profile of elderly, higher percentages of elderly were in the young old (60-70 years) category (52.4%) than old (70-80 years) or very old (80+ years). Higher ratio of women, (62.4%) were found in both free living and institutionalized categories than men (37.6%). Majority of elderly (93%) were not engaged in active, economically productive work and only one third (29.2%) had full economic independence. Employment pensions for themselves (24.4%) or spouses were the main source of income for day to day living whereas an equal percentage of elders (20.6%) received regular remittance from children.

More than half of the elderly (54%) were married whereas 30 percent were widowed. More than a negligible proportion (15%) were unmarried also.

Regarding support and status in living arrangement, a higher percentage of institutionalized elderly acknowledged receiving support for food, clothing and medication than the free living group. A higher percentage of free living elders (80.8%) felt that they were loved and respected compared to elderly in old age homes (32.7%). The reasons for institutionalization as reported by majority of elderly were not having children or unsupportiveness from them.

Social activities and life satisfaction of elderly were rated on a three point scale and individual scores were computed. Social activities were significantly ($p<0.001$) better for free living elders than those in old age homes; men than women and the 'young-old' than 'old' or 'very old' elderly. Similarly life satisfaction was found to be significantly better ($p<0.01$) for free living elderly and elderly men than their counterparts, though there was no change in life satisfaction levels with rise in age.

Certain significant associations were found with regard to general psychological indices of elderly. Lack of orientation was significantly higher among older elderly ($p<0.001$) and among institutionalized elderly ($p<0.001$). Feelings of confusion were associated to being an elderly female ($p<0.05$) than male. 29.8 percent elders complaint of disordered sleep through there was no significant difference between elderly with respect to living arrangements, gender or rising age. Complaints of poor memory was

markedly higher ($p<0.001$) in institutionalized elderly and elderly of higher age groups, though no gender differences emerged regarding this aspect.

Depression was assessed by using the Geriatric Depression Scale (Yesavage et al., 1986) The overall depression prevalence was 19 percent. No significant difference in depression prevalence was found between elderly in two living arrangements or between men and women. However significant association was found between incidence of depression and increasing age ($p<0.05$), having lower education ($p<0.001$) and being economically dependent ($p<0.001$). The above findings have been well supported by other studies also.

Functionality was assessed by using Physical Activities of Daily Living (PADL) scale developed by Katz et al (1986) as suggested by WHO (1995). It was found that majority of elders were functionally independent in domains of bathing, dressing, toileting, mobility and feeding. However, bowel or bladder incontinence was reported by 12.2 percent of elderly and the incidence of incontinence increased with increase in age ($p<0.05$).

Unhealthy habits like smoking, alcohol use and chewing tobacco were found among 7.4 percent, 8.6 percent and 4.4 percent of elderly. The former two were solely reported by elderly men . Only a little more than half of the elderly (53.4%) engaged in some form of exercise. Majority (83.3%) preferred walking to other forms of exercise.

The Dental Screening Initiative (Morley, 1998) was used to identify elderly with dental problems that may affect health and nutritional well being. Based on DSI scores, it was found that 10.8 percent of elders had poor dental status. Incidence of dental problems was found to have a significant association with living in an institution ($p<0.001$), being female ($p<0.01$) and increased with rising age ($p<0.01$). It also lead to chewing problems (25.4%) and swallowing problems (10.2%). Other age related inabilities found were visual disabilities (10.8%), hearing disability (15%), smell and taste perception loss (2.6%) restricted mobility (10%) and incidence of stiff back

(21.4%). A significant association ($H<0.05$) of mean number of inabilities was found with increasing age.

The mean number of minor morbidities per person was found to be around six, which is much higher than the average number of minor morbidities reported in other studies. However significantly higher ($p<0.01$) number of free living elderly were free from minor ailments than the institutionalized as well as men rather than women ($p<0.01$).

High prevalence of diabetes (25.4%) and hypertension (33%) was found among the subjects. Arthritis was found in 40 percent of subjects. The prevalence of life style related morbidities were found to be generally higher than comparable studies done in other states. However there was no statistically significant differences between the different categories of elderly regarding incidence of major morbidities. Complimenting the above findings, the most frequently used drugs were anti-hypertensivess (40.9%), hypoglycemic agents (26.5%) and over the counter nutritional supplements (11.2%)

To get an overview of the actual quality of life of the elderly, five objective factors were selected based on previous evidence on their effect on the quality of life of elderly. The factors were economic dependency, depression, age related inabilities, incidence of minor moribidities and incidence of major morbidities. Weighted scores regarding the overall quality of life were computed and it was found that significantly higher percentage of free living elders, elderly men and younger elderly had excellent quality of life than institutionalized elderly, elderly women and older elderly.

The major findings with respect to the anthropometric characteristics of the population were that there was a decline in height and weight of elderly with increasing age, at statistically significant levels for all ages and both genders. But, the BMI decline with age was at significant levels only for elderly men, not women. Comparison of body weights of elderly with NHANES III percentile data showed that low body weight was prevalent among oldest (80+ years) men and oldest women.

Further analysis of BMI revealed that percentage of Chronic Energy Deficient (CED) elderly increased with advancing age in both genders, but the association of low BMI and increasing age was at significant levels only for elderly men. Overall prevalence of CED was 17.2 percent in men and 8.8 percent in women, the lower prevalence in women being supported by large scale NNMB surveys also.

The overweight (BMI≥25-29.9) prevalence was 25.3 percent in men and 26.5 percent in women. Obesity (BMI≥30) was found in two percent men and 8.8 percent women. Thus, both overweight and obesity prevalence was found to be higher among elderly women than men.

Significant association of declining calf circumference with increasing age was found for both men and women. However mid upper arm circumference showed a significant decline with age only for elderly women and not men. As found for BMI data, there was significant difference between female elderly in two living arrangements regarding calf circumference but elderly men in both living arrangements had similar measurements.

Significant association was found between low calf circumference and advancing age ($p<0.01$) and having low BMI ($p<0.001$). But low mid upper arm circumference was significantly associated to only low BMI ($p<0.001$).

Body fat measurements comprising of waist-hip ratio, skinfold thickness and body fat impedance revealed higher mean values for all groups except institutionalized men. Institutionalized women also had comparatively lower mean body fat estimate measurements than their free living counterparts.

Armspan measurements suggested as an alternative to height was found to have a linear relationship with height of the elderly. Therefore linear regression equations for deriving height measurements from armspan was arrived at as Height (cm) = 72.44+(0.54 x armspan) for elderly men and Height (cm) = 66.3 + (0.53 x armspan) for

elderly women. However, the above equations need to be checked with measurements of young adults of the region for further validation.

A comparison of anthropometric measurements of elderly with other published reports revealed that All India Survey data (NNMB) and Mumbai Slum reports were lower than Kochi values whereas Delhi, NHANES III mean values and other international reports presented higher anthropometric values.

Biochemical assessment of elderly revealed that anemia as identified by low haemoglobin values were significantly higher among elderly men than women ($p<0.05$) and increased with age ($p<0.01$). Anemia prevalence among elderly men was 76.2% and among women was 55.6%, the overall prevalence being 65.4 percent.

Mean haemoglobin levels of institutionalized elderly were lower than their free living counterparts, though mean haemoglobin levels of both categories of elderly were significantly lower than reference values.

Complete blood count assessment showed abnormal deviations only for haemotacrit and ESR measurements. 87 percent and 70 percent of elderly had low haemotocrit values. ESR was raised in majority in elderly, which may be due to infections and undetected malignancies. It was found that 83.3 percent men and 44.4 percent of women having low haemoglobin levels had serum iron levels also lower than normal, implying anemia due to chronic disease.

Serum albumin was low in 6.7 percent institutionalized men and 8.3 percent institutionalized women, whereas none of the free living elders had lower mean values of albumin.

Random blood glucose levels exceeded normal range in higher proportion of elderly women than men and in institutionalized elderly than free living elderly.

Total cholesterol levels exceeded normal range in 51.7 percent and 70.4 percent of institutionalized and free living elderly women, whereas only 40 percent each of free living and institutionalized men had high levels. The prevalence of high total cholesterol in a considerable proportion of elderly is indicative of high risk of coronary heart diseases among this group.

Findings of clinical examination of the elderly revealed symptoms of vitamin A deficiency, B complex deficiency including pyridoxine, biotin and riboflavin deficiencies, iron deficiency and iodine deficiency. The symptoms were significantly higher among the institutionalized elderly than the free living ($p<0.001$). However, the association of greater incidence of clinical symptoms with gender or age was not statistically significant.

Dietary assessment of the elderly involved ascertainment of both qualitative and quantitative aspects, qualitative assessment revealed that majority (81.4%) of elders were non-vegetarians and had three main meals a day. Non-involvement in menu planning was significantly high for the institutionalized ($p<0.001$), for men ($p<0.001$) and the very old elders ($p<0.001$).

Modification of diet in terms of foods or nutrients were adopted by 17.6 percent of elderly. Low salt/sugar diets were adopted by 50 percent and 30.2 percent of elders. The specific behaviour of including healthy foods and avoiding unhealthy foods were found to be higher among free living elders than the institutionalized elderly.

Food variety and phytochemical density of diets of elderly were assessed using modified WHO checklists. The phytochemical density of diets of almost half (45.8%) of elderly were rated as good to excellent. Significantly higher percentage of men had better phytochemical dense diets than women. When food variety of elderly diets were analyzed, significant association was found between good food variety and being free living ($p<0.001$), being elderly men ($p<0.001$) and younger age ($p<0.001$)

One day weighment data yielded information on the actual food and nutrient consumption of the elderly. The data was compared to the Recommended Dietary Allowances (RDA) for sedentary Indian elderly as suggested by Pasricha and Thimmayamma (1997).

In general the mean food intakes were much lower than the RDA at highly significant levels ($p<0.001$) except for milk, flesh foods, fat & oil and sugar intakes. Mean food consumption of free living elderly was higher than their institutionalized counter parts regarding all food groups. Cereal, pulse, fruit and vegetable intake was significantly lower than the recommended levels by both groups of elders. The higher consumption of fats, sugars and non-vegetarian foods by the elderly clearly demonstrates the dietary transition that is underway in this population group.

Regarding nutrient intake, energy consumption was grossly inadequate for both free living and institutionalized elderly. Protein intake was also lower than RDA at significant levels. Due to reduced food intake and lack of dietary variety, the micronutrient intake levels were also found to be grossly inadequate. However, the intake of fat exceeded the RDA, though not at significant levels. Nutrient intakes were also found to be higher for the free living elderly than the institutionalized.

Analysis of the proportion of older people consuming nutrients by percent adequacy revealed that the proportion of elderly consuming nutrients greater than or equal to RDA was small except in the case of fat and thiamin. The intake of fat exceeded RDA in 20 percent men and 33 percent women. Majority of subjects had intake levels below 70 percent RDA for calcium, iron, vitamin A and vitamin C.

The nutritional status of elderly were defined using a non-invasive tool – Mini Nutritional Assessment (MNA) which has been validated for the same purpose by several large scale studies. Prior to assessment, the sensitivity and specificity of the tool was assessed by comparing it to approved markers of nutritional status.

Using clinical status of subjects as assessed by two qualified physicians as 'gold standard, the MNA demonstrated a sensitivity of 90.2% percent and specificity of 96.4% percent in identifying well nourished and malnourished elderly, which is excellent. Use of BMI as a 'gold standard' also showed that MNA had excellent sensitivity (95.4 %) and specificity (93.9%) in identifying malnutrition.

With respect to Mid Upper Arm Measurements, the sensitivity of MNA was only 90.9% percent whereas the specificity was average (59.3%).The sensitivity of MNA was found to be fair (73.4 %) on using calf circumference as the gold standard. However the specificity of the tool was rated highest (98.21%) in this analysis.

Thus it was concluded that MNA is able to classify the elderly as well nourished and malnourished with reasonable accuracy. Therefore the feasibility of use of the MNA tool in routine geriatric assessments in the study region is acceptable.

Association of selected biochemical indices with MNA scores were checked. The mean values of serum albumin progressively declined with poorer MNA scores, the association being significant ($p<0.01$). It was also found that haemoglobin and haemotocrit values were also significantly associated ($p<0.05$) with MNA scores

MNA assessment revealed that more than half of elderly (53.6%) were well nourished, followed by at-risk elders (39.6%) and mal nourished (6.8%).

Step wise multivariate logistic regression was employed to elucidiate the risk factors significantly associated with the nutritional status of elderly.

The significant risk factors related to low body mass index of elderly were found to be institutionalization (r.r5.6), being single (3.7), having depression (r.r. 4.85), having dental problems (r.r. 3.0) , adherence to vegetarian diet (r.r.7.95) and being Hindu (r.r.8.6).

The risk factors significantly related to low MNA scores (indicative of malnutrition) were economic dependence (3.37) poor life satisfaction (19.110),

depression (r.r.14.99) poor social activities (r.r.3.575), dental problems (r.r.6.049) and having a major disease (r.r.10.77).

To ascertain the specific strata of elderly having the highest risk with respect to malnutrition (as per low MNA scores) a malnutrition risk index (MRI) was formulated by assigning weighted scores to the significant risk factors of malnutrition (as per MNA) as elucidated by multivariate logistic regression.It was found that the higher risk was for oldest old (80+) institutionalized men followed by oldest old (80+) free living women. Lowest risk groups were young old (60-70 years) men, both free living and institutionalized.

When the comparative contribution of risk factors to malnutrition scores were analysed, it was found that economic dependency, dental problems, followed by poor life satisfaction and depression put higher proportion of elders at risk of malnutrition.

Logisitic regression of several independent variables to incidence of overweight and obesity among elderly demonstrated that being depressed (r.r. 4.13), non vegetarian diet (r.r. 2.355) and living alone (r.r. 2.716) were significantly associated to an undesirably high BMI among elderly.

Factors significantly associated to incidence of Depression were poor life satisfaction (r.r 7.99), lower educational status (r.r 4.5) and lower MNA scores indicating malnutrition (r.r.9.0).

The conclusions derived from the present study point to the fact that the elderly in Kochi are subjected to the dual burden of malnutrition, with overweight and obesity co-existing with chronic energy deficiency among a sizeable proportion of elders. Elderly women had lower prevalence of chronic energy deficiency and higher prevalence of overweight or obesity compared to elderly men.

Biochemical assessment revealed high prevalence of anemia (65.4%), the prevalence being higher among elderly men than women. Serum Iron estimations revealed that a sizeable proportion of elders may have anemia due to chronic disease. Erythrocyte Sedimentation Rate was raised in majority of elderly, implying infections

and undetected malignancies to be prevalent. Lower Serum albumin values were found only among institutionalized elderly, which points to the issue of protein energy malnutrition in old age homes. Random blood glucose and total cholesterol levels exceeded normal range in higher proportion of elderly women than men, which coincided with findings of nutrient intake assessment. Higher proportion of elderly women had higher energy and fat intakes than elderly men. However, gross inadequacies were noticed in micro-nutrient intakes by the elderly.

Food intake data revealed that even the diets of elderly had undergone the transition from the traditional low fat, nutrient dense, vegetarian food habits to being high fat, empty calorie and predominantly non-vegetarian. Clinical examination revealed symptoms related to vitamin A, B complex, vitamin C, Iron and Iodine deficiencies to be also more prevalent among the institutionalized elderly than free living elders.

Mini Nutritional Assessment (MNA) demonstrated excellent sensitivity and specificity with respect to clinical evaluation by physicians ('gold standard'),Body Mass Index, circumference measurements and biochemical indices and is therefore recommended for use in the study region. Based on MNA evaluation, 53.6 percent elderly were rated as well nourished, followed by 39.6 percent elders to be at-risk and 6.8 percent elders to be malnourished.

Multiple inter-relationships emerged on analyzing the factors related to poor nutritional status. Socio economic variables, psychological factors and physical factors had significant impact on the conditions of Chronic Energy Deficiency, Overweight/obesity and Malnutrition (as per MNA). The median Malnutrition Risk Scores were highest for oldest old (80+) elderly men in institutions and oldest old (80+) free living women.

To sum up, the comparative effect of various risk factors of poor nutrition among elderly as studied using logistic regression analysis found psychological depression to be the most common risk factor leading to nutritional problems among elderly. Multiple risks were also associated with being single, living along and having

poor life satisfaction. This clearly points to psychosocial variables among elderly to be important determinants of their health and nutritional status.

Thus the present findings reveal the institutionalized elderly, and the older elderly to be groups requiring special concern. Elderly men as having equal or more vulnerability to malnutrition compared to elderly women is also note worthy. The findings suggest that a sizeable proportion of elderly in the study region follow a sedentary lifestyle, have undesirable Body Mass Index (high or low), a diet high in fat and poor quality of habitual diets. Moreover, psychological distress and high rates of morbidity and multiple medication intake have been noted. These are well established adverse factors that affect the elderly. Programs addressing issues related to nutritional status of elderly should focus on psychological aspects, health and socio-economic issues of the elderly as these factors in a complex inter-related manner, affect the nutritional profile of elderly.

Interventions should consider the following factors which lead to better health and nutrition of the elderly: physically active lifestyles, appropriate range of BMIs, adequate quantity and quality of diet, absence of substance abuse and a supportive social and family environment. Practical measures to address the above risk factors among elderly have to be envisaged, if the vision of livelier longevity is to come true.

Recommendations for the further research

1. Studies to develop and evaluate strategies for community based health promotion, dietary improvement and adoption of healthy lifestyles by the elderly.
2. Intervention studies on improving psychosocial problems of elderly and is impact on their nutritional and health status.
3. MNA validation study on elderly with larger sample size representing different geographical areas of Kerala.
4. Use of multiple medications by elderly and their effect on nutrient absorption and metabolism need to be investigated.
5. Feasibility studies on use of vitamin and mineral fortified foods and supplementation initiatives through PHC's to improve nutritional status of elderly in poor communities.
6. Prospective studies are required to assess the role of anti-oxidant nutrients and micronutrients in retarding the onset and progression of chronic diseases in the elderly.
7. Validation studies on using alternate measures of anthropometry (armspan, knee height etc) in evaluating nutritional status of oldest old (80+ years) and bed bound elderly.
8. Malnutrition and cognitive deficiencies among elderly and viable strategies to overcome it.
9. Validation of tools to assess the Quality of Life (QoL) of Indian elderly would be beneficial.
10. Studies on food and nutrient requirements of Indian elderly should be elucidated and Recommended Dietary Allowances (RDA) for 60 + population specifically defined.

REFERENCES

1. Adams, P.B., Lawson, S., Sanigorski, A and Sinclair, A. 1996. Arachidonic acid to eicosapentanoic acid ratio in blood correlates positively with clinical symptoms of depression. Lipids. Vol. 31. pp: S157-S161.

2. Akner. 2005. Treatment of protein–energy malnutrition in chronic non malignant disorders. American Journal of Clinical Nutrition. vol. 74. pp 6 – 24.

3. Alexopoulos, G.S. 2005. Depression in the elderly. The Lancet. Vol..365. Issue 9475. pp: 1961-1970.

4. Alhamdan, A.A. 2008. Body Mass Index, Waist, Waist to Hip ratio and lipid profile in elderly subjects being in a nursing home. J. Med. Sci. 8(2). pp. 177-181.

5. Allen, S.C. 1989. The relation between height, arm span and forced expiratory volume in elderly women. Age ageing. No.18. pp:113-116.

6. Allison, D.B., Zannoth, R., Faith, M.S., and Heymsfield, S.B. 1999. Weight loss increases and fat loss decreases cause mortality rate: results from two independent cohort studies, Int. J. Obes. Relat. Metab. Disord. No.23,. pp: 603-616.

7. Amarantos. E. 2000. Nutrition and Quality of Life in older adults. Journal of Gerontology. Vol. 56 A. pp:54-64.

8. Anderson, M., Reddy, K.K., Rao, A. 1999. Social Welfare 51. 7. pp: 16-19

9. Andres, E., Zimmer, J. Federici, L., Loukili, N.H., and Kaltenbach, G. 2007. Clinical aspects of cobalamin deficiency in elderly persons. European Journal of Internal Medicine. Vol.18. No.6. pp: 456-462.

10. Andres, R., Elahi, D., Tobin, J.D., Muller, D.C., and Brant, L. 1985. Impact of age of weight goals. Ann. Intern Med. No.103. pp:1030.

11. Andrew. 2000. Identifying the older person likely to require long term care services. Journal of American Geriatric Society. Vol.35. pp:761-766.

12. Andrews, G.R., Esterman, A.J., Mayer, A.J., and Rungie, C.M.1986. Ageing in the Western Pacific. Malina Regional Office for the Western Pacific.

13. Anonymous. 2005. Making Kerala Nutrition Rich; A Mission to reach nutritional level of best performing countries. Kerala Calling. January issue. Pp: 21-22.

14. Arlappa, N., Balakrishna, N., Kumar S., Brahman, G.N.V and Vijayaraghavan, K. 2003. Diet and Nutritional Status of elderly in Rural India. Journal of Nutrition for the elderly. 22(4). The Haworth Press. Inc. pp. 35-50.

15. Arlappa. N., Balakrishna. N., Kumar, S. 2004. Nutritional Status of the aged in rural India. Nutrition News. April. Vol.25, No.1&2.

16. Artz, A.S., Fergusson . D., Drinka P.J. et al. 2004. Prevalence of anemia in nursing home residents. Archives of Gerontology and Geriatrics. 39(3). Pp. 201-206.

17. Ashabai, P.V, Murthy, B.N, Chellamariappan, M. et al. 2001. Prevalence of known diabetes in Chennai city .JAPI. Vol.49(10). pp:974-81.

18. Atchley R.C. 1989. A continuity theory of normal ageing. Gerontologist. 29(2).pp:148-149.

19. Bagchi, K. 2001. Healthy aging. Help Age India – Research and Development journal. Vol.6. No.3. pp: 17-21.

20. Bailey, L.B., Wagner, P.A and Christakis, G.J. 1981. Folacin , iron status and hematolagic findings in predominantly black elderly persons from urban low income households. American Journal of Clinical Nutrition. No.32. p: 2346.

21. Baker, J.P., Detsky, A.S and Wesson, D.E. 1986. Nutritional assessment – a comparison of clinical judgment and objective measurements. New England Journal of Medicine. Vol. 306. pp: 969-972.

22. Balcombe, N.R., Ferry, P.G., and Sawairs, W.M. 2001. Nutritional status and well being. Is there a relationship between body mass index and the well being of older people? Current medical research and opinion. Vol.17, No.1. pp:1-7.

23. Balducci, L. 2003. Epidemiology of anemia in the elderly : Information on diagnostic evaluation. Journal of American Geriatrics Society. Vol.51, Issue.3, pp: 2-9.

24. Bamji M.S., Rao, N. and P.Reddy. 2003. Text book of Human Nutrition. Second Edition. Oxford and TBH Publishing Co. Pvt. Ltd. pp: 10-142.

25. Banks, K.L and Mc Guire T.C. 2001. The acute phase protein response in patients receiving subcutaneous IL-6. Clinical and Experimental Immunology. p: 217.

26. Banthia, 2001. Census of India 2001. Series 1. Provisional Population Totals. Register General and Census Commissioner of India.

27. Bassey, E.J. 1986. Demi-span as a measure of skeletal size. Ann. Hum. Bio. No.13. pp: 499-502.

28. Bastow, M.D. 1982. Anthropometrics revisited, Proceedings of Nutrition Society. No.41. pp:381-387.

29. Bates, C.J., Prentice, A and Finch,S. 1999. Gender differences in foods and nutrient intakes and status indices from the National diet and nutrition survey of people aged 65 years and over. Eur. J. Clin Nutr : 53(9). pp:694-699.

30. Bauer E.,M., Cristina M. Jeckel. M. and Luz. C. 2009. The Role of stress Factors during ageing of the Immune System. Annals of the New York Academy of Sciences 1153:1. 139-152.

31. Bauer J M., Voldert D and Wirth R et al. 2007. Diagnosing malnutrition in the elderly. Atsch Med. Wochenschr 131(5). Pp: 223-227.

32. Baweja, S., Agarwall, H, Mathur, A et al. 2008. Assessment of nutritional status and related risk factors in community dwelling elderly in Western Rajasthan. Journal of the Indian Academy of Geriatrics. Vol.1. p. 5-13.

33. Beard L.J. 2001. Iron Biology in Immune Function, Muscle Metabolism and Neuronal Functioning. Journal of Nutrition. Vol.131. pp:568S-580S.

34. Beck, A.M., Ovesen, L. 1999. Modification of nutrition questionnaire for elderly to increase its ability to detect elderly with inadequate intake of energy, Calcium, Vit. D and Vit. C. European Journal of Clinical Nutrition. Vol. 53. pp560-590.

35. Beghe C., Wilson A., Ershler W.B. 2004. Prevalence and outcomes of anemia in geriatrics: A systematic review of literature. Am. J. Med. 5(116). Suppl. 7A. Pp: 35-10S

36. Benfante, R.J., Reed, D.M., Maclean, C.J., Yano, K. 1990. Is serum cholesterol level a risk factor in coronary heart disease in the elderly? JAMA. Vol.263. pp: 393-396.

37. Bergdahl E., Gustavsson J.M., Kallin K et al. 2005. Depression among the oldest old : the Umea 85+ study. Int. Psychogeriatr 17(4). pp: 557-575.

38. Bermudez, I.O and Dwyer, J. 1999. Identifying elders at risk of malnutrition : A universal challenge. CAN News. No.19.p.41

39. Berner Y.N. 2003. Assessment tools for nutritional status in the elderly, Isr Med. Associ. J 5(5), Pp: 365-367.

40. Bernstein, I.L., Bernstein, I.D. 1981. Learned food aversions and cancer anorexia. Cancer Treat. Rep 65 (Suppl 5). Pp: 43-47.

41. Bernstein, M.A, Tucker, K.L. Ryan, N.D et al. 2002. High Dietary Variety Associated with better nutritioned status in frail elderly people. J. Am. Diet Assoc. 102(8). Pp: 1096-104.

42. Bhooma, N, and Chitra, P. 2005. Trace Minerals, Calcium and Magnesium profile of institutionally elderly. The Ind. J. Nutr. Dietet. Vol.42. pp: 201-206.

43. Bhosale, B, and Devi. R. 2008. Health Status of Institutionalised elderly. Indian Journal of Gerontology. Vol.22, No.2. pp: 227-232.

44. Bidlack, W.R. and Wang, W. 1996. Nutrition requirements in elderly. In Geriatric Nutrition : a comprehensive review. ed. JE Morley. Z. Glick. LZ Rubenstein. pp: 25-49. New York. Raven Press.

45. Bilehal, and Naik, K.R.1999. Clinical and biochemical profile of free living elderly. NSI XXXII Annual Meet, Scientific Prog & Abstracts.

46. Bingham, S.A. 1987. Dietary intake assessment of individuals : methods, accuracy, new techniques and recommendations. Nutrition abstracts and reviews. Vo. 57. pp: 705-742.

47. Biovert, W.A., Russel, R.M.1993. Riboflavin requirement of healthy-Elderly humans and its relationship to macronutrient composition of the diet. Journal of Nutrition. Vol.123. pp: 915-925.

48. Bird, A. 2007. Perceptions of epigenetics. Nature 447. pp: 396-398.

49. Bishop, C.W., Bowen, P.E., Ritchey, S.J. 1981. Norms for nutritional assessment of American adults by upper arm anthropometry. Am. J. Clin. Nutr. Vol.34. p: 2530.

50. Bjornthorp, P. 1988. The association between obesity. Adipose tissue distribution and disease. Acta Med. Scand. No.223 (Suppl.). pp:121-134.

51. Blanchard, J. 1990. Vitamin C disposition in young and elderly men – American Journal of Clinical Nutrition. Vol. 51. pp:837-845.

52. Bleda, M.J., Bolibar, I., Pares, R., Salva A. 2002. Reliability of the MNA in institutionalized elderly people. J. Nutr Health Aging. Vol.6, pp: 134-137.

53. Boisvert, W.A., Russen, R.M. 1993. Riboflavin requirement of healthy elderly humans and its relationship to macronutrient composition of the diet. Journal of Nutrition. Vol. 123. pp: 915-925.

54. Bonnefoy M., Jauffret M., Kostka.T., Jusot J.F. 2002. Usefulness of calf circumference in assessing the nutritional status of hospitalized elderly people. Gerontology. Vol. 48. pp.162.169.

55. Borreli.R., Cole T.J. Di Blasé and Contaldo, F.1989. Some statistical considerations on dietary assessment methods. Lur. J.Colin Nutr. 43. pp: 453-460.

56. Bose, K., Bisai. S and Chakraborty F. 2006. Age variations in Anthropometric & body composition characteristics and underweight among male Bathundis – a tribal population in Orissa, India. Coll. Anthropol. Vol.30. pp. 771-775.

57. Bouillanne. O., Golmard, J.L., Coussieu. C. et al. 2007. Leptin a new biological marker for evaluating malnutrition in elderly patients. Eur J Clin Nutr. 61(5). pp: 647-654.

58. Boukaiba, N., Flament,C and S Acher et al.1993.A physiological amount of zinc supplementation: effects on nutritional, lipid, and thymic status in an elderly population. American Journal of Clinical Nutrition. The American Society for Clinical Nutrition, Inc. Vol 57. pp:566-572 .

59. Bowman, B. and Rosenberg, I.H. 1984. Assessment of the nutritional status of elderly. American Journal of Clinical Nutrition. No.35, p: 1142.

60. Brahmam, GNV. 2005. Changing Profile of the aged in India. Conference on Nutrition and Self Care for Healthy Aging. NIN. Hyderabad. Pp:1-2, 3-4.

61. Brahman GNV. 2007. NNMB in India – an overview. Indian Journal of Community Medicine. Vol.32. No.1.p;7

62. Browne, J.P, Boyle, C.A, Mc Gee H.M. et al., 1994. Quality of Life Research Vol.3, pp: 235-244.

63. Burden, S.T., Bodey, S., Bradburn. Y.J. 2001. Validation of a nutrition screening tool, Journal of Human Nutrition and Dietetics. Vol. 14, pp: 269-275.

64. Burg, K., and Gazibarich, B. 1999. Nutritional risk among a sample of community living elderly attending senior citizen's centers. Australian J. Nutr. Dietet. Vol.56. No.3. pp: 137-143.

65. Burns,A.,Lawlor,B and Craig,S.2002.Journal of Psychiatry.no:180.pp:161-167

66. Butler, R.N., 1992. Quality of life – How can it be measured? Am. J. Clin. Nutr. Vol. 5. pp: 1267-1270.

67. Butt M.L, Philips K.M .1984. Anthropometric norms in the elderly. Brit. J.Nutr. 51. pp. 165-169.

68. Cains, W.S., and Gent, J.F. 1991. Olfactory sensitivity : reliability, generality and association with aging, J. Exp. Psychol. Hum. Percept. Perform 17. pp: 382-391.

69. Calle, E.E., Thun, M.J, Petrelli, J.M et al. 1999. Body Mass Index and mortality in a prospective cohort of US adults. N. Engl J. Med. Vol.341. pp. 1097-1105.

70. Campbell, A.J. and Buchner, D.M. 1997. Unstable disability and the fluctuations of frailty. Age Ageing. Vol. 26. pp: 15-18.

71. Campbell, A.J., Robertson, M.C., Gardner, M.M. 1997. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. British Medical Journal. Vol. 315. pp: 1065-1069.

72. Campbell, W.W., Evans, W.J. 1985. Protein requirements of elderly people. European Journal of Clinical Nutrition. Vol. 50. pp: 180-185.

73. Carmel. R. 1988. Food Cobalamine malabsoaption occurs frequently in patients with unexplained low serum cobalamin levels. Archives of Internal Medicine Vol. 148. pp : 1715-1719.

74. Carstensen L.L.,Fung H.H and Charles T.S.2003.Socioemotional Selectivity theory and regulation of emotion in the second half of life.Motivation and Emotion.Springer Publ.27(2).pp:103-107.

75. Castel H., Shahar D and Harman Bochm I. 2006. Gender differences in factors associated with nutritional status of older medical patients J. Am. Coll. Nutr. 25(20), Pp: 128-134.

76. Castenada, C. 1995. Elderly women accommodate to a low protein diet with losses of body cell mass, muscle function and immune response. American Journal of Clinical Nutrition. Vol. 62, pp: 30-39.

77. Cederholm, C. and Hellerstrom, K.1992. Nutritional status and recently hospitalized and free living elderly subjects. Gerontology. Vol. 38. pp: 105-110.

78. Census Report. 2001 .<http://censusindia.gov.in/> accessed on July 3,2010.

79. Cereda. E., Pedrolli, C and Gini A .2009. Disease specific versus standard, nutritional support for the treatment of pressure ulcer in older adults. J.Am Geriatr Soc. Aug 57(8). pp: 1395-402.

80. Chacko, A., Joseph. A. 1990. Health Problems of elderly in rural south India. Indian Journal of Community Medicine. Vol. XV (2). pp.70-73.

81. Chadha, N.K. 1997. Theories of Ageing. Ageing and the aged – Challenges before Indian Gerontology. Friends Publications. New Delhi. pp: 142-159.

82. Chan, D.K.Y., Woo, J and Ho, S.E. 1998. Risk factors for Parkinson's disease in a Chinese population. J. Neurol. Neurosurg Psychia. Vol. 65. pp: 781-784.

83. Chandra, R.K. 1997. Nutrition and the immune system-an introduction. American Journal of Clinical Nutrition. 66. pp. 460S-463S.

84. Chandra, R.K.1998. Nutrition and immunity in old age. Nutrition Research Reviews .Vol.4 .Cambridge University Press. pp. 88-93.

85. Chandrasekhar, U and Bhooma. N. 1999. Geriatric Nutrition – A study of the elderly, National Institute of Nutrition proceedings of annual meet, pp. 77-79.

86. Chapman, K.M. Ham, J.O. Pearlman, R.A. 1996. Anthropometric indices in elderly. Journal of Gerontological and biological sciences. 51,4 pp: 261-269.

87. Charles R.P. 1998. Nutritional Assessment Methods for the Older Irish Adult in the Clinical and Community Settings. Proceedings of the Nutritional Society. 57. pp. 599 – 602.

88. Chatta, Gurkamal, S and Lipschitz D.1999. Anemia : In principles of Geriatric Medicine and Gerontology. Hazzard, Blass and Ouslander ed., 4th edn, Mc Graw Hill. pp: 899-906.

89. Chaudhary. T.P.S. 1991. A hand book of methodology of Research, Sri Ramakrishna Mission Vidyalaya Press, Coimbatore. Pp. 111.

90. Chen. L.H., Fan Chiang, W. 1986. Biochemical evaluation of Vit B6 status of institutionalized elderly. Int. J. Vit Nutr. Res. Vol. 51. pp: 231-238.

91. Chernoff, 2001. Nutrition and Health Promotion in older adults. Journal of Gerontology. Vol.56(a). pp:47-53.

92. Chernoff, R. 1994. Meeting the nutritional needs of elderly in institutional setting. Nutrition Reviews. Vol.52. No.4. pp: 132-136.

93. Chernoff.R. 2006. Geriatric nutrition: the health professional's handbook Jones and Bartlett publishers. p:223.

94. Chhabra, S.K. 2008. Using armspan to derive height : Impact three estimates of height on interpretation of Spirometry. Annals of Theracic Medicine. Vol. 3. No.3. pp: 94-99.

95. Chiari MM, Bagnoli R, De Luca PD, Monti M, Rampoldi E, Cunietti E. 1995. Influence of acute inflammation on iron and nutritional status indexes in older inpatients. J Am Geriatr Soc. Jul.43(7).pp:767-71.

96. Chilima, D.M and Ismail, S.J. 1998. Anthropometric characteristics of older people in rural Malawi. Eur. J. Clin. Nutr. Vol.52, pp.643-649.

97. Chilma M.D. and Ismail S.J. 2000. Nutrition and Hand grip strength of older adults in Rural Malawi. Public Health Nutrition. 4(1). Pp. 11-17.

98. Chin, H., 1996. Vitamin B12 deficiency and dementia, Int J. Geriatr. Psychiat. Vol. 11. pp: 851-885.

99. Christensen, L. 1997. The effects of Carbohydrate. Nutrition. Vol.13. pp:503-504.

100. Christensen. H., Korten. A and JormA,F et al. 1996. Activity levels and cognitive functioning in an elderly community sample.Age and Ageing. January issue.pp:45-60

101. Christenson, L. 2002. Evaluation of nutritional assessment technique in elderly people newly admitted to municipal care. European Journal of Clinical Nutrition. 56(9). Pp 810 – 818.

102. Christenson, L., Unossons, M and Ek A.C.2003. Measurement of perceived health problems as a means of of detecting elderly people at risk of malnutrition. J. Nutr Health Aging. Vol.7, pp: 257-262.

103. Chumlea WMC and Guo, S.1992. Equations for predicting stature in white and black elderly. Journal of Gerontology. No.47. pp: M197-203.

104. Chumlea WMC., Guo, S. and Vellas, B. 1994. Anthropometry and Body Composition in the Elderly, Facts and Research in Gerontology. Supplement : Nut;ration, Serdi Publishing Company. France. pp:61069.

105. Chumlea WMC., Roche, A.F. and Webb, P.1984. Size, subcutaneous fat and total body fat in the elderly. International Journal of Obesity. Vol.8. pp: 311-318.

106. Chumlea, D., and Ismail, S.J. 1998. Anthropometric characteristics of older people in Malawi. Eur. J. Clin. Nutr. No.52. pp: 643-649.

107. Chumlea, WMC. 1996. Mechanical and physiologic modifiers and bioelectrical impedance spectrum determinants of body composition. American Journal of Clinical Nutrition. 64. pp 413 – 225.

108. Clarke, D.M., Wahlquist, M.L., and Strauss, B.J.G. 1998. Under eating and under nutrition in old age : integrating bio-psychosocial aspects. Age Ageing. No.27. pp: 527-534.

109. Clarke, R., Briks, J., Nexo, E., Scott, J., Molloy, A., and Evans J.G. 2007. Low vitamin B_{12} status and risk of cognitive decline in older adults. American Journal of Clinical Nutrition. Vol. 86 (5). pp: 1384-1391.

110. Clayton, D., and Gill, C. 1997. Measurement error, Design concepts in nutritional epidemiology, 2nd Ed, Chp.4, Oxford University Press.

111. Cobbs, L.E. and Duthie, H.E. 2001. Osteoarthritis. A care curriculum in Geriatric medicine. Geriatrics Review Syllabus. Hunt Publishers. New Delhi. 4th Edn. pp: 226-230

112. Cockburn, J and Smith, T.P. 1999. The Relative influence of intelligence and age on everyday memory. Journal of Gerontology.Vol.46. No.1. pp: 31-36.

113. Coelho A.K., Rocha L.F and Fausto A.M. 2006. Prevalence of undernutrition in elderly patients hospitalized in a geriatric unit in Belo Horizonte, Brazil, Nutrition. Vol. 22.No.3 pp: 1008-1011.

114. Coleman, P and Krondal. 1993. Social factors in nutrition of the elderly. Nutrition. Vol.1. No.2. pp: 4-5.

115. Colledge, N.R. 2002. Frail Old People. Davidson's Principles & practice of medicine .19th edn, Churchill Livingston Publishers pp: 238-240.

116. Collins, S., Duffield A., Myatt, M. 2000. Assessment of Nutritional Status in Emergency Affected Populations. European Journal of Clinical Nutrition. Vol. 56. pp: 615-620.

117. Committee on Medicinal Aspects of Food Policy, 1992. The Nutrition of Elderly. Publ. by COMA. pp: 71-75

118. Conceino J. 1993. Study of anthropometric indicators among a population of 224 elderly subjects living in retirement home. L. Annex' gerontolgique. Vol. 23, pp: 26-34.

119. Constans, T., Bacq, Y., Brechot, J.F., Guilmot, J.L., Choutet, P., and Lamisse, F. 1993. Protein Energy Nutrition in elderly medical persons. J. Am. Geriatr. Soc.: Vol 40. pp : 263-268.

120. Cook, K., John, B and Wanda, L. 2002. Trends in Nutritional risks and effect of Nutrition Education among low income Elderly in Manice. Journal of Nutrition for the Elderly. The Haworth Press. Vol. 21(4). pp: 3-18.

121. Corish, C.A and Kennedy, N.P. 2000. Protein-energy under nutrition in hospital in-patients. British Journal of Nutrition. Vol. 83. pp: 575-591.

122. Correa, B., Merhi, L., Fogace, P. et al. 2009. Care givers education level as a determing factor of nutritional status of individuals cared for at home, J. Nutr Health Aging 13(7). pp.609-14.

123. Corti, C., Guralnik, J.M., Salive, M.E and Sorkin J.D. 1999. Serum Albumin level and physical disability of predictor of mortality in older persons. Journal of American Medical Association. Vol.27. No.2. pp: 1036-1042.

124. Corti, M.C, Guralnik, M.J, Salive, E. M. et al. 1999.Clarifying the direct relation between total cholesterol levels and death from coronary heart disease in older persons. Annals of Internal Medicine. Vol.126. Issue 10. pp: 753-760.

125. Cowart, B.J., Yokomukai, Y. and Beauchamp, G.K. 1994. Bitter taste in aging : Compound specific decline in sensitivity. Physiol, Behav. Vol. 56. pp: 1237-41.

126. Craig J.I.O.,Haynes,A.P.,Ludlam C.A and Mc Clennad D.B.L.2002.Blood Disorders,Davidson's Principles and Practice of medicine.19th ed.Churchill Livingston Publishers.pp:902

127. Crawford, P.B., Eva,O and Morrison, J. 1994. Comparative advantage of 3 day food records over 24 hour recall and 5 day food frequency validated by observation of 9 and 10 year old girls. J. Am.Diet.Assoc., 94, pp: 626-830.

128. Crogan, N.L., and Pasvagel, A. 2003. The influence of protein calorie malnutrition on quality of life in nursing homes. Journal of Gerontology. Vol. 58. pp: 159-164.

129. Cuervo, M., Ansorena, D and Garcia, A. 2009. Assessment of calf circumference as an indicator of the risk of hyponutrition in the elderly .Nutr Hosp. 24(1). p.63.

130. Cumming, E. and Henry E.W. 1961. Two theories of aging. Growing old, the process of Disengagement. Basic Books. New York. pp. 13-21.

131. Cunietti, E., Chiari, M.M., Monti, M. et al. 2004. Distortion of iron status indices by acute inflammation in older hospitalized patients. Archieves of gerontology and geriatrics. 39(1). pp: 35-42.

132. Dandekar, K. 1996. The elderly in India. Sage Publications India Pvt. Ltd. New Delhi.p 1-28.

133. Das, K.S., Sanyal, K. and Basu, A. 2005. Study of urban community survey in India : Growing trend of high prevalence of hypertension in a developing country. International Journal of Medical Sciences. Vol.2. No.2. pp: 70-78.

134. Dawson Hughes, B. 1990. A controlled trial of the effect of calcium supplementation on bone density in post menopausal women. New England Journal of Medicine. Vol. 323. pp: 878-883.

135. Dawson, D., Hendershot, G., & Jutton, J. 1987. Ageing in the eighties : Functional limitations of individuals 65 and over. DHHS Publication No.87. Hyattsville. P: 1250.

136. De Baat, C., Kalk, W and Schuil G.R.E. 1993. The effectiveness of oral hygiene programme for elderly people. Gerodentology. Vol. 10. pp : 109-113.

137. De Groot, L., Van Staveren, W.J and Hautvast, J.G.1991. Euronut – SENECA. Nutrition and the Elderly in Europe, Eur, J. Clin. Nutr. Vol. 45 (Suppl.3). pp:1-5.

138. De Groot, LC, Bec, A.M., Scroll, M. et al. 1998. Evaluating the DETERMINE your Nutritional Health Check list and the Mini Nutritional Assessment as tools to identify nutritional problems in elderly Europeans. Eur J. clin. Nutr. Vol.52, pp: 877-883.

139. De Jong, N., Mulder, J., De Graaf, C. and Van staveren, W.A. 1999. Impaired sensory functioning in elderly : the relation with its potential determinants and nutritional intake. J. Gerontol.

140. De Lappe, E., Mc Greevy, C., Grimes H. 2006. Vit. D insufficiency in older female community dwelling acute hospital admissions. European Journal of Clinical Nutrition. Vol. 60. No.8. Nature Publishing Group. pp:1009-1015.

141. De Marchi., F. Hugo., J.and Hilgert, D.2008. Association between oral health status and nutritional status in south Brazilian independent-living older people. Nutrition. Vol.24. Issue 6. pp: 546-553**.**

142. Delacorte, R.R., Moriguti, J.C., Matos, F.D., Pfrimer, K et al. 2004. MNA score and the risk of undernutrition in free living older persons. J. Nutr Health Ageing. Vol.8. pp:531-534.

143. Department of Social and Economic Affairs. 2009. Long Range Population Projections. Population Division of the Department of Economic and Social Affairs. United Nations.

144. Deshmukh, P.R., Maliye, C., Gupta. S.S et al 2005. Does Waist Hip ratio matter? – A study in rural India. Non-communicable diseases. Regional Health Forum. Vol.9, No.2. pp: 28.

145. Deurenberg, P and Roubenoff. R. 2002. Body Composition. Introduction to Human Nutrition. pp: 53-56.

146. Dey, D.K., Rothenberg, E, Sundh. V et al. 2001. Body Mass Index., Weight Change and mortality in the elderly. A 15 year longitudinal population study of 70 year olds. Eur J. Clin Nutr. Vol.55. pp: 482-492.

147. Dilip, T.R. 2001. The Burden of ill health among elderly in Kerala. Help Age India. Research and Development Journal. Vol.7, No.2. pp: 7-15.

148. Dilip, T.R. 2007. Age – specific analysis of Reported Morbidity in Kerala. World Health and Population. Vol.9. No.4. p 3-5.

149. Dipictro, L., Seeman, J.E., Katz, L.D., and Nadal, E.R. 1998. Moderate intensity aerobic training improves glucose tolerance in aging independent of abdominal obesity. J. Am. Geriate Soc. Vol. 46. pp: 875-879.

150. Dodd, N.S. 1999. Constipation in the elderly. Help Age India – Research and Development Journal. Vol.5. No.2. pp: 28-34.

151. Donkin, J.M., Johnson, A.E., Lilley, J.M et al. 1998. Gender and living alone as determinants of fruit and vegetable consumption among elderly living in home. Appetite Vol.30. Issue 1, P. 39-51.

152. Dorn, J.M., Schisterman, E.F., Winkelstein, W. et al. 1997. The Buffalo health Study. Am. J. Epidemiol. Vol.146. pp: 919-931.

153. Doty, R.L. 1990. Olfaction. In : Boller, F. and Grafman, J (eds). Handbook of Neuropsychology Elsevier Science Publishers : Amsterdam.

154. Doty, R.L., Shaman, P., Applebaun, S.L., Giberson, R., Siksorski, L., Rosenberg, L. 1984. Smell identification ability : Changes with age. Science.vol. 226. pp: 1441-43.

155. Dovar, B.V .1999. Mental Health of Indian Women : A feminist agenda. Sage. New Delhi.

156. Drewenowski, A 1997. Taste preferences and food intake. Annual review of Nutrition. Vol.17. pp.237-253.

157. Dube, A.K. 1999. The angst aging. Nutrition. 33(3). pp 22- 25.

158. Dudeja, V., Misra, M., Pandey, R.M et al. 2000. High body fat with relatively lower BMI in Asian Indian in Northern India. Diabetes Research and Clinical Practice. Vol.50. Supplement 1. pp: 122-126.

159. Duffy, V.B., Bachstrand, J.R. and Ferris, A.M. 1995. Olfactory dysfunction and related nutritional risk in free living elderly women. J. Am. Diet. Assoc. Vol.95. pp: 879-884.

160. Durnin, J.V. 1989. Anthropometric methods of assessing nutritional status. nutrition in the elderly. Oxford : OUP. Pp: 15-32.

161. Dutta, E. 2002. Greying with grace, Health dialogue. Vol.29. No.3. pp: 10-15.

162. Dwyer, J. 1994. Nutritional problems of elderly minorities. Nutrition reviews. Vol.52. No.8. pp: S25-S26.

163. Edmund, H. and Duthie, H.E. 2001. Osteoarthritis. A care curriculum in Geriatric medicine. Geriatrics Review Syllabus. Hunt Publishers. New Delhi. 4th Edn, : 215-220.

164. Eisenstaed, R, Pennix, B and Woodness, R. 2009. Anemia in the elderly - current understanding and emerging concepts. Blood reviews. Vol. 20. Issue. 4. pp: 213-226.

165. Elango, S, 1998. A study of health and health related social problems in a geriatric population in a rural area of Tamil Nadu, Indian Journal of Public Health. Vol.42(1). pp: 7-8.

166. Elias, Beers, H.M. and Robert. 2000. Diabetes Mellitus. The Merk Manual of Geriatic Medicine. 3rd ed., Publ. by Merk Research Laboratories. Pp: 90-92.

167. Elisat, M. 2001. The treatment of Coronary heart disease : An update. Current. Med. Res. Opin. 17(1). Pp. 18-26.

168. Enas, E.A. 1996. Cooking oil, cholesterol and coronary artery disease. Indian Heart Journal. Vol.48. pp. 423-428.

169. Ezekowitz, J, Mc Alister, F, Armstrong, P. 2003. Anemia is common in heart failure and associated with poor outcomes : insights from a cohort of 12,085 patients with new onset heart failure. Circulation, Vol. 107: pp. 223-225.

170. Falciglia G., O'Connor., J and Gedling, E. 1988. Upper arm anthropometric norms in elderly white subjects. J.Am Diet Associ. 88. pp. 569-574.

171. FAO / WHO joint expert consultation on fats and oils in Human Nutrition. 1994. FAO Food and Nutrition paper No. 57.

172. FAO. 1996. Sixth World Food Survey, Rome, FAO. p:11.

173. Farquhar, I. Summers H.K and Sorkin, A. 2008. The value of innovation: Impact on health, life quality, safety and regulatory research. Research in Human Capital and Development. Vol. 16. Emerald Group Publ. pp: 42-44.

174. Farquhar, M.1995. Elderly people's definitions of quality of life. Social Science & Medicine. Vol. 41. Issue 10. November. pp: 1439-1446 .

175. Fats and oils in Human Nutrition. 1994. Report of a joint FAO/WHO expert consultation Rome. FAO Food and Nutrition Paper No.57.

176. Feldblum I., German L., Castel H., Harman Boehm I and Bilenko N. 2007. Characteristics of undernourished older medical patients and identification of predictors for undernutrition status. Nutr.J. Pp. 36-38.

177. Ferdous, T., Kabir, Z.N., Wahlin, A. et al. 2009. The multidimensional background of malnutrition among rural older individuals in Bangladesh – a challenge for the millennium development goal. Public Health Nutr. Mar 4. pp: 1-9.

178. Ferguson, R.P., O'Connor, P., Crabtree, B., Bachelor, A., Mitchell, J. and Coppola, D. 1993. Serum albumin and pre albumin as predictor of clinical outcomes of hospitalized elderly nursing home residents. J. An. Geriatr. Soc. 41. pp: 545-549.

179. Ferrans, E.C and Powers, M.J. 1998. Quality of Life Index for elderly. Version. III. Research in Nursing and Health. 15, pp:29-38.

180. Ferris, A.M. et al. 1985. Insomnia and nutritional status . Nutr. Res.5. pp: 149-156.

181. Ferris, A.M., and Deffy, V.B. 1989. Effect of olfactory deficits on nutritional status. Annals New York Acad Sci. Vol. 561. pp: 76-87.

182. Ferro-Luzzi, A., Sette, S., Franklin, M., James WPT. 1992. A simplified approach of assessing adult chronic deficiency. Eur. J. clin. Nutr., Vol.46, pp:173-186.

183. Fiatarone, M.A., Neil, E.F., Ryan, N.D. 1994. Exercise training and nutritional supplementation for physical frailty in very elderly people. N Eagl J Med. Vol. 330. pp: 1769: 1775.

184. Finchum,T and Weber, A.J. 2000. Applying Continuity theory to older adults friendships, Journal of Ageing and Identity. Vol.5. No.3.p.3.

185. Fishman, E. 2000. Healthy People – What progress towards better nutrition. Geriatrics. Vol 51.No. 4. pp:38-43.

186. Fletcher, A.E., Bulpitt, C.J.1992. Epidemiologic aspects of cardio vascular disease in the elderly. Journal of Hypertension. Vol.10. Suppl.2. pp: S51-58.

187. Foley, D.J, Monjan, A.A, Brown, S.L, Simonsick C.M . 1995. Sleep complaints among elderly persons : an epidemiologic study among three communities. Sleep. Jul 18 (6). Pp.425-35.

188. Framingham Heart Study. 1993.<www.usda.org.>

189. Franke, R and Chasen, B. 1993. Kerala- Development through Radical Reform. San Francisco Inst. for food and development Policy.pp:11,12

190. Frauenrath C., Volkert D., Oster P. and Schlierf F. 1999. Dietary habits of the aged. Gerontol. 22(1), Pp: 11-15.

191. Friedman, M.I., and Mattes, R.D. 1991. Chemical senses and nutrition. Smell and Taste in Health and Disease. 8th Ed.. Raven Press. New York. pp: 391-405.

192. Friedwald, T.W. 2002. Cardiovascular Disease – Gale Encyclopedia of Public Health. The Gale Group Inc. Mac Millar Reference. USA. New York. pp 212-214.

193. Fries, J.F. 1996. Physical activity, the compression of morbidity and the health of the elderly. JR. Soc. Med. Vol. 89. pp: 64-68.

194. Frisancho, A.R. 1981. New norms of upper limb fat and muscle areas for assessment of nutritional status. Am. J. Clin. Nutr. Vol.34. p: 2540.

195. Friscancho, A.R. 1984. Anthropometric standards for the assessment of growth and nutritional status. The University of Michigan Press, Ann Arobor, USA.

196. Frontera, W.R., Hughes, V.A., Lutz K.J and Evans W.J. 1999. A Cross sectional study of muscle strength and mass in 45-78 year old men and women. J.Appl. Physical. 71:644-650.

197. Ganguli, M., Dube, S and Johnston, M.J . 2000. Depressive symptoms, cognitive impairment and functional impairment in a rural elderly population in India. International journal of Geriatric Psychiatry. Vol.14, Issue.10, pp. 807-820.

198. Garcia A.L., Wagner K., Hothorn T. et al. 2005. Improved prediction of body fat by measuring skinfold thickness, Circumferences and bone breadths. Obes. Tes. 13(3), Pp: 626-634

199. Garcia, S.S., Pena, G.C., Lopez, D.M. et al. 2007. Anthropometric measures and nutritional status in a healthy elderly population. 2007. BMC Public Health. Vol. 7(2), pp: 2-7.

200. Gariballa, S.E., and Sinclair, A.J. 1998. Nutrition, ageing and ill health. British Journal of Nutrition. Vol.80.,pp: 7-23.

201. Garry, P.J.1994. Nutrition and Aging – Geriatric Clinical Chemistry reference values. edited by WR Faulkner and S Meites. American Association for Clinical Chemistry Press. Washington

202. Gary, P.J., Hunt, W.C, Kochler, K.M. 1992. Longitudinal study of dietary intakes and plasma lipids in healthy elderly men and women. Am. J., Clin. Nutr. Vol. 55. pp:682 – 688.

203. Gazotti, C., Albert, A., Pepinster, A et al. 2000. Clinical usefulness of the MNA in geriatric medicine. J. Nutr Health. Ageing. Vol.4. pp: 176-181.

204. Gerber, S. 2003. Nutritional status using the Mini Nutritional Assessment Questionnaire and its relationship with bone quality in a population of institutionalized elderly women. Journal of Nutrition Health Aging. 7. pp 140 – 145.

205. German, L., Feldblum, I., Bilenko, N .2008. Depressive symptoms and risk for malnutrition among hospitalized elderly people. J. Nutr. Health Aging. 12(5) pp: 313-8.

206. German, L., Feldblum, I., Bilenko, N., Castel, H. 2008. Depressive symptoms and risk for malnutrition among hospitalized elderly people. J. Nutr. Health Aging. May Vol 12. (15). pp: 313-318.

207. Gerosvitz M., Madden J.P. and Smiciklas – Wright. 1978. Validity of the 24 hour dietary recall and seven day record for group comparisons. Journal of American Dietetic Association. 73. pp:48-55

208. Gershoff, S.N., Brusis, O.A., Nino, H.V., Huber, A.M., 1977. Studies on elderly in Boston – the effects of iron fortification on moderately anemic people. American Journal of Clinical Nutrition. No.30. p: 226.

209. Ghosh A. 2004.Age and sex variations in measures of body composition among elderly Bengalee Hindus of Calcutta,India. Coll Anthropol. Vol.28:pp:553-561

210. Ghosh, A. 2006. Variation in measures of calf circumference and skinfold by age and Gender among the Elderly Bengalee Hindus of Kolkata. India. Human ecology special issue No.14, pp.153-158.

211. Goldman, N. Korenman, S, Weinstein, R. 1994. Marital status and health among elderly. Proceedings of the annual meeting of population association of America. May 5-7. P.35.

212. Goodwin, J.M and Garry, P.J .1983. Association between nutritional status and cognitive functioning in a healthy elderly population. JAMA. No.249. pp: 2917-21.

213. Goodwin, S.J. 1989. Social, psychological and physical factors affecting the nutritional status of elderly subjects. Am. J. Clin. Nutr. Vol. 50. pp: 1201-9.

214. Goswami, A, Reddaiah, V.P, Kapoor, S.K. et al. 2005. Health Problems and Health seeking behaviour of the rural aged. Indian Journal of Gerontology Vol.19, No.2, pp:163-180.

215. Gottileb, L.G. 1990. Sleep disorders and their management. Special considerations in the elderly. The American journal of Medicine. Vol.88. Issue.3. Supplement.1, pp: S29-S33.

216. Goyal, S and Goyal, N. 1999. Health of the tribal old. Social Welfare. Vol. 45. No.10. pp: 27-29.

217. Grabowsky, D.C., Ellias, J.E. 2001. High BMI does not predict mortality in older people : Analysis of the longitudinal study of aging. J Am Geriatr Soc. Vol. 49 : pp: 968-979.

218. Greenblatt, D.J., 1980. Reduced Serum albumin concentration in the elderly : A report from the Boston Collaborative Drug Surveillance Programme. Journal of American Geriatric Society. pp: 20-27.

219. Greiger, J., Nowson, C.A. 2006. Anthropometric and biochemical markers for nutritional risk among residents in an Australian residential care facility. Asia Pacific Journal of Clinical Nutrition. Vol.16, No.1. pp:178-186.

220. Griep, M.I. 1995. Food odour thresholds in relation to age, nutritional and health status. J. Gerontol. Vo. 50A. pp : 407-414.

221. Griep, M.J., Verleye, G., Franck, A.H., Collys, K., Mets, T.F. and Massar, D.L., 1996. Variation in nutrient intake with dental status, age and odour perception. European Journal of clinical nutrition. Stockton Press. pp: 816-823.

222. Guigoz Y and Vellas, B. 2002. Identifying the elderly at risk for malnutrition-The Mini Nutritional Assessment. Clinical Geriatric Medicine.vol.18, pp 737 – 757.

223. Guigoz Y. 2006. The Mini Nutritional Assessment Review of literature – What does it tell us? J.Nutr. Health Aging 10(6), Pp: 485-487.

224. Guigoz, Y and Vellas, B. 1995. Test to assess the nutritional status of the elderly: The Mini Nutritional Assessment. Med Hyg; Vol.53, pp: 1965-69.

225. Guigoz, Y., and Munro, H.N. 1985. Nutrition and Aging in Handbook of the Biology of aging (Ruich, C.E and Schneider, E.K., Editions. Van Nostrand Reinhold. New York. pp: 878-893.

226. Guo, S.S., Zeller. C., Chumlea. W.C et al. 1999. Ageing, body composition and life style: the Fels longitudinal study. Am. J. clin. Nutr. Vol. 70. pp: 405-411.

227. Gupta S.P. 2003. Statistical Methods. Sultan Chand and Sons. New Delhi. p. 310.

228. Guralnik, M.J., Ershler, B.W., Schrier, S.L et al. 2005. Anemia in the elderly – A public health crisis in hematology. Hematology Jan. pp: 528-532.

229. Hagopian, K., Ramsey J.J and Weindruch, R. 2009. Caloric restriction counteracts age related changes in the activities of Sorbitol metabolizing enzymes from mouse. Biogernotloty. 10(4). Springer pp: 471-479.

230. Hall, K.E. 2008. Gastro intestinal disease. A core curriculum in geriatric medicine. Geriatrics Review Syllabus. Hunt Publishing Company. Pp: 156-158.

231. Ham, J.R., and Soloaine, D.P. 1997. Primary Care Geriatrics. Mosby – Year Book Publishing. New York. 3rd Edn. Pp: 153-165.

232. Hanna, R.I., K. Nanette and Wenger. 2005. Secondary Prevention of coronary heart disease in elderly patients. Journal of American Family Physician. Vol. 71 (22). pp: 89-96.

233. Hartz, S.C., Rosenberg, I.H., and Russel R.M. 1992. Nutrition in the Elderly. The Boston Nutritional Status Survey. Smith – Gordon. London.

234. Hassan, M. 1998. Health Promotion : Prevention and Treatment. Helpage India – Research and Development Journal, Vol.5, No.1, pp: 14-21.

235. Hayflick, L., 1976. The cellular basis for biological aging. New York. NY: Academic Press. pp, : 103-22.

236. Health Information of India .1996. Directorate General of Health Services, MOHFW. Govt. of India. New Delhi.

237. Hebert, R.J., Gupta, C.P and Bhonsle B.R et al. 1998. Development and testing of a quantitative food frequency questionnaire for use in Kerala, India. Public Health Nutrition. Vol.1, No.2. pp: 123-130.

238. Hellstrom Y., Persson G., Hallberg I.R. 2004. Quality of Life and Symtoms among older people living at home, J.Adv. Nurse. 48(6), Pp: 584-593.

239. HelpAge India.2005.Directory of Old age Homes in Tndia. HelpAge India. New Delhi.pp:1-3

240. HelpAge International. 2010. <http://www.helpage.org/research and policy/state of the worlds older people/ > accessed on June 12,2010.

241. Hemalatha, R. 1999. Ageing and Immunity. Nutrition. Vol. 33, No.4. pp: 8-11.

242. Hengstermann. S., Nieczraj R., Steinhagen., Thiessen E and Schulz R.J. 2008. Which are the most efficient items of mini nutritional assessment in multi morbid patients? J.Nutr. Health Aging. 12(2), Pp: 117-122.

243. Henken ,L.B., Hudgens,J., Stechmiller,K and Garcia,H . 2005. Mini nutritional assessment and screening scores are associated with nutritional indicators in elderly people with pressure ulcers. Journal of American Dietetic Association. 105. pp 1590 –1596.

244. Hermann, F. R, Safran, C, Levkoff, S.E et al. 1992. Serum albumin level as a predictor of death, lengh of stay and readmission. Arch Intern Med. Vol.152 (1), pp: 125-130.

245. Hetherington, M.M. 2008. Taste and Appetite regulation in the elderly. Proceedings of the Nutrition Society. Cambridge University Press. pp: 625-631.

246. Hibbeln, J.R and Salem, N. 1995. Dietary PUFA and Depression : When cholesterol does not satisfy. Am. J. Clin. Nutr. Vol. 62. pp: 1-9.

247. Hickey, T. 1992. The continuity of Gerontological themes. International Journal of Ageing and Human Development. Vol. 35. No.1. pp:7-17.

248. Hildebrandt, G., Dominguez, B., Schork, M and Loesche, W. 1997. Functional Units, Chewing, swallowing and food avoidance among the elderly. The Journal of Prosthetic Dentistry. Vol. 77. Issue 6. pp: 588-595.

249. Hirvay, I., and Mahadevia, D, 1996. Critique of Gender Development Index : Towards an alternative. Vol.31. No.43. Economic and Political Weekly. pp: 87-96.

250. Hoffman, N. 1993. Diet in the elderly : Needs and risk. Clinical Nutrition. Vol.77. pp: 745-756.

251. Hoffman,R.,Benz,E.J and Shattil,S.J.2005.Hematology:Basic Principles and Practice.4 th ed.Churchill Livingston Publ.pp:27-33

252. Hollis, J.H. and Henry, C.J.K. 2007. Dietary variety and its effect on food intake of elderly adults. J Hum Nutr. Vol.20. The British Dietetic Association Ltd. pp: 345-351.

253. Horn, S.D. 2005. The National Pressure Ulcer Long-Term Care Study: Pressure Ulcer development in long term care residents Journal of American Geriatric Society. 52. pp 359 – 367.

254. Horwath, C.C. 1989. Dietary intake studies in elderly people. World Review Nutr. Diet. Vol. 59. p : 1070.

255. Horwitt. M.K. 1950. Correlation of urinary excretion with dietary intake and symptoms of riboflavinosis. Journal of Nutrition. Vol. 41. pp: 247-264.

256. Hudgens, J and Henken B.L. 2004. The Mini Nutritional Assessment as an Assessment Tool in Elders in Long-Term Care .Nutrition in Clinical Practice. Vol. 19. No. 5. pp: 463-470 .

257. Hughes. A. Kimberly and Reynolds, M.R. 2005. Evolutionary and mechanistic theories of aging. Annual review of Entomology. Vol.50. pp:421-445.

258. Hurwitz, A at al. 1997. Gastric acidity in older adults. Journal of the American Medical Association. Vol. 278. pp : 659-662.

259. Husaini, A.B, Moore, T.S, Castor, S.R et al. 1991. social density, stressors and depression – Gender differences among black elderly. Journal of Gerontology. 46(5). pp.36-42.

260. ICMR. 2010. Project on Health Care of the Rural Aged. (Phase III) 1984-1988. accessed from http://www.icmr.nic.in/final/hcra_6.html/

261. ICMR.1989.Nutrient Requirements and Recommended Dietary Intakes for Indians.NIN.Hyderabad.

262. ICMR.1991. Mental Health and Ageing. KMR Bulletin. No.19. pp: 1-2.

263. IIPS(International Institute of Population Services) .2009. IIPS News Letter. Vol.50. Numbers 1 and 2. Mumbai.

264. Irvin, H., Rosenberg, Ana Sastri. 1999. Nestle Nutrition Workshop Series. Clinical and Performance Programme. Nutrition and Aging. 6. pp 223 – 234.

265. Ismail S. 1994. Assessing Nutritional vulnerability in older people in developing countries, Nutrition and Healthy ageing. Vol. 18. pp;18-21.

266. Ismail, S, Manandhar M. 1999. Better Nutrition for Older People: Assessment and action. Helpage International. London.

267. Ismail, S. 1999. Assessing nutritional vulnerability in older people in developing countries. ASCN News. No.19.New Delhi.

268. Jackson, J.E, Ramsdell, J.W, Renvall, M et al .1989. Reliability of drug histories in a specialized geriatric outpatient clinic. Journal of General internal medicine Vol. No.1. pp: 39-43.

269. Jagarstad, M., Westesson. A.K. 1979. Folate. Scandinavian Journal of Gastroenterology Vol 14. (Suppl, 53) : 196-202.

270. Jain, M and Purohit, P. 2007. Spiritual intelligence, living status and general health of senior citizens. Indian Journal of Gerontology Vol.21, No.3, pp:314-323.

271. James, W.P.T., Mascie-Taylor, G.O.N., Nongan, N.G., Shetty, P.S., Ferro-Luzzi. A. 1994. The values of arm circumference measurements in assessing chronic energy deficiency in third world adults. Eur. J. Cli. Nutr. No.48, pp: 883-694.

272. James,W.P.T.,Ferro Luizzi and Waterlow,J.C.1988.Definition of Chronic Energy Deficiency in adults-Report of the working party of the intervention dietary energy consultation group.AJCN.42.pp:969-98

273. Janssen, et al. 2005. Body Mass Index is inversely related to mortality in older people. Journal of American Geriatric Society. Vol.53. pp:2112-2118.

274. Jeejeebhoy, K.N and Keith, M.E. 2005. Nutritional Assessment, Clinical Nutrition – The Nutrition Society Text Book Series. Gibney M.J. Elia Metal (eds.). Black Well Publishing. pp: 15-25.

275. Jelliffe, D.B. 1966. The Assessment of Nutritional Status of the Community. WHO.Geneva. P. 61.72.

276. Jialal, J., Vega, G.L., Grundy, S.M. 1990. Physiologic levels of ascorbate inhibit the oxidative modification of low density lipoprotein. atherosilerosis. Vol. 82. pp : 185-191.

277. Johansson. V., Bachrach L M and Carstensen, J. 2008. Malnutrition in a home living older population: prevalence, incidence and risk factors. A prospective study. J.Clin Nurs. P. 29.

278. John, S. and Arulmani, J.J. 2004. Study on the factors contributing to the nutritional status of the elderly. The Ind. J. Nutr. Dietet. Vol.41. pp: 241-247.

279. Johnson and Andrey. 2003. Dietary Intake and Nutritional Status of older Adult Homeless Women – A pilot study. Journal of Nutrition for the Elderly. Vol.23, No.1, pp:1-5.

280. Johnson C.S. 2005. Psychosocial Correlates of Nutritional Risk in Older Adults, Can J Diet Pract Res. 66(2), Pp: 95-97.

281. Johnson M.A., Fischer J.G., Bowman B.A. and Gunter E.W. 1994. Iron nutriture in elderly individuals. The FASEB Journal. Vo. 8. pp. 609-621.

282. Jongenelis, K., Pot,A.M., Eisses,A.M and Beekman,A.T. 2004. Prevalence and risk indicators of depression in elderly nursing home patients. J. Affect Disord. Dec. Vol.83. No.2. pp: 135-42.

283. Jorgensen, T, Johansson, S, Kennerfalk. A et al. 2001. Prescription drug use, diagnoses and healthcare utilization among the elderly. The annals of pharmacotherapy. Vol.35. No.9. pp:1004-1009.

284. Joseph, A, V.R. Kutty, C.R. Soman. 2000. High risk of coronary heart disease in Thiruvananthapuram City. Indian Heart Journal. Vol.52. No.1. pp: 29-35.

285. Joshi, S.A. 2002. Nutrition and Dietetics. Second edition. Tata Mc Grow Hill Publishing Company Ltd., p.383.

286. Joshi, S.V, Menson, K.S, Sawant, S.M et al. 2006. Demographic Health Profile in Urban and Rural Elderly Population, Indian Journal of Gerontology. Vol.20 No.11, pp: 337-346.

287. Jyrkka, J., Vartiainen, L., Hartijkainen. S et al. 2006. Increasing use of medicines in elderly persons : a five year follow up study. European Journal of Clinical Pharmacology Springer Berlin / Heidelberg. Vol.62, No.2, pp: 151-158.

288. Kalavathy, M.C., Thankappan, K.R., Shankara Sarma.. P., and Vasan V.R. 2000. Prevalence, awareness, treatment and control of hypertension in an elderly community based sample in Kerala. Natl Med. J. India. Vol.13. pp: 9-15.

289. Kamalamma, N and Selsa, S. 2000. Urban Elderly Women – Problems and Solutions. Social Welfare. Vol.47, No.3. pp: 30-33.

290. Kapur, R.L and Shah, A. 1992. A Psychosocial perspective of women's mental health in women in development III : Gender Trainer's Manual. Sakthi. Bangalore.

291. Katz, S. and Akpom, C.A. 1976. A measure of primary sociological functions. International journal of health services. Vol 6. pp:493-507.

292. Katz, S., Downs T.D. and Cash H.R. 1970. Progress in Devlopment of the Index of ADL. Gerontology. Vol. 10. pp: 20-30.

293. Kaufman, W.D, Kelly, J.P, Rosenberg, L et al., 2002. Recent patterns of medicine use in the ambulatory adult population of the United States, JAMA, Vol.287, No.3, pp: 337-344.

294. Kaur, P., Radhakrishnan, E., Sankara Subhaiyan, S., Rao. S.R et al. 2008. A comparison of anthropometric indices for predicting hypertension and type 2 diabetes in a male industrial population of Chennai, South India. Ethnicity and Disease. Vol.18, No.1. pp:31-36.

295. Kaurich, M. 1991. The oral cavity and nutrition. In Morley, J.E. Glick, Z., Rubenstein, L.Z. (eds). Geriatric Nutrition : A comprehensive review. Raven Press. New York. pp: 225-231.

296. Kerala Aging Survey. 2005 <www.govt.of Kerala.org>

297. Kerketta, A.S., Bulliyya, G., Babu, B.V et al. 2009. Health status of the elderly population among four primitive tribes of Orissa, India : a clinico – epidemiological study. Z. Gerontol Geriatr. 42(1). pp: 53-9.

298. Khokhar, A and Mehra, M. 2001. Lifestyle and morbidity profile of geriatric population in an urban community Delhi. Indian J.Med Sci. Vol.55. pp: 609-615.

299. Khongdier, R. 2005. BMI and morbidity in relation to body composition: a cross sectional study of a rural community in North East India. Br. J. Nutr. Vol.93, pp: 101-107.

300. Kikafunda, J.K., Lukwago, F.B. 2005. Nutrition. Vol.21. P.59.

301. Kim K.K., Yu.E., Liu W.T., Kim, J., Kohrs M.B. 1993. Nutritional status of Chinese, Korean and Japanese American elderly. J.Am Diet Assoc. 93. pp. 1416-1422.

302. Kimura, Y., Wada T., Ishine M et al. 2009. Community dwelling elderly with chewing difficulties are more disabled, depressed and have lower quality of life scores. Geriatr Gerontol Int. Mar 9 (1). pp: 102-4

303. Kirkeby, O.J, Risoe, C, Vikland, R. 1989. Significance of a high ESR in general practice. Br J Clin Pract. Vol. 43(7). Pp: 252-4.

304. Kishore, S, Garg, B.S. 1997. Socio medical problems of aged population in rural area of Wardha District. Indian Journal of Public Health, Vol.41(2), pp: 43-48.

305. Koehler, K.M., Romera, L.J., Baumgartner, R.N., and Garry, P.J. 1997. Folate Nutrition and Older Adults. challenges and opportunities. Journal of the American Dietetic Association. Vol. 97. No.2. pp: 167-173.

306. Kostika, 2002. Nutritional risk of elderly. Clinical Nutrition. Vol.11(3). pp: 41-48.

307. Kothari C.R. 1991. Research Methodology – Methods and Techniques, Second Ed. Wiley eastern Limited, New Delhi. pp: 54-56.

308. Kouris – Blazos. A et al. 1999. Are the advantages of Mediterranean diet transferable to other populations? A cohort study in Melbourne, Australia. British Journal of Nutrition Vol. 82: pp. 57-61.

309. Krasinki S.D. et al. 1986. Fundic atrophic gastritis in an elderly population. Effect on hemoglobin and several serum nutritional indicators. Journal of the American Geriatrics Society. Vol. 34, pp : 800-806.

310. Kullah K.M and Ramanath T. 1985. Nutritioanl status of aged in rural areas of Andhra Pradesh. India J.Nutr. Diet. 22(11). Pp. 330-336.

311. Kumar, S.2005. Ageing in India – An anthropological outlook. Help Age India – Research and Development Journal. Vol.2. No.1. pp :41-44.

312. Kumar,K.V., Sivan, Y.S., Das, R.R. and Kutty, V. 1994. Health of Elderly in community Transition Survey in Thiruvananthapuram city, Kerala. Health Policy and Planning. Vol. 9, No. 3. pp: 331-336.

313. Kurpad, A.V. 2004. Body Composition and BMI criterion for Indians. NFI silver jubilee seminar “Towards National Nutrition Security” proceedings. NFI, New Delhi.

314. Kuzuya, M, Izawa, S and Enoki, H. 2007. Is serum albumin a good marker for malnutrition in the physically impaired elderly? Clinical Nutrition Vol.26, No.1, pp: 84-90.

315. Kuzuya, M, Kanda, and Koike, T. 2005. Lack of correlation between TLC and nutritional status in elderly clinical nutrition. Nutrition. Vol.24. Issue. 3, pp: 427-432.

316. Kuzuya, M., Kanda, S and Koike, T .2005. Evaluation of Mini Nutritional Assessment for Japanese frail elderly. Nutrition. Vol.21. pp: 498-503.

317. Kwok, T and Whitelaw, M.N. 1991. The use of arm span in nutritional assessment of the elderly. J. Am. Geriatr. Sc. No.39. pp: 492-496.

318. Kwok. T., Woo J., Chan H H. and Lau E. 1997. The reliability of upper limb anthropometry in older Chinese people, Int. J. Obes Relat. Metab. Disrod, 21(7), Pp:542-547.

319. Lakshminarayanan, T.R. 1999. Adjustment Problems are related to deprivations in life among pensioners. Journal of Psychological Research, Vol.43(1). pp. 73-76.

320. Laugue, S., Soleithavoup, C., Faisant, C., Ghisofi Marque and Bertiere, M.C. 1995. Prospective study of the consequences of retiring on nutritional intake : Preliminary study, facts and research in Gerontology. Supplement, Nutrition. pp: 133-139.

321. Leaf, A. 1992. Ageing : Nutrition and the quality of life. American Journal of Clinical Nutrition. Vol.55. pp: 1191-1270.

322. Leelahagul, P. 1995. Current status on diet related chronic diseases in Thailand. Intern Med. Vol.11. pp: 28-33.

323. Lehmann A.B., Bassey. F.J., Morgan K and Dallosso H.M. 1991. Normal values for weight. Skeletal size and Body Mass Indices in 890 men and women aged over 65 years. Clinical Nutrition. 10, 18-22.

324. Lemonnier D., Acher S. and Boukaiba N et al. 1991. Discrepancy between anthropometry and biochemistry in the assessment of nutritional status of the elderly.

325. Lockenhoff E.C. and Carstensen L.L. 2004. Socio emotional selectivity theory. Aging and Health. Journal of Personality. Vol. 72 (6). Blockwell Publishing. Pp.16-21.

326. Lopez, D.R.M. Torres, R.M., Lopez, C.M. 2003. Nutrition. 19. pp 767 – 771.

327. Lovat L.B. 1996. Age related changes in gut Physiology and Nutritional status. Gut 38(3), Pp: 306-309.

328. Lowenstein, F.W. 1990. Nutritional requirements of the elderly, Nutrition, Aging and Health. Alan R Liss Inc. pp: 52-53.

329. Lowink, M.R.H., Van Den Berg, H., Odin, K.J. and Van Houten, P. 1992. Marginal nutritional status among institutionalized elderly women as compared to those living independently. J. Am. Coll. Nutr. Vol.11. pp : 673-681.

330. Lucia ,de E.,Lemma ,F.,Tesfaye,F.2002.The use of armspan measurement to assess the nutritional status of adults in four Ethiopian ethnic groups.European Journal of Clinical Nutrition.vol.56.pp:91-95

331. Lucia, E., Lemma, F., Fesfaye, F., Demisse, T and Ismail, S. 2002. The use of arm span measurement to assess the nutritional status of adults in four Ethiopian ethnic groups. Eur. J. Clin. Nutr. No.56. pp: 91-95.

332. Luthra. P:N. 1991. Do not segregate the aged from the mainstream. Social Welfare. Vol.38, No.3. pp:35-36.

333. Mac Rac, P.G., Asphind, L.A., Schnelle, J.F., Ouslander, J.G., Abraham, A. and Morris, C. 1996. A walking programme for nursing home residents – effect on physical activity, morbidity and quality of life. J. Am. Geriatric Society. Vol. 178. p: 80.

334. Mackintosh, H.T and Hankey, N.F. 2001. Reliability of a nutrition screening tool for use in elderly day hospitals. Journal of Human Nutrition and Dietetics. Vol.14. pp:129-136.

335. Mahan, L.K. and Escott Stump. 2000. Krause's Food. Nutrition and Diet Therapy. 10 edn. W.B. Saunders Company. pp:167, 462.

336. Malik, R. 2007. Vit. D and Secondary hyperparathyroidism in institutionalized elderly. Journal of Nutrition for Elderly. Vol.26. No.4. pp: 119-130.

337. Mallick, A. 2003. Elderly widows need protection. Social Welfare. Vol.2 : pp: 28-30.

338. Manandhar, M.C., Anklesaria, P.S and Ismail S.J .1997. Weight, Skinfold and Circumference characteristics of poor elderly people in Mumbai, India. Asia Pacific J. Clin Nutr. Vol.6, No.3, pp: 191-199.

339. Marcus, L.E., and Berny, M.E. 1998. Refusal to eat in the elderly. Nutrition Reviews. Vol. 56. No.6. pp: 163-171.

340. Mari Bhat, P.N. 2002. Changing demography of elderly in India. Current Science. Vol.63. no.8. pp:440-48.

341. Markides, S.K and Ferrell, J. 1985. Marital Status and depression among Mexican Americans, Social Psychiatry and psychiatric Epidemiology published by Steinkopff. Vol. 20, no.2, pp:86-91.

342. Marshall, T.A., Stumbo, P.J., Warren, J.J., Xie, X.J. 2001. Inadequate nutrient intakes are common and are associated with low diet variety in rural community dwelling elderly J. Nutr. 131(8). Pp: 2192-6.

343. Mattila. K., Maaristo, M.T. Rajala., S .1986. Body Mass Index and Mortality in the elderly. British Medical Journal 292, 867-868.

344. Mayer Davis, E.J., Agostino, R., Karter, A.J. 1998. Intensity and amount of physical activity in relation to insulin sensitivity. JAMA Vol. 279. pp: 669-674.

345. Mc Ardle, A., Vasilaki, A and Jackson, M. 2002. Exercise and skeletal muscle ageing : Cellular and molecular mechanisms. Ageing research reviews. Vol.1, Issue 1. pp: 79-93.

346. Mc Pherson R.A and Pincus M.R.2007.Henry's Clinical diagnosis and managementby laboratory methods.21st ed.W.B Sounders Publishing Co.Philadelphia.pp:461-470

347. Medhi, G.K., Hazrika, N.C., Borah, P.K and Mahanta, J. 2006. Health problems and disability of elderly individuals in two population groups from same geographical location. J Assoc Physicians India.54 p:539

348. Meguid, M and Laviano, A .1999. Clinical examination, Nutritional Status, Encyclopedia of Human Nutrition. Vol.3. Academic Press. pp. 1373-1388.

349. Mehta, B. 2001. Self appraisal of elderly in slums of Vadodara city. Help Age India – Research and Development Journal. Vol. 7. pp: 2-22.

350. Mehta, B. and Thakore, P. 1995. Effect of Ageing on taste sensitivity, Food preferences and dietary intake of female population of Baroda City. The Indian Journal of Nutrition and Dietetics. 33(11), pp: 11-14.

351. Mehta, P and Shringarpure, B. 2000. Diet, Nutrition and Health profile of elderly population in urban Baroda. Indian Journal of Public Health. Vol.44(4). pp: 75-78.

352. Menon, V., Kumar. K.V., Gilchrist A., Sugathan T.N et al. 2006. Prevalence of known and undetected diabetes and associated risk factors in central Kerala – ADEPS. Diabetes Res Clin Pract : Vol.74, Pp. 289-94.

353. Methilda, M. and Prakash, J. 1998. The social and ecological stress of daily life of the elderly in a religious order. Ind Jr. Ger. 12 (3&4). Pp: 94-101.

354. Meydani, S.N., Ribaya M, J.D., Russell, R.M., Sahyoun, N., Morrow, F.D., Gershoff, S.N., 1990. Effect of Vitamin B6 on immune response of healthy elderly. Annals NY Acad Sci. Vol. 587. pp: 303-306.

355. Mian, L.C., Mc Dawell, J.A. and Heaney, L.K. 1994. Nutritional assessment of the elderly in ambulatory case setting. Nurse. Pract. Forum. Vol. 5(1). pp: 46-51.

356. Miccozzi M.S and Harris T.M. 1990. Age variations in the relation of body mass indices to estimates of body fat and muscle mass. Am. J. Phis. Anthopol; Max., 81(3), pp: 375-9.

357. Michael, J.P., Lesourd ,B., Conne, P., Richard, D and Rapin C.H. 1991. Prevalence of infections and their risk factors in geriatric institutions : a one day multi centre survey. WHO Bulletin. Vol 69. pp : 35-41.

358. Mickey, S. 1992. Elderly Patients in Critical Care: An Overview AACN Advanced Critical Care. Vol. 3(1). Pp. 120-128.

359. Miller, D.K., Marley, J.E., Rubenstein, L.Z. et al. 1990. Formal Geriatric instruments and the care of elderly general medical outpatients. J. Am. Geriatr. Soc. Vol. 38. pp : 645-650.

360. Miller, W.J, Beaudel, M.P, Chen, J. et al. 1994-95. National Population Health Survey Overview (Statistics Canada Catalogue 82-567) Ottawa : Ministry of Industry.

361. Minten V.K.A.M., Lewik M.R.H., Deurenberg P., Kok, FJ. 1991. Inconsistent associations among anthropometric measurements in elderly Dutch men and women. J.Am. Diet. Assoc. 91(11). Pp. 1408-1412.

362. Mistretta, C.M. 1984. Aging effects on anatomy and neurophysiology of taste and smell. Gerodontology. Vol. 3. p: 131-49.

363. Miyazaki, et al. 2002. Effects of low Body Mass Index and smoking on all cause mortality among elderly Japanese. Journal of Epidemiology. Vol.12. pp: 40-44.

364. Mohamed, E, Rajan Irudaya, Anil Kumar. K et al. 2002. Gender and Mental Health in Kerala. Report by Institute of Social Studies Trust, Centre for Development Studies, Trivandrum.

365. Mohan, V., Deepa, M., Deepa, R et al. 2006. Secular trends in the prevalence of diabetes and glucose tolerance in urban south India – the Chennai Urban South India – the the Chennai Urban Rural Epidemiology Study (CURES-17). Diabetobgia. Vol.49: pp. 1175-8.

366. Mohanty M., Maulik Ghosh S.K. 2003. Observation on Physical conditions of elderly Santhals of Orissa. Help Age India – Research and Development Journal. Vol. 9, No.2. pp: 10-16.

367. Mohanty, S.P., Babu, S.S. and Nair S.M. 2001. The use of arm span as a predictor of height : A Study of South Indian Women. Journal of Orthopaedic Surgery. Vol. 9. No. 1. pp: 19-23.

368. Mohapatra, G.B., Kerketta, S.S., Jangid A.S et al. 2002. Status of Anemia with paudi Bhuniya Primitive tribal population of Sundergarh Dist. Orissa. IJND, Vol.39. pp.117-120.

369. Moli, K.G. 2004. Ageing in Kerala. Kerala Calling. Vol. 24, No.10. pp: 10-11.

370. Moody, H.R. 2000. A team paper in Gerontology. Ageing – Concepts and Controversies. 4th Edition.

371. Mora Gandarillas I., Orejas R.A., Bousono G.C. 1996. Nutritional Status assessment in a group of cystic fibrosis patients, An Esp . Pediatr. 44(1), Pp; 40-44.

372. Morley, J. E.1998. Protein Energy Malnutrition in older subjects. Proceedings of the Symposium on Nutrition and the Elderly. Nutrition Society and the Royal College of Physicians of Ireland.Cambridge University Press.Vol.57, pp:587-592.

373. Mowe, M and Bohmer, T. 1991. The prevalence of undiagnosed protein calorie under nutrition in a population of hospitalized elderly, J. Am. Geriatr. Soc. Vol. 39. pp: 1089-1092.

374. Mulligan, J.E., Greene, G.W., and Caldwell, M. 2007. Sources of folate and serum folate level in older adults. Journal of American Dietetic Association. Vol 107(3). pp: 459-499.

375. Murphy. S.P., Davis, J., Neuhaus, L, and Lein, D. 1990. Factors influencing the dietary adequacy and energy intake of older Americans. The Journal of Nutrition Education. Vol. 22. pp: 284-291.

376. N.S.Park 2009. The Relationship of Social Engagement to Psychological Well-Being of Older Adults in Assisted Living Facilities Journal of Applied Gerontology. 28(4): 461-481.

377. Nabi,H.,Kivimaki,M.,Suominen,S et al. 2010.Does Depression predict coronary heart disease and cerebrovascular disease equally well? The Health and social support prospective cohort study. International Journal of Epidemiology. Oxford University Press. April issue. abstract accessed on pubmed.

378. Nandi, P.S, Banerjee, G, Mukherjee, S.P., Nandi. S and Nandi D.N. 1997. A study of psychiatric morbidity of the elderly population of a rural community in West Bengal. Indian journal of psychiatry; 39 : pp. 122-129.

379. Natarajan V.S, Ravindran. S, Sivashanmugam T, Kailash K, Krishnaswamy B, Suresh B. and Prabhu P. 1993. Assessment of nutrient intake and associated factors in an elderly Indian population. Age Ageing. 22. pp. 103-108.

380. Natarajan, V.S. 1999. Prevalence of nutritional disorders in rural elderly, NIN proceedings of annual meet. pp: 73-75.

381. Natarajan, V.S. 2005. Cardiovascular Diseases in the elderly. Proceedings of the Nutrition Society of India. Vol.48. pp:158-164.

382. Natarajan, V.S., Shivashanmugham., Thyagarajan and Karthik. K. 1991. Nutrition in Health and Diseases in the elderly. Roussel Scientific Institute. pp: 5-47.

383. Natarajan,V.S. 1999. Miles to go Ageing. The Hindu Folio on Ageing. Oct. 18. P: 25.

384. National Diet and Nutrition Survey in UK. 1998.

385. National Nutrition Monitoring Bureau. 1984. Report on diet and nutritional status of specific groups of urban population. 1975-79. National Institute of Nutrition. Hyderabad.

386. National Nutrition Monitoring Bureau. 1988-90. Report of NNMB. National Institute of Nutrition. Hyderabad. Annex II.

387. Nayar. P:K.B. 2000. 'The ageing scenario in Kerala – A holistic perspective'. Help Age India. Research and Development Journal. Vol.6, No.2. pp:20-25.

388. Nelson M.F. and Evans, W.J. 1992. Macronutrients and anthropomries. In: Nutrition in the elderly: the Boston Nutritional Status Survey ed Hartz. S C. Russel SC, Russel R.M and Rosenberg. I H Smiwth Gordon. Nishimura. London. Pp.55-64.

389. Neri M.C., Lai.L., Bonetti P. et al. 1996. Prevalence of Helicobacter Pylori infection in elderly impatients and correlation with nutritional status. Age Ageing. 25(1). Pp: 17-21.

390. Neuhaus, R.H. 1982. Successful Ageing. John Wiley and Sons. New York. P: 50.

391. NFHS-www.nfhsindia.org/research.shtml

392. NHANES- http:// www.cdc. gov/nchs /products /elec_ prods/ subject/ nhanes 3.htm

393. NHANES II. 1988-1994. Reported by U S Department of Health and Human Services. Centres for disease control and prevention. National Centre for Health Statistics.

394. NHANES-III Plan and operations 1988-94. Vital Health Stat. J. 1994. July. 32. pp. 1-407.

395. NIN, 2000. NIN Annual Report 1999-2000. NIN Hyderabad.

396. Niriy, A and Jhingan, H.P. 2002. Life events and Depression in Elderly. Indian Journal of Psychiatry. Vol.44(1).

397. NNMB. 1997. Vijayaraghavan. K.N, Balakrishna, Grace Maria Anthony 2000. Report on food and nutrient intakes of individuals. NNMB. NIN Hyderabad.

398. NNMB. 2002. Diet and Nutritional Status of rural population. Technical report No.21, NIN, Hyderabad. pp. 107-108.

399. NNMB. 2005-06. Technical Report No.24. "Diet and Nutritional Status of Population and prevalence of hypertension among adults in rural areas" NIN, Hyderabad.

400. Norman K., Smoliner C., Valentini L et al. 2007. Is bioelectrical impedence vector analysis of value in elderly with malnutrition? Nutrition 23(7), Pp: 564-569.

401. NSSO, 60th round. 2004. http://mospi.gov.in/

402. NSSO, Jan-June 2004. Morbidity, healthcare and condition of the aged. NSS 60th round New Delhi. Government of India. Ministry of Statistical Implementation March 2006. No.507

403. NSSO. 1991. Report of National Sample Surveying Organization 1986-87. Dept of Statistics. Ministry of Planning. (National Sample Survey 1986-87). Government of India. p: 16.

404. Nutrition Screening Initiative (NSI). 1992. Nutrition Intervention manual for professionals caring for older Americans, Washington D.C.

405. Nyyssonen, K. 1997. Vitamin C deficiency and risk of myocardial infarction : prospective population : Study of men and eastern Finland. British Medical Journal. Vol. 314. pp: 634-638.

406. Oguntona, C.R.B and Kutu, O. 2000. Anthropometric Survey of elderly in South Western Nigeria. Ann. Hum. Biol. 27: Pp.257-260.

407. Omran,M.L and Morley J.E. 2000. Assessment of PEM in older persons. Journal of Nutrition. Vol. 16. pp: 50-63.

408. Ortega, R.M., Andres, P., Redondo, M.R. and Jamona, M.J. 1994. Influence of meat consumption in relation to various cardiovascular risk factors in the elderly. Rev. Clin. Esp. Vol. 194(5). pp: 147-51.

409. Osler, M, Schroll M. 1997. Diet and mortality in a cohort of elderly people in a north European community. International Journal of Epidemiology. Vol.26: pp. 155-159.

410. Pal S and Palacios R. 2008. Understanding poverty among the elderly in India. Implications for social pension policy Institute of study Labour (IZA). Discussion paper No. 3431.

411. Papas, A.S., Palmer, C.A. and Rounds, M.C. 1989. Longitudinal relationships between nutrition and oral health. Annals New York Acad Sci. Vol. 561. pp : 124-143.

412. Park, Y.H and Suh, E.E. 2007. The risk of malnutrition, depression and perceived health status of older adults. Tachan Kanho Hakhoe Chi.Oct 37(6), pp: 941-948.

413. Pasricha, S. and Thimmayamma B.V.S. 2000(reprinted). Dietary tips for the Elderly. A publication of NIN. ICMR.pp:1-7

414. Patel K.V. 2008. Epidemiology of anemia in older adults. Semin Hematol. Vol.45. pp. 210-217.

415. Patel, M. 2003. Death, Anxiety and Psychological well being among institutionalized and non-institutionalised aged. Journal of Personality and Clinical Studies. Vol. 19(1). pp.10-12.

416. Patil, P.B, Gaonkar, V, Yadav, V.S. 2003. Effect of socio-demographic factors on depression of the elderly, Man in India, Vol.83. pp: 173-181.

417. Patil, P.B. 2000. Psycho-Social Problems of the retired Social Welfare. Vol.47, No.10. pp:13-17.

418. Paul, G. 2006. Geriatric care- Kerala perspective. Kerala Calling. December issue p: 12.

419. Pawaskar, M.D., Anderson, K.T and Balakrishnan, R. 2007. Self reported predictors of depressive symptomatology in an elderly population with type 2 diabetes mellitus : a prospective cohort study, Health Quality Life Outcomes. Ang 2(5). p:50.

420. Payette, H, Gray Donald K, Cyr R and Beutier V. 1995. Predictors of dietary intake in a functionally dependent elderly population in the community. American journal of Public Health. Vol.85, Issue 5, pp: 677-683.

421. Payette, H., Coulombe, C., Boutier, V and Donald, K.G. 2000. Nutrition risk factors in a free living functionally dependent elderly population. Journal of clinical epidemiology. Vol.53. Issue 6, pp: 579-587.

422. Pearson, J.M., Schlettwein, G.D., Brzozowska, A and Van Staveren., M.A.2001. Life style characteristics associated with nutritional risk in elderly subjects aged 80-85 years. J. Nutr. Health Aging. Vol.5. No.4. pp: 278-83.

423. Peet, M. and Edwards, R.W. 1997. Lipids, Depression and Physical Disease. Curr. Opin. Psychiatr. Vol.10. pp: 477-480.

424. Perissinotto, E., Pisent, C., Sergi, G., Grigoletto, F., and Enzi, G. 2002. Anthropometric measurements in the elderly: age and gender differences, British Journal of Nutrition. 87. pp 177 – 186

425. Persson, M.D, Brismar, K.E., Katzarski, K.S. 2002. Nutritional Status using Mini Nutritional Assessment and subjective global assessment predict mortality in geriatric patients. J. American Geriatr Soc. Vol.50, pp: 1996-2002.

426. Peters, E.T., Seidell, J.C., and Menotti, A. 1995. Changes in body weight in relation to mortality in 6441 European middle aged men – the seven countries study, Int. J. Obes. Relat. Metab. Disord. 19. pp: 862-868.

427. Pinchcofsky, D and Kaminisky, M.V. 1986. Correlation of pressure sores and nutritional status. J. Am. Geriatr. Society. Vol. 34. pp: 435-440.

428. Planning Commission. 2002. National Human Development Report. Govt of India. March.

429. Polley, K.J et al. 1987. Effect of Calcium Supplementation on fore arm bone mineral content in post menopausal women; a prospective sequential controlled trial. Journal of Nutrition. Vol. 117. pp : 1929-1935.

430. Posner B.M., Marin M., S.S. Smigelski, C. Cupples, L.A., Cobb, J.L. Schaefer, E., Miller, D.R. and D'Agostino, R.B. 1992. Comparison of techniques for estimating nutrient intakes; The Framingham study. Epideoiology. 3(2). Pp: 171-177.

431. Posner, B.M., Martin, M.S and Smigelski. C et al. 1992. Comparison of techniques for estimating nutrient intake – the Framingham Study. Epidemiology. Vol. 3. pp:171-177.

432. Potter, J., Klipstein, K., Reilly, J.J and Roberts, R. 1995. The nutritional status and clinical course of acute admissions to a geriatric unit. Age ageing. Vol. 24. pp: 131-136.

433. Prabhakaran, S. 2002. Osteoporosis – A potentially crippling disease of thin and fragile bones. The Indian Journal of Nutrition and Dietetics. Vol.40. p:105.

434. Prakash, C. Gupta, Shekhar Saxena, Mangesh S,. Pednekar et al. 2003. Alcohol consumption among middle aged and elderly men : a community study from western India. Alcohol and Alcoholism. Vol.38. No.4. pp: 327-331.

435. Prakash, P. 1999. Dental problems of old age. Social Welfare. Vol.46. No1. pp: 27-28.

436. Prince, R.L . 1991. Prevention of post menopausal osteoporosis. A comparative study of exercise. calcium supplementation and HRT. New England Journal of Medicine.Vol. 325. pp: 1189-1195.

437. Proust, J.J., Filburn, C.R., Harrison, S.A., Buchholz, M.A and Nordon, A.A. 1987. Age related defect in signal transduction during lectin activation of marine lymphocytes. J. Immunol. Vol. 139. pp : 14720-S.

438. Province,A.M., Hadley C.E. and Hornbrook C.M. 1995. The Effects of Exercise on Falls in Elderly Patients. JAMA. 273 (17).pp. 1341-1347.

439. Purohit C.K and Sharma R.A.A .1976. A study of nutritional status of persons 60 years and above. Indian. J.Med. Res. 64(2). Pp. 202-209.

440. Pushpam, Ramaswamy,L and Prasanth, S. 2004. Psychological Problems of elderly. Kerala Sociologist. Journal of Kerala Sociological Society. XXXII (2). pp: 37-42.

441. Raguso, C.A., Kyle, U., Kossovsky, M.P .2006. A 3 year longitudinal study on body composition changes in the elderly : Role of Physical exercise. Clinical Nutrition. 25(4), Elsevier Ltd. pp: 573-580.

442. Rahman Mujeeb-Ur and Visweswara Rao.K .2000. Diet surveys by weighment and 24 hours recall oral questionnaire method. A case study of agreement The Ind.J. Nutr. Dietet. 37. 240.

443. Rahman. S.A. Zalifah M.K. Zrinorni J.J. 1998. Anthropometric measurements of the elderly. The American Journal of Nutrition. vol. 4. pp: 55-63.

444. Rajagopalan, S. 2000. Demographic Ageing of the population and its implication in the next millennium. Proceedings of NSI. NIN Hyderabad.

445. Rajan Irudaya, S. 1999. Old and Old age homes in Kerala. Kerala calling. Dept of Public Relations. Government of Kerala. Vol.20, No.2. pp.11-16.

446. Rajan Irudaya, S. 2003. Living Arrangements among Indian Elderly : New Evidence from National Family Health Survey, Economic and Political Weekly Vol. 38, No.1, Jan. 4, pp: 75-80.

447. Rajan Irudaya, S. 2007. Population Ageing, Health and Social Security in India, Centre for Development Studies, Trivandrum. CREI Discussion Paper Series No.3.p.27

448. Rajan Irudaya,S. 2004. Chronic Poverty among Indian Elderly. CPRC-IIPA Working paper No. 17. Indian Institute of Public Administration. New Delhi.

449. Rajkumar, A.P., Thangadurai, P and Senthilkumar. P. 2009. Nature, Prevalence and factors associated with depression among elderly in a rural South Indian community. International psychogeriatrics. Cambridge University Press.pp 1-6.

450. Rajkumar, S, Kumar, S, Thara, R. 1997. Prevalence of dementia in a rural setting. A report from India. International journal of Geriatric Psychiatry. Vol.12, pp: 702-707.

451. Rajkumar,A.P and Kumar,S. 1997. Journal of Ageing and Social Policy. Issues of Elder Care and Elder Abuse in the Indian Context. 15(2). pp: 125-142.

452. Ramachandra, S.S.and Kasthuri, A. 2009. Anemia in the elderly residing in the South Indian Rural Community, Ind. Medica. Vol.5. No.4. pp161-168.

453. Ramachandran, V, Sarada Menon, M and Ramamurthy, B. 1981. Family structure and mental illness in old age. Indian Journal of Psychiatry. 23: pp. 21-26.

454. Ramel A., Jonsson, P.V., Bjornsson, S and Thorsdottir, I. 2008. Anemia, nutritional status and inflammation in hospitalized elderly. Nutrition. Vol. 24. No. 11-12. pp: 1116-22.

455. Rao H.D and Vijayaraghavan, K. 2003. Anthropometric Assessment of Nutritional Status. In Textbook of Human Nutrition .Bamji et al. (Eds). Oxford and IBH Publishing Co. pp:110-114

456. Rao, A.V. 1999. Key Note Address. Kerala Sociologist. Journal of the Kerala Sociological Society. Vol. 27. pp: 7-8.

457. Rao, K, Visweswara, Rao. P. and Thimmayamma B V S. 1986. Nutritional anthropometry of Indian adults. India.J.Nutr. Diet. 28(8). Pp. 239-256.

458. Rashmi, S. and Lalitha, S. 2005. Post Menopausal Osteoporosis in India. Growing Public Health Concern. Published by National Institute for Research in Reproductive Health. Mumbai. Pp: 230-235.

459. Reddy, K.K., Bulliya, G., Ramachandraiah, T et al. 1991. Serum lipids and lipid peroxidation pattern in industrial and rural workers in India. Age ageing. Vol.14. pp: 33-38.

460. Reeves, S.L., Varakamin. C and Henry, C.J.K. 1996. The relationship between arm span measurement and height with special reference to gender and ethnicity. Eur. J. Clin. Nutr. No.50. pp: 398-400.

461. Registrar General of India.2010.<http://censusindia.gov.in/> accessed on June 26,2010.

462. Reilly, W.M. 2007. The Global Ageing Problem, Terradaily News about Planet Earth. United Nations.

463. Reinhart, W.H. 2006. ESR – More than an old fashion ? Ther Umsch, Vol 63(1), pp: 108-112.

464. Resenbloom, C.A., and Whittington, F.J. 1993. The effect of bereavement on eating behaviour and nutrient intakes in elderly widowed persons. Journal of Gerantology. Vol.48, pp: S222-S229.

465. Reuben, B.D., Moore, A.A., Damesyn, M., Keeler, E., Harrison, G. and Greendale, G. 1997. Correlates of hypoalbuminemia in community dwelling older persons. Am. J. Cin. Nutr. Vol.66. pp: 38-45.

466. Rezende, C.H., Coelho, L.M., Oliveira, L.M et al. 2009. Dependence of geriatric depression scores on age, nutritional status and haematologic variables in elderly institutionalized patients. J. Nutr Health Aging. 13(7). pp.617-21.

467. Rezende, C.H., Cunha, M.T., Junior, A., Silva, P. 2005. Dependence of Mini Nutritional Assessment scores with age and some hematological variables in elderly instituionalised patients. Gerontology. 51(5). pp.316-21.

468. Richard, E., Brenda, W.J.H., and Richard, C.W. 2006. Anemia in the elderly: Current understanding and concepts. Blood reviews. Vol. 20(4). pp: 213-225.

469. Rijnsburger, W.E, Blauw, J, Lagacy, M.A et al. 1997. Total cholesterol and risk of mortality in oldest old. Lancet. Vol.350, pp:1119-23.

470. Rissanen, A. 1991. Weight and mortality in Finnish men – Journal of clinical epidemiology. Vol. 42. pp: 781-789.

471. Ritchi. C.S., Burgio. K.L and Locher, J.L. 1997. Nutritional Status of urban homebound older adults. American Journal of Clinical Nutrition. Vol.66. No.4. pp: 815-818.

472. Roberts, R.E., Kaplan, G.A, Shema, S.J et al. 1997. Does Growing old increase the risk for depression ? The Americal Journal of Psychiatry. Vol.154. pp. 1384-1390.

473. Roberts, S.R., Young, V.R. 1993. Ageing and Energy Metabolism. Proceedings of the XVth Congress of the International Association of Gerantology. Budapest, Hungary, Mon duzzi, S.P.A, Bologna. ed. Pp: 269-276.

474. Robinson, C.H. and Lawler, M.R.. 1992. Normal and Therapeutic Nutrition, 17th Edition, Oxford and IBH Publishing Co. Pvt. Ltd.. pp: 383-384.

475. Robinson, G.E. 2001. Strengthening the role of nutrition and improving the health of the elderly population. Journal of American Dietetic Association. Vol.10 (1053). p: 337.

476. Rodes, A.E. 2001. Gender and Outpatient mental health service use. Social Science and Medicine. 54. pp.1-10.

477. Roe. D.A. 1994. Medications and Nutrition in the elderly, Prim Care. 21(1), Pp: 135-147.

478. Rose, D., Meershock, S., Ismael, C. and Mc Ewan, M. 2002. Evaluation of a rapid field tool for assessing household diet quality in Mozambique. Food and Nutrition Bulletin. The United Nations University. Vol.23. No.2. pp: 181-189.

479. Rosenberg I.H and Miller, J. 1996. Undernutrition in nursing homes – causes, consequences and prevention, pp: 113-124.

480. Rosenberg, I.H. 1992. Folate Nutrition in the Elderly. The Boston Nutritional Status Survey. London. Smith Gordon & Co. Ltd.. pp:135-139.

481. Rosenberg, I.H., and Miller, J. 1992. Nutritional factors in physical and cognitive functions of elderly people, Am. J. Chin. Nutr. No.55. pp: 1237S-1243S.

482. Rothschild, M.A., Oratz, M. 1988. Serum albumin, Hepatology. No.8 pp: 385-401.

483. Roubenoff, R. 2000. Sarcopenia and its implications for the elderly. Eur. J. Clin. Nutr. No.54. Suppl.3. pp: S40-S47.

484. Rowlatt, C., Franks, L.M. 1973.Aging in tissues and cells. Edinburgh : Churchill – Livingston.

485. Royal College of Physicians. 1991. Medical aspects of exercise: benefits and risks. Royal College of Physicians of London. Annual Report. P:16.

486. Rubenstein, S. 1997. Geriatric assessment technology. State of art. Kutiz Publishing Co. pp 217 – 221.

487. Rudman, D., Mattson, D.E. and Jackson, D.L. 1990. Antecedents of death in a nursing home. J. Am. Geriatr, Soc. Vol.35. pp: 496-500.

488. Rueda, S and Artazcoz, L. 2009. Gender inequality in health among elderly people in a combined framework of socio economic position, family characterization and social support. Ageing and society. Vol.29. pp:625-647.

489. Runel, M.R., Sahyourn, R.N and Perry, W.R. 1985. Assessment of Nutritional status of adults.Nutritional Biochemistry and Metabolism. Elsevier Publishing Company. London. pp: 140-145.

490. Rush. 2004. Nutrition Screening in old people. European Journal of Clinical Nutrition. Vol.53, Pp:17. 101.

491. Russel, R.M., and Suter, P:M. 1993. Vitamin requirements of elderly people : an update. Am. J. Clin – Nutr. Vol. 58. pp: 4-14.

492. Russell, R.M., Jacob, R and Greenberg, L. 1985. Clinical assessment of the Nutritional status of adults. Nutritional biochemistry and metabolism. Elsevier Science Publishing Co.. New York. pp: 285-308.

493. Sakamoto Y., Ueki S., Kasai T., Takato J. et al. 2009. Effect of exercise, aging and functional capacity on acute secretary immunoglobulin A response in elderly people over 75 years of age, Geriatr Gerontology Int. 9(1), Pp:81-88.

494. Salive, M.E., Cornono – Huntley, J., Philips, C.L. 1992. Serum albumin in older persons : relationship with age and health status. Journal of clinical epidemiology. No.45. pp: 213-221.

495. Sallve, M.E. 1992. Anemia and Haemoglobin levels in older persons : Relationship with age, gender and health status. J AM Geriatr Soc. Vol 40, P.489.

496. Salminen, H., Saaf, M., Johansson, S.E., Ringertz, H., Strender, L.E. 2006. Nutritional status as determined by the mini nutritional assessment and Osteoporosis: A cross sectional study of an elderly female population. European Journal of Clinical Nutrition. 60. pp. 486 –493.

497. Saltzman, E., Roberts, S.B. 1996. Effects of energy imbalance on energy expenditure and respiratory quotient in young and older men : Two metabolic studies. Aging. pp: 370-378.

498. Salzman, C, Kupfer, D.J, Frank, E. 1995. Medication compliance in the elderly : Discussion paper. The Journal of Clinical of Psychiatry.

499. Sandman, P. O., Adolfson, R., and Hallmane, G. 1987. Nutritional status and dietary intake in institutionalized patients. J. Am. Geriatr, Soc. Vol. 35. pp: 31-36.

500. Sano, M., Ernesto, C., Thomas, R.G. 1997. A controlled trial of Selegiline, alphatocopherol or both as treatment for Alzheimer's disease. N. Engl, J. Med. Vol. 336. pp: 1216-1222.

501. Satyanarayana, U and Chakrapani, V. 2006. Biochemistry 3rd edn. Books and Allied (P) Ltd. pp: 182-184.

502. Schiffman, S and Warwick S.Z .1993. Effect of flavor enhancement of foods for the elderly on nutritional status: Food intake, biochemical indices and anthropometric measures. Physiology and behaviour. Vol. 53. Issue.2. pp: 395-402.

503. Schiffman, S.S and Gatlin, C.A.1993. Clinical Physiology of taste and smell. Annu Rev. Nutr. Vol. 13. pp : 405-436.

504. Schiffman, S.S. 1991. Drugs influencing taste and smell perception. In smell and taste in health and disease. ed. TV Getchell. RL Doty. Raven Press. New York. pp: 845.

505. Schiffman, S.S. 1997. Taste and smell loss in normal aging and disease. JAMA 278. pp 1357-1362.

506. Schiffman, S.S. and Warwick, Z.S. 1991. Changes in taste and smell over the life again : Effects on apetite and nutrition in the elderly. in chemical senses, appetite and nutrition. Vol.4. Marcel Dekker. New York. pp: 341-365.

507. Schiffman, S.S. and Warwick, Z.S. 1992. The biology of taste and food intake. In the science of food regulation. Food intake, taste, nutrient partitioning and energy expenditure. ed GA Bray and DH Ryan. pp: 293-312.

508. Schiffman, S.S., Wedral, E. 1996. Contribution of taste and smell losses to the wasting syndrome. Age Nutr. Vol. 7. pp: 106-120.

509. Schlettwein – Gsell, D., Trichopoylou, A, Osler, M. 1991. Eating habits and dietary attitudes. Euronut Senea Investigators. Eur. J. Clin. Nutr. Vol. 45. pp: 83S-96S.

510. Schriffin, E.J., Guigoz Yues, Stephanie Blum, Yves Delneste, Robert Mansourian, B., Vellas and A, Blancher. 1997. MNA and Immunity – Nutritional status and immunological markers in the elderly. MNA : Research and Practice in the elderly. Nestle Nutrition Workshop Series Clinical and Performance Programme. Vol.1. pp: 35-40.

511. Schuler, D., Eey-Yensan, N., Pacheco, H.E and Belyea, M. 2003. Elderly food stamp participants are different from eligible non-participants by level of nutrition risk but not nutrient intake. Journal of the American Dietetic Association. Vol. 102 (1). pp: 103-107.

512. Seidell, J.C. and Visscher, T.L.S. 2000. Body weight and weight change and their health implications for the elderly. European Journal of Clinical Nutrition. Suppl.3. No.54. pp: S33-S39.

513. Selhub. J. 1993. Vitamin Status and intake as primary determinants of homocysteinemia in an elderly population – Journal of the American Medical Association. Vol. 270. pp:2693-2698.

514. Sen Amartya. 1994. D.T Lakadawala Memorial Lecture. New Delhi. Institute of Social Sciences.

515. Sen. P. 2004. Poverty undernutrition linkages. NFI. silver Jubilee Seminar "Towards National nutrition security" proceedings. NFI. New Delhi.

516. Sergi, G., Coin A and Enzi G. 2006. Role of Visceral proteins in detecting malnutrition in the elderly. European Journal of Clinical Nutriton. vol. 60, pp: 203-209

517. Shah, B. and Prabhakar, A.K. 1997. Chronic morbidity profile among elderly. Indian Journal of Medical Research. No.106. pp: 265-270.

518. Shah, N. 2003. Gender issues and oral health in elderly Indians. International dental journal, FDI World Dental Press Ltd. CB abstracts.

519. Shah, N. and Sundaran, K.R. 2004. Impact of socio-demographic variables, oral hygiene practices, oral habits and diet on dental caries experience of Indian elderly : a community based study. Gerodontology. Vol.21. Issue 1, pp: 43-50.

520. Shahar, Dr, R. Schultz, R.R. Wing. 2001. The effect of widowhood on weight change, dietary intake and eating behaviour in the elderly. Journal of Aging and Health. Vol.13. No.2, pp. 186-199.

521. Shanta, M and Swaminathan, M.C. 1966. A comparative study of two method of diet surveys.Indian Journal of Medical Research, 54(5). pp: 480-485.

522. Shapiro, F.M and Greenfield, S. 1979. The complete blood count and lymphocyte differential count : An approach to their rational application. Annals of Internal Medicine. Vol.106. Issue 1. pp: 65-74.

523. Shay, K.S. and Ship, J.A. 1995. The importance of oral health in the older patient. J. Amer Ger Soc. Vol 43. pp : 1414-1422.

524. Shearer, O.E. 2002. ‘Ageing – a new challenge to health care in the new millennium. West Indian Medical Journal. Vol.50, No.2. P:95.

525. Shephard, J.R. 1987. Physical activity and ageing. Croom Helm. London. P.53.

526. Shetty, P.S. and James, W.P.T. 1994. Body Mass Index, A measure of chronic energy deficiency in adults, Rome FAO Sixth World Food Survey. p:13.

527. Shils, E.M., Olson, A.J., Ross, C,A. et al.2006.Nutrition in the elderly. Modern Nutrition in Health and Disease. 9th ed, Lippincott Williams and Wilkinson. London.

528. Shimizu. K., Kimura F., Akimoto T., Akama T. et al. 2007. Effects of exercise, age and gender on salivary secretary immunoglobulin in elderly individuals. Exerc Immunol Rev. Vol 13, Pp: 42-46

529. Shirai, K. 2004. Obesity as the core of the metabolic syndrome and the management of coronary heart disease. Curr. Med. Res. Opin. 20(3). Pp.253-260.

530. Shock, N.W. 1977. Biological theories of ageing Handbook of the Psychology of Ageing. Van Nostrand Reinhold. New York. Pp: 16-20.

531. Sibai, et al. 2003. Nutritional status of Elderly Men and Women. Journal of Gerontology. Vol.49. pp:215-224.

532. Side, X., Mingtang, A, Shuquan M, Zhaomei M, Yuju, I, Jun W and Kui J. 1991. Anthropometric dietary survey of elderly Chinese. Brit. J.Nutr. Vol.66. pp. 355-362.

533. Sikai, M.A., Zard, C., Adra, N. et al. 2003. Variations in Nutritional status of elderly men and women according to place of residence. Vol.49, No.4. pp: 215-224.

534. Simmons, A. 1997. Hematology – A combined theoretical and Technical approach, 2nd Ed., Butterworth – Heinemann Publishers, pp: 420-431.

535. Sinaki, M. 1989. Exercise and Osteoporosis. Arch. Phys. Med. Rehabil. Vol. 70. pp: 220-229.

536. Singh, P, Kapil, U and Dey, A.B 2004. Prevalence of overweight and obesity among elderly patients attending a geriatric clinic in tertiary care hospital in Delhi, India. Indian Journal of Medical Sciences. Vol. 58 (4). pp: 162-163.

537. Singh, R., 2004. Ageing : A social concern. Social welfare. Vol.51.No. 7. pp: 4-5.

538. Siva Raju, S. 2002. Health Status of the Urban Elderly: A Medico-Social Study.. B. R. Publishing Co .Delhi.pp.1-12.

539. Small, W.G. 2002. Age related memory loss. BMJ. Vol. 324 : pp. 1502-1505.

540. Smith, D.L. 2000. Anemia in the elderly. American Family Physician. Oct. pp:162-67.

541. Smith, J.H., Lips P., Van Schoor et al. 2008. Vit. D deficiency as a risk factor for osteoporotic Fractures, Bone Vol. 42(2). Pp:260-266.

542. Smoliner, C., Norman, K, Wagner, K.H, Hartiq, W. 2009. Br. J. Nutr. July 2009. pp: 161-169.

543. Sohyun, P., and Mary, A.J. 2006. What is an adequate dose of Vit. B_{12} in older people. Nutrition Reviews. Vol.64(8). Pp: 373-378.

544. Soini, H, Rougtasalo, P., Langstrom, H. 2004. Characteristic of the MNA in elderly home care patients. Eur. J. Clin Nutr. Vol.58. pp:64-70.

545. Solanki, S. 1986. Organoleptic evaluation of malted, Ready to eat mix on aged women. Indian Journal of Nutrition and Dietetics. Vol.23. pp: 69-72.

546. Solomons, N.W. 1992. Nutrition and ageing, Potentials and problems for research in developing countries. Nutrition Reviews. Vol.50, No.8. pp: 224-229.

547. Soman, C.R. 2007. Fifty years of Primary Health Care. The Kerala Experience. NFI Bulletin. Vol.28. No.4. pp.1-3.

548. Souba W.W. 1997. Nutritional Support. New England Journal of Medicine. Vol. 336. pp : 41-47

549. Sreeramulu, D. and Raghuramulu, N. 1999. Nutrition and ageing. Nutrition and ageing. Nutrition 33(4). NIN, Hyderabad. Pp: 3-5.

550. Steele, M.F and Chenier T.C. 1990. Arm span, height and age in black and white women. Ann Hum. Biol. Vol. 17. No.6. pp: 533-41.

551. Steele. J.G. 1998. National Diet and Nutrition Survey of people aged 65 and older. Report of the oral health survey. The Stationery Office. Vol. 2. pp: 16-20.

552. Steen, B. 1992. Nutrition of the elderly in Munro, H., Schlierf, G. (eds). Raven Press. New York. pp: 211-217.

553. Steffens, C.D., Norton, M.C, Hart. A.D et al. 2000. Prevelance of depression and its treatment in al elderly population. Archives of general psychiatry. Vol.57, No.6, pp.601-607.

554. Stevens, D. Tallis, R. Hollrs, S. 1995. Persistent grossly elevated ESR in elderly people. One year follow up of morbidity and mortality. Gerontology. Vol. 41, (4) pp. 220-226.

555. Stevens, J., Cai, J., Williamson, D.F., Thun, M.J. and Wood, J.L. 2000. The effect of age on the association between body mass index and mortality. N. Engl. J. Med. No.338. pp: 1-7.

556. Stevens, J.C., and Cain, W.S. 1985. Age related deficiency -the perceived strength of six odorants. Chem Senses. Vol. 10. pp: 517-529.

557. Stevinson, C, Pittler, M.H, Ernst, E. 2000. Garlic for treating hypercholesterolemia. A meta analysis of randomized clinical trials Annals Intern Med; 133(6), pp: 120-429.

558. Stitt. S., O'Connell, C. and Grant D. 1995. Old, poor and malnourished. Nutr. Health. Vol.10. No.2. pp:135-154.

559. Stooky. 2000. Nutrition of elderly population in China. Asia Pacific Journal of Clinical Nutrition. Vol.9. pp: 243-251.

560. Stuart, B. and Lago, D. 1989. Prescription Drug Coverage and Medical Indigence among Elderly. Journal of Aging and Health. Vol. 1. No. 4. pp.451-469.

561. Stunkard, A.J. 1996. Current views on obesity. Am. J. Med. 100 (2). Pp. 230-236.

562. Sudhir, M.A. 1998. Psychosocial characteristics, problems and strategies for the welfare of the aged in rural India : An approach paper. National Seminar on Psychosocial characteristics, problems and strategies for the welfare of the aged in rural India. Help Age India. Pp: 1-10.

563. Sullivan, D.H. 2000. Risk factors for early hospital readmission in a selected population of geriatric rehabilitation patients the significance of nutritional status. Journal of American Geriatric Society. Vol.40. pp: 792-798.

564. Sullivan, D.H., Walls, R.C. and Lipschitz, D.A. 1991. Protein energy under nutrition and the risk of mortality within 1 year of hospital discharge in a select population of geriatric rehabilitation patients. Am. J. Clin. Nutr. L 53. pp: 599-605.

565. Sumathi, A., Malleshi, N.G., Venkat Rao. 2000. Nutritional status of institutional elderly in an old age home in Mysore city : Dietary habits and Food and Nutrient intakes. Nutrition Research. Vol.19.Issue. 10.pp:3-6

566. Sumathi, S., Dalus, H.I. 1999. Nutrient requirement for the elderly. Helpage India – Research & Development Journal. Vol.8, No.8, No.1, pp:10-15.

567. Suter. P:M. 1991. Reversal of protein bound Vit. B_{12} mal-absorption with antibiotics in atrophic gastrilis. Gastroenterology. Vol.101. pp: 1039-1045.

568. Swaddiwudhipong. W., Lord Lukanavonge, P., Chaovakiratipong, C. 1996. Screening assessment of elderly in Rural Thailand by a mobile unit. Transactions of the Royal society of tropical medicine and hygiene, Vol.90, pp: 223-227.

569. Swami, H.M., Bhatia, V., Dutt. R., et al. 2002. A community based study on the morbidity profile among the elderly in Chandigarh, India. Bahrain Med bull. 24(1), Pp : 13-16.

570. Swaminathan M. 2003. Advanced text book of food and Nutrition. The Bangalore printing and Publishing Co. Ltd. pp:585-590.

571. Swaminathan, D. 1996. Integration of the aged into the development process of India. Help Age India – Research Development Journal. Vol. 2. pp:3-8.

572. Swaran Pasricha. 1959. An assessment of reliability of the Oral questionnaire method of diet survey as applied to Indian communities. Indian Journal of Medical Research. 47(2). pp: 207-213.

573. Szostak, W.B. 1994. The need for improved methods of diet assessment for developing food policy in Eastern Europe. Am. J. Clin. Nutr. Vol. 59 (1). pp: 273S – 274S.

574. Tambay, J.L and Cathlin, G. 1995. Sample Design of the National Population Health Survey. Health Reports (Statistics Canada, Catalogue 82-003). pp: 1-11.

575. Tanphaichitr, V., Senachach, P., Nopchinda, S., Leelahagul, P., and Pakpaenkitvatana, R. 1997. Global assessment nutrition risk factors in the elderly. Science and health – opportunities and challenges in the 21st century. South East Asian Journal of Tropical Medicine and Public Health. Vol.28. No.2. pp: 94-99.

576. Thimmayamma B.R.S and Rao. P. 1986. Dietary Assessment as part of Nutritional Status Assessment Text Book of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd. Allan R. Liss Inc. pp:25-35.

577. Thorsdottir, I., Jonsson,P.V., Asgeirsdottir,A.E et al. 2005. Fast and simple screening of nutrition status of hospitals and elderly people. The British Dietetic Association Ltd.. Journal of Human Nutrition and Dietetics. Vol.18. pp: 53-60.

578. Tietz N.W.1995.Clinical guide to laboratory tests .3rd ed. W.B Sounders Publishing Co.Philadelphia.pp:112-13

579. Tiwari, S.C. 2000. Geriatric Psychiatric morbidity in rural northern India : Implications for the future. International Psychogeriatrics; Vol. 12; 35-48.

580. Tjani, E. 2000. Folate status of institutionalized elderly. American Journal of Clinical Nutrition. 19. pp 392 – 404.

581. Toss, G., Almqvust, S., Larsson, L., and Zetterquist, H. 1980. Vit. D deficiency in welfare institutions for the aged, Journal of Nutrition for the Elderly. (2). pp: 87-89.

582. Trant, A.S., Serin, J. and Douglass, H.O. 1982. Is taste related to anorexia in cancer patients ?. Am. J. Clin. Nutr. Vol. 36. pp: 45-48

583. Trichopoulos. D, Lagion P. 2000. Evidence based Nutrition. Asia Pacific J. Clin Nutr. Vol.9 (Suppl.) : pp.4-9.

584. Trichopoulous, A. et al. 1995. Diet and overall survival in elderly people. British Medical Journal. Vol. 311. pp.1457-1460.

585. Tripp: F. 1997. The use of dietary supplements in the elderly : Current issues and recommendations. Journal of the American Dietetic Association. 97. Supplement 2. pp: 181-183.

586. Tyagi, R. 2007. Body composition and nutritional status of institutionalized and non-institutionalised senior citizens. European Anthropological Association 1st Summer School. pp: 225-231.

587. Tzeng, B and Eisendreth, J.S. 2002. Dementia – Gale Encyclopedia of Public Health. Mac Millan Reference. The Gale Group Inc.New York. pp 412-416.

588. U.N Report on World Population ageing: 1950- 2050. Published by U.N. 2010.

589. U.S. Bureau of Census.2001.International Data Base of Aging. National Institute on Aging. Survey Research Centre. University of Michigan.pp:1-10

590. U.S. Department of Health and Human Services. 2002. A profile of Older Americans.

591. UNDP. 1995. Human Development Report. Oxford University Press. New Delhi.

592. UNDP. 1999. Health Action. Vol. 39. No.2. p:16.

593. Varums H., Heymisfield, S.B, Nuez C, Testolin C and Gallagher D. 2002. Anthropometry and methods of body composition measurement for research and field application in elderly, Eur J Clin Nutr., No.54. Supple.3. pp: 26-32.

594. Vas, J and Robinson, S. 2001. Prevalence of Dementia in an urban Indian population. International Journal of Psychogeriatrics. Vol.13.No.4. pp: 439-450.

595. Vasavda,T and Mehta,P. 2003. A study on Assessment of Diet, Nutrition and Health Profile of Elderly in Religious Order. Indian Journal of Gerontology.Vol.17.No.3&4. pp:389-397.

596. Veehof, L.J, Stewart, R.F, Meyboom-de Jong. 1999. Adverse drug reactions and polypharmacy in the elderly in general practice. European Journal of Clinical Pharmacology, Vol.55. No.7. pp: 533-536.

597. Vellas, B. Garry P.T. and Guigoz, P. 2000. Mini Nutritional Assessment. Research and Practice in the elderly. Nestle Nutrition Workship Series. Clinical and Performance Programme. Vol..1. pp: 131-140.

598. Vellas, B. Guigoz, Y., Baumgartner, M. et al. 2000. Relationship between nutritional markers and the mini nutritional assessment in 155 older persons. J. Am Geriatr Soc Vol. 48, pp: 1300-1309.

599. Venjatraman J.T., Fernandex G. 1997. Exercise, immunity and aging, Aging (Milano), 9(1-2), pp:42-46.

600. Venkataraman, M.S. 1998. The age old problem. The Hindu folio on Ageing. Oct 18. pp: 12-15.

601. Venkateswarlu, V., Saraswathi Raju Iyer and Koteswara Rao, M. 2003. Health Status of the rural aged in Andhra Pradesh : A Sociological Perspective – Help Age India – Research and Development Journal. Vol.9(2), pp: 17-21.

602. Vestergaard S., Kronborg C, Puggaard L. 2008. Aging Clin. Exp. Res. 20(5), pp. 479-486

603. Vijaya Kumar, S. 1999. Population ageing in India. Help age India Research and Development Journal.Vol. 5.pp 26 –34.

604. Vijayakumar, S. 1998. Ageing in India – An anthropological outlook. Research and Development Journal. Vol.2. No.1. pp: 41-44.

605. Vijayaraghavan, et al. 2003. Diet and Nutritional Status of the elderly n rural India. Journal of Nutrition for the Elderly. Vol.22. No.4. pp: 35-40.

606. Vijayaraghavan,K., Surya Prakasan, B and Laxmaiah, A. 2002. Intra Family distribution of dietary energy in rural India and time trends. Food and Nutrition Bulletin. Vol.23. pp.390-394.

607. Vissacher, T.L.S., Seidell, J.C., Menolti, A. and Krombout, D. 2000. Under and overweight in relation to mortality among man age 40-59 and 59-69. The seven countries study. Am. J. Epidemiology. pp: 16-20.

608. Visser, M., Harris, T.B., Langlois, J., Hannan, M.T., Roubenoff, R. and Kiel, D.P. 1998. Body's fat and skeletal muscle mass in relation to physical disability in very old men and women. Journal of Gerontology. No.53A. pp: 214-221.

609. Visvanathan R. 2003. Under-Nutrition in Older People: A Serious and Growing Global Problem. Journal of Postgraduate Medicine. Vol. 49. No.4.
Medknow Publications and Staff Society of Seth GS Medical College and KEM Hospital. Mumbai. India. pp. 352-360.

610. Visvanathan, R., Penhall, R., Chapman, I. 2004. Nutritional screening of older people in a sub-acute care facility in Australia and it's relation to discharge outcomes. Age ageing. Vol.33, pp: 260-265.

611. Volkert, D., Kreue. K., Heseker. H and Stehle. P. 2004. Energy and nutrient intake of young old, old-old and very old elderly in Germany. European Journal of Clinical Nutrition. Vol.58, pp:1190-1200.

612. Volkert, D., Kruse, W., Oster, P. and Schlierf, G. 1992. Malnutrition in geriatric patients, Diagnostic and prognostic significance of nutritional parameters. Ann. Nutr. Metab. Vol. 36. pp: 97-112.

613. Waaler, H., 1988. Hazard of obesity – the Norwegian experience. Acta Med Scand. Vol. 723. (Suppl.). pp: 17-21.

614. Wadhwa, M., and Sharma, S. 1999. Nutritional status of institutionalized elderly, ageing Indian and Global scene. New Delhi. AIIMS. pp: 275-281.

615. Wahlqvist, M.L and Flint, D.M. 1998. Assessment of loss of weight in elderly women. Eur. J. Clin. Nutr. Vol. 42. pp: 679-682.

616. Wahlqvist, M.L and Savige. G.S., 2000. Dietary and lifestyle changes in elderly. European Journal of Clinical Nutrition. Vol. 54(3). Pp: 148-154.

617. Wahlqvist, M.L, Worsley, A, Lukito, U.S., 2001. Evidence based Nutrition and Epidemiology in the Asia-Pacific region. Asia Pacific J. Clin Nutr. Vol.10. No.2, pp.72-75.

618. Wahlqvist, M.L. 2002. Focussing on Novel Foods: their role, potential and safety. Asia Pacific, J. Clin Nutr. Vol.11(S6) : pp.98-99.

619. Wahlqvist,M.L and Savige. 2001. Intervention aimed at dietary and lifestyle changes to promote healthy aging. European Journal of Clinical Nutrition. Vol. 54(3). pp:148-156.

620. Walia,K. 2003. Emerging problem of antimicrobial resistance in developing countries; Intertwining Socio economic issues. Regional Health Forum – vol. 7, No.1. WHO Publ. pp: 3-8.

621. Wallace J.1995. Interpretation of diagnostic tests. Little Brown & Co. U.S.A.. p: 464.

622. Webb, G.P. and Copemann, J. 1996. The Nutrition of Older Adults. First Edition. Arnold Inc. pp: 10-17.

623. Weich, S., Slogget, A. and Lewis, G. 2001. Social role and the gender difference in rates of common mental disorder in Britain : a 7 year population based cohort study. Psychological medicines 31, pp. 1055-1064.

624. Weimer, P:J. 1997. Many elderly at nutritional risk, Nutrition Reviews. Vol.52. No.3. pp: 16-19.

625. WHO expert Consultation. 2004. Appropriate Body Mass Index for Asian populations and its implications for policy and intervention strategies. The Lancet, pp: 157-163.

626. WHO QoL.1996.WHOQoL BREF-Introduction, Administration and Scoring-Field trial version. Programme on Mental Health.WHO.Geneva.pp:2-15.

627. WHO, 1995. Physical status: the use and interpretation of anthropometry. Report of a WHO expert committee. Technical Report series No.854. Geneva.pp:234-267

628. WHO. 1989. Preventing and Controlling Iron deficiency Anemia through primary health care – a guide for health administrators and programmers.WHO .Geneva.

629. WHO. 1999. Highlights of activities from 1989-99. International Journal of Health Development. Pp: 452-453.

630. WHO. 1999. Nutritional Anaemia. Technical report series. No. 503. Geneva.

631. WHO. 2000. Obesity : Preventing and managing the global epidemic. Report of the WHO Consultation. TRS 894. WHO Geneva.

632. WHO. 2000. Poverty and Inequity – A proper focus for the new century. Bulletin of the WHO. p:78.

633. WHO. 2008. Defining the specific nutritional needs of older persons. Ageing and Nutrition: A growing global challenge. WHO publication .pp:5-67

634. WHO.2002. Keep Fit for Life– Meeting the Nutritional Needs of older persons. WHO. Geneva. pp: 2-159.

635. Willet, W.C. 1997. Weight loss in the elderly : Cause or effect of poor health. Am. J. Clin. Nutr. No.66. pp: 737-738.

636. Wilson M.M.G and Morley J.E .1999. Nutritional management of geriatric patients. Older people. Encyclopedia of Human Nutrition. Vol.3, Academic press. pp: 1485-1488.

637. Winograd, C.H., Gerety, M.B., Chung, M., Goldstein, M.K., Dominguez, F. Jr. and Vellone, R. 1991. Screening for frailty – criteria and predictors of outcomes. J. Am. Geriatr. Soc. Vol. 39. pp: 778-784.

638. Wissing, U., E.K. A.C, Unosson, M. 2001. A follow up study of ulcer healing, nutrition and life situation in elderly patients with leg ulcers. J. Nutr Health, Aging. Vol.5. pp: 37-42.

639. Wolfson, L., Whipple, R., Derby, C. 1996. Balance and strength training in older adults : Intervention gains and Tai Chi Maintenance. J. An. Geriatr. Soc. Vol. 44. pp: 498-506.

640. Woo, J. 2000. Relationship among Diet, Physical activity and other lifestyle factors in the Elderly. European Journal of Clinical Nutrition. Vol.54. No.3. pp: 143-147.

641. Worsley, A, Wahlqvist, M.L, Dalais, F.S, Savige, G.S. 2002. Characteristics of Say bread users and their beliefs about Soy products. Asia Pacific J. Nutr Cliss Vol. 11(1); pp.51-5.

642. Wu Xiaoqin and De Maris Alfred. 1996. Gender and Marital Status differences in depression : The effect of chronic strains. Journal of Sex roles. Vol.34. No.5-6 (March). Springer Netherlands Publication.pp52-57

643. Wurtman, R.J and Wurtman. J.J. 1998. Serotoninergic mechanisms and obesity. J. Nutr. Biochem. Vol. 9. pp: 511-515.

644. www.aging.stat.accessed on May 9 th.2010.

645. Wylie, C., Copemann, J and Kirk, S.F.L. 1999. “Health and Social factors affecting the food choice and nutritional intake of elderly people with restricted mobility”. J. Humn, Nutr. Dietect. Vol. 12. No.5. pp: 375-380.

646. Wylie,C, Copemann, J and Kirk, S.F.L. 1999. Health and Social Factors affecting the food choice and nutritional intake of elderly people with restricted mobility. Journal of Human Nutrition and Dietetics. Vol.12. No.5. pp.375-380.

647. Wysocki, C.J. and Pelchat, M.L. 1993. The effects if ageing on the human sense of smell and its relationship to food choice. Crit. Rev. Food Sci. Nutr. Vol. 33. pp : 63-82.

648. Yasin, Z and Terry R.D. 1991. Antrhopometric characteristics of rural elderly females in Malaysia. Exol Food Nutr. 26. pp. 106-117.

649. Yearick, E.S., Wang, M.L and Pisias, S.J. 1990. Nutritional status of the elderly : Dietary and Biochemical findings. Journal of Gerontology. No.35. p.663.

650. Yesavage, J.A., Brink T.L., Lun, O., Huang, V., Aday, M and Leirere, V.O. 1983. Development and evaluation of a Geriatric Depression Screening Scale. A Preliminary Report. Journal of Psychiatric Research. 17. pp: 37-49.

651. Yip, R., Dallman, P.R. 1988. The role of inflammation and iron deficiency as causes of anemia. American Journal of clinical nutrition. Vol. 48. pp: 1295-1300.

652. Zhan,C ., Sangl, J and Arlene S. et al.2001. Potentially Inappropriate Medication Use in the Community-Dwelling Elderly .JAMA 286(22) pp:2823-2829.

653. Zunzunegui, V.M., Minicuci, N. Blumstein, T et al. 2007. Gender differences in depressive symptoms among older adults : a cross national comparison. Social Psychiatry and Psychiatric Epidemiology. Vol.42. No. 3. pp. 198-207.

APPENDIX I

KOCHI CDP AREA– CORPORATION, MUNICIPALITY AND PANCHAYATS

KOCHI CORPORATION -71 WARDS

1. Fort Cochin
2. Panayappally
3. Veli
4. Island North
5. Amaravathy
6. Island South
7. Island -North
8. Kalvathy
9. Iraveli
10. Karipalam
11. Mattanchery
12. Kochangadi
13. Chakkamadam
14. Edappally
15. Mamangalam
16. Palarivattom
17. Poonithura
18. Vytilla
19. Girinagar
20. Panampilly Nagar
21. Kadavanthara
22. Thevara
23. Ravipuram
24. South
25. Gandhinagar
26. Kaloor – South
27. Kaloor – North
28. Ernakulam Central
29. Ernakulam North
30. Cheralai
31. Vytilla Janatha
32. Ponekkara
33. Karuvelippady
34. Thoppumpady
35. Edakochi -N
36. Edakochi - S
37. Perumpadappu
38. Vaduthala – West
39. Vaduthala-East
40. Elamakkara-N
41. Puthukkalavattom
42. Kunnumpuram-N
43. Kunnumpuram_-S
44. Vennala
45. Devankulangara
46. Thamanam
47. Chakkaraparambu
48. Chalikkavattom
49. Ponnurunny
50. Karanakodam
51. Elamakkara-S
52. Pachalam

53. Thattazham
54. Konthuruthy
55. Karanakodam
56. Perumanoor
57. Thazappu
58. Tharebhagom
59. Konam
60. Nambearpuram
61. Elamkulam
62. Mundamvely
63. Manasserry
64. Moolamkuzhi
65. Chullickal
66. Nazreth
67. Karukappally
68. Thrikkanarvattom
69. Pullardesam
70. Kadebhagom
71.Kacherippady

Two Municipality areas-

Tripunithura, Kalamassery

13 Panchayath areas

1. Elankunnapuzha
2. Njarakkal
3. Mulavukadu
4. Kadamakkudi
5. Cheranelloor
6. Eloor
7. Varapuzha
8. Thrikkakara
9. Thiruvankulam
10. Maradu
11. Kumbalam
12. Kumbalangi
13. Chellanam

APPENDIX II

LIST OF OLD AGE HOMES SELECTED FOR THE STUDY

Paid homes

1. Vanaprastha, Sree Ramakrishna Sevasram, Asramam Lane, Azad Road, Kaloor, Kochi
2. Santhigiri Health Complex and Old age home, NAD Road, HMT Colony P O., Kalamassery, Ernakulam.

Government Aided Homes

1. House of Providence, Old age home, Providence Road, Kacheripady, Kochi
2. Little Flower Poor Home, Njarackal, Vypin, Ernakulam

Government Home

1. Government Old Age Home, Thevara P O, Ernakulam

APPENDIX III

COMPREHENSIVE HEALTH ASSESSMENT SCHEDULE FOR THE ELDERLY ('CHASE')

SCHEDULE I – SOCIO ECONOMIC, LIFE STYLE AND MORBIDITY PATTERN OF THE ELDERLY

Name, address with telephone No. :

Code Number :

I General demographic and Socio-economic variables

1. Age (in years) :

   60-70 ☐ 70-80 ☐ above 80☐

2. Sex:

   Male ☐ Female☐

3. Marital status:

   a) Married ☐ b) widowed ☐

   c) divorced or separated ☐ d) Single, never married ☐

4. Educational status:

   a) Illiterate, no school ☐ b) Literate, no school ☐

   c) Primary school ☐ d) Secondary school ☐

   e) High school / higher secondary☐ f) graduate ☐

   g) Post graduate ☐ h) Professional qualified ☐

5. Occupational status : Are you :

   a) in service ☐ (specify) b)retired ☐

   c) Retired and working ☐ others (specify)

6. Religion :

   a) Christian ☐ b) Hindu ☐

7. c) Muslim ☐ d) other (specify) ☐

8. Income level per month? (including spouse)

   a) No income ☐ b)upto Rs.2000/- ☐

   c) Rs.2000/ - Rs.5000/- ☐ d) >Rs.5000 ☐

9. Source of Income:

a) Employment ☐ b) Employment pension ☐

c) Spouse's pension ☐ d) income from property ☐

e) Business ☐ f) Savings ☐

g) investments ☐ h) Remittance from children ☐

i) Old age pension ☐ j)From other relatives ☐

k)Anyother (Specify) ☐

10. Economic independence

a) Independent ☐ b) Partially independent ☐

c)Fully dependent ☐

11. Do you receive any form of support (other than money) Yes☐ No☐

If yes, a) what sort of support?

a) Food ☐ - Regularly ☐ occasionally ☐

b) Clothing ☐ - Regularly ☐ occasionally ☐

c)Medication ☐ - Regularly ☐ occasionally ☐

d) Others……. (Specify) Regularly ☐ occasionally ☐

b) Who supports you? a) Children ☐ b) Relatives ☐

c) NGOs ☐ d) Charitable institutions ☐

12. ✱ What are the reasons for living in a home for the aged?

a) No relatives ☐ b) Children not supportive ☐

c) Relatives are unhelpful☐

d) Migration of children ☐ e) Preferred to live alone ☐

f) poverty ☐ g) others (specify)

13. ✱ How long have you been in an old age home?

a) <1 year ☐ b) 1 to less than 5 years ☐ c) 5 to less than 10 years☐

d) 10-15 years ☐ e)>15 years ☐

14. Type of family :

a) Joint ☐ b) Nuclear ☐ c) Extended ☐

15. Status in the family/institution:

a) Feels neglected but living family/inmates ☐

b) tolerates other family members/inmates ☐

c) Loved and respected, not controlling the household ☐

d)Loved and respected, controlling the household ☐

16. Are you happy with your present living arrangement?

    Yes ☐ No ☐ Reason…..

17. According to you, which one of the following living arrangement is most suitable for people in old age?

    a) Living with married son ☐ b) Living with married daughter ☐

    c) Living separately ☐ d) Living in a home for the aged ☐

    e) Living with relatives ☐

    ✱ Only for elderly in old age homes

18. **a) Social activities and networks**

Events	**Very often (3)**	**Some times (2)**	**Never (1)**
1. Visits by children/ grand children during the last month In the last month, how often you engaged in the following activities? 2. Social contacts with friends or relatives 3. Reading a book, magazine 4. Reading newspaper 5. Watching TV 6. Listening to radio or music 7. Cultural programme 8. Worship / prayer 9. Pursuing your hobby 10. How often do you discuss your problems with some one close to you?			

Max Score : 10 x 3 = 30 20-30 good 10 – 20 average <10 - Poor

b) Life Satisfaction

Areas of satisfaction	Fully satisfied (3)	Slightly dissatisfied (2)	Very dissatisfied (1)
1. Emotional (11)			
a. Respect shown to you by people around you b. Degree of support extended to you c. Intimacy with friends d. Intimacy with spouse e. Intimacy with children f. Concern of care givers g. Emotional support from family / friends h. Involvement in family decision i. Sharing of views and feelings j. The amount of worries in your life Your happiness in general			
2. Economic (8)			
a. Income for day to day living b. Income to meet emergencies c. Freedom to spend as per your choice d. Source of your present income e. Your social standing f. Your possessions (land, building or household possessions) g. The current accommodation h. Not having a job			

(Contd…)

	Areas of satisfaction	Fully satisfied (3)	Slightly dissatisfied (2)	Very dissatisfied (1)
	3. General and perceived health (4)			
	a. Your health and mobility b. Your health care c. The energy you have for day to day activities d. Your ability to take care of yourself			
	4. Dietary (9)			
	a) Importance given to your food preferences or choices b) Quantity of food c) Quality of food • Taste • Texture • Appearance • Food variety • Meal timings • Companion ship during meal times • Your dietary modification (if any)			
	5. Other aspects (3)			
	a. Avenues for social contacts b. Recreational / cultural activities c. Spiritual activities			

Max. Score: 35 x 3 = 105 **(> 80: Excellent, 50-80: Average, < 50: poor)**

19. Do you have a hobby? Yes ☐ No ☐

If yes, specify……..

III. **Psychological Assessment**

a. General Aspects

20. Do you lack orientation?

a) Time □ b) Place □ c) Persons □

21. Do you feel confused at times?

Yes □ No □

22. Are you comfortable in sleep?

Yes □ No □

23. How many hours do you sleep a day? ……

24. Was there any recent bereavement?

Yes □ No □

b. Memory score

25. Today's day ……., This month……..,Current year …….. (3 marks)

Your address……..(1 mark)

Do you forget things and people very often?

Yes □ No □ (1 mark)

[< 3 - Poor memory score]

26. **Geriatric Depression Scale (Yesavage et al., 1983)**

Are you basically satisfied with your life? Yes □ NO □

Do you often get bored? YES □ No □

Are you in good spirits most of the time? Yes □ NO □

Are you afraid that something bad is going to happen to you ?

YES □ No □

Do you feel happy most of the time? Yes □ NO □

Do you feel helpless? YES □ No □

Do you prefer to stay at home, rather than going out and doing new things?

YES □ No □

Do you have severe memory problems than most people?

YES □ No □

Do you think it is wonderful to be alive now? Yes □ NO □

Do you feel pretty worthless the way you are? YES □ No □

Do you feel full of energy? Yes □ NO □

Do you feel your situation is hopeless? YES □ No □

Do you think that most people are better off than you are?

YES □ No □

Do you suffer severe sleep problems? YES □ No □

Do you get angry with those around you many times a day?

YES □ No □

(EACH ANSWER IN CAPITALS SCORES 1; SCORES > 5 INDICATE PROBABLE DEPRESSION)

IV Physical Assessment

27. Bowel/bladder activity

a) Is your bowel activity i) normal ☐ ii) Incontinent ☐

b) Is you bladder activity i) normal ☐ ii) Incontinent ☐

28. Do you have any bone fracture in the recent past? Yes ☐ No ☐

if yes, state the location and nature of fracture

29. How difficult is it for you to walk about a kilometer?

a) Not difficult ☐ b) A little difficult ☐

c) Somewhat difficult ☐ d) Very difficult but possible ☐

e) cannot do it ☐

30. Do you have problems with a stiff back when you get up in the morning?

a) No, never ☐ b) Yes, sometimes ☐

c) Yes, very often ☐ d) Yes, always ☐

31. The Dental Screening initiative: (Morley, 1998)

Eating difficulty (1)

No recent dental care, within 2 years (1) Tooth loss (1)

Alternative food selection because of masticatory problems (1)

Lesions, sores or lumps in mouth (1)

[Any score ≥ 2 indicates a dental problem that may affect health and nutritional well being]

32. Do you have tooth problems? Yes ☐ No ☐

if yes, is it i)Edentulous (Loss of teeth) ☐

ii) Dental caries ☐ iii) Others…….

33. Do you wear dentures? Yes ☐ No ☐

If yes, it is for i) Upper teeth ☐ ii) lower teeth ☐ iii)both☐

34. Do you have problems with chewing? Yes ☐ No ☐

35. Do you have problems with swallowing? yes ☐ No ☐

36. Is you eyesight good enough both to see things clearly at a distance and to read close up

a) Without eyeglasses ☐ b)With some type of visual aid ☐

c) Partial blind ☐ d)Blind ☐

37. How good is your hearing? (without a hearing aid)

a) No problem ☐ b) Can hear only if spoken to loudly ☐

c) Nearly deaf ☐

38. How would you rate your taste and smell sensitivity?

a)Good ☐ b) Fair ☐ c) poor ☐

V . Physical Activities of Daily Living (PADL) "Katz" PADL Scale

For each area of functioning listed below, check description that applies. (The word "assistance" means supervision, direction or personal assistance)

Independent ☐	Minor dependence ☐	Full dependence ☐

1. Bathing

Receives no assistance ☐	Receives assistance in bathing only one part of the body (such as back or a leg) ☐	Receives assistance in getting clothes or in getting dressed or stays partly or completely undressed ☐

2. Dressing (gets cloths from closets and drawers, including underclothes, outer garments and using fasteners)

Gets clothes and gets completely dressed without assistance ☐	Gets clothes and gets dressed without assistance except for minor assistance ☐	Receives assistance in getting clothes or in getting dressed or stays partly or completely undressed ☐

3. Toileting (going to the “toilet room” for bowel and urine elimination, cleaning self after elimination)

Goes to “toilet room” cleans self and arranges clothes without assistance (may use object for support, such as cane, walker or wheelchair and may manage night bedpan or commode, emptying same in morning) ☐	Receives assistance in going to “toilet room” or in cleansing clothes after elimination or in use of night bedpan or commode ☐	Does not go to room termed “toilet” for the elimination process. ☐

4. Transfer

Moves in and out of bed as well as in and out of chair without object for support, such as cane or walker. ☐	Moves in and out of bed for chair with assistance ☐	Does not get out of bed ☐

5. Continence

Controls urination and bowel movement completely by self ☐	Has occasional “accidents” ☐	Supervision helps keep urine or bowel control, catheter is used or is incontinent. ☐

6. Feeding

Feeds self without assistance ☐	Feeds self except for getting minor assistance such as cutting meat or buttering bread ☐	Receives assistance in feeding or is fed partly or completely by using tubes or intravenous fluids. ☐

VI. Personal Habits

39. Do you smoke?

i) No ☐ ii) Yes ☐ iii) Used to smoke, but quite ☐

40. If yes, how often?

i) Chain smoker ☐ ii) A few (1-5 Nos) daily☐ iii) Occasionally☐

41. Do you drink alcohol?

i) No ☐ ii) Yes, at social events ☐ iii) Yes, daily ☐

42. a) Chew tobacco / betel leaves? Yes ☐ No ☐

b) If yes, how often? i) Regularly ☐ ii) Occasionally ☐

43. Do you have some sort of daily exercise or physical activity?

Activities	**Time spent / day / week**
a) Walking	
b) Jogging	
c) Sports activity (Specify)	
d) Breathing exercise	
e) Yoga	
f) Gardening	
g) others	

VII. Illness and Illness Impact

44. During the past one year, how many times have you been to a doctor for medical help?

i) 0-2 time☐ ii) 3-6 times☐ iii) >6 times ☐

45. What was the reason for visiting a doctor?

i)Mainly routine visit ☐ ii) Mainly treatment ☐ iii) Both ☐

- **Immunity**

46. How many days did you spend overnight in a hospital during the past 12 months? a)None ☐ b) 1-21 days ☐ c) >21 days ☐

47. How many days did you spend ill at bed at home during the past 12 months

a) 0-3 days ☐ b) 4-14days ☐ c) >14 days ☐

48. During the last month, have been bothered by the following minor ailments.

Common ailments	**Very often**	**Sometimes**	**Rarely**	**Not at all**
Cough				
Cold				
Diarrhoea				
Fever				
Stomach pain				
Constipation				
Head ache				
Back pain				
Leg pain				

49. Major health problems

Sl No	**Health problems**	**Age of onset**		
		<30	**30-60 years**	**60 years**
1	Diabetes			
2	Cardiovascular diseases Arteriosclerosis Coronary heart diseases Myocardial infarction			
3	Cancer			
4	Arthritis			
5	Osteoporosis			
6	catacract			
7	Asthma			
8	Hypertnsion			
9	Peptic ulser			
10	Renal diseases			
11	Liver diseases			
12	Bone fracture in recent past			
13	urinary tract infection			
14	Surgeries you have undergone?			
15	Have you had protein, albumin, blood or sugar in your urine?			

50. List of Medications you consume.

Drugs	**Name**	**Dosage**	**Frequency**	
			Regular	**Occasional**
Analgesics				
Antacids				
Antibiotics				
Anti –coagulants				
Anti convulsants				
Anti hypertensives				
Anti-parkinsonian				
Anti viral				
Anti fungal				
Anti histamine				
Anti cholinergic				
Cardiac glycosides				
Diuretics				
Hypoglycemic agents				
H_2 blockers				
Psychotherapeutics				
Steroids				
Lipid lowering				
Vitamin/mineral supplements				
Anyother				
None				

APPENDIX XII

CHASE SCHEDULE II

FOOD HABITS AND DIETARY PATTERN OF THE ELDERLY

1. Type of meal

   1) vegetarian ☐ 2) non-vegetarian ☐

   3) Ovo-vegetarian ☐ 4) any other (Specify)

2. How many main meals do you have a day?

   1) One ☐ 2) Two ☐ 3) Three ☐

3. Meal preparation is done:

   1) Self ☐ 2)Others ☐ 3) Self with assistance ☐

4. Are you consulted in planning the menu?

   1) Often ☐ 2) Sometimes ☐ 3) Rarely ☐ 4) Never ☐

5. Food shopping is done by

   1) Self ☐ 2) Others ☐ 3)Self with assistance ☐

6. Do you feel you take sufficient quantity of food? Yes☐ No ☐

   If no, why? 1) Poverty ☐ 2) Lack of appetite ☐ 3)Neglected appetite ☐

7. In case you want a special dish, you get it arranged? Yes ☐ No☐

8. Appetite 1)Good ☐ 2)Fair ☐ 3) Poor ☐

9. Water/beverage intake per day?

   1)1-3 glasses ☐ 2) 4-7glasses ☐ 3)8 glasses or more ☐

10. Preference of food forms:

    1)Liquid ☐ 2)Semi-solid ☐ 3)Soft ☐ 4)Solid ☐ 5)Crunchy ☐ anyother

11. Preference of food taste:

    1)Bland foods ☐ 2) Saltyfoods ☐ 3) Sweets☐ 4)Hot, spicy foods ☐

12. Do you have any dietary modification than a normal diet? Yes ☐ No ☐

Type*	**Need for special diet**	**Modification in**	
		Nutrient	**Consistency**

*Low energy; low salt, low protein, low fibre, high calorie, high protein, high fat, high fibre, diabetic, vegetarian etc

13. How long have you been on this diet? ……Year…….Months

14. Do you include certain foods in your meals for health reasons? If yes, what foods or food ingredients?

Food stuffs	Frequency of consumption			
	Daily often	Occasionally	Never	Reason
Green leafy vegetables				
Yellow vegetables				
Other vegetables				
Yellow fruits				
Vit. C rich foods(Citrus fruits)				
Other fruits				
High fibre breads				
Unrefined cereals				
Ragi				
Sea foods				
Garlic				
Tea				
Health foods, specify				

15. Do you avoid certain scores foods or food ingredients? If yes, what foods or food ingredients?

Food stuffs	Frequency of consumption			
	Totally avoided	Occasionally avoided	Never avoided	Reasons
Meat in general				
Pork				
Beef				
Fatty meat/meat products				
Eggs				
Dairy products				
Sea food				
Fats and oils				
Sugar or sugar products				
Pastries				
Salt and salty foods				
Carbonated beverages				
Tea/coffee				
Others, specify				

16. Food check list : Food Frequency, Food variety and Phytochemical density

Food variety list	Food items	Frequency			Food Variety score*	Phyto- chemical density score**
		High (daily)	Medium (1- 6 times / Week)	Low (Less than once a week)		
	Cereals/ cereal products					
F.V. 1.	**Rice**[* 1]					
F.V. 2.	**Wheat**[* 2]					
F.V. 3.	**Ragi**[* 3]					
F.V. 4.	**Corn**[* 4]					
F.V. 5.	**Oats**[* 5]					
F.V. 6.	**Barley**[* 6]					
F.V. 7.	***Pulses***					
	Lentils (Red, green, black, bengal) [*7]					
	Dals (Green gram, red gram, Bengal gram, black gram)					
	Peas (Fresh, dried) [*8]					
	Soya bean/soy products[* 9]					
	Beans (Kidney, broad) [* 10]					
	Vegetables					
F.V. 8.	**Green leafy vegetables**[* 11]					
F.V. 9.	**Drum stick**					
	Ladies finger					
	Beans					
	Brinjal					
	Gourds					

Food variety list	Food items	Frequency			Food Variety score	Phyto- chemical density score
		High (daily)	Medium (1- 6 times / Week)	Low (Less than once a week)		
	Green plantain					
	Green papaya					
	Cow pea					
	Cabbage					
F.V. 10.	**Cauliflower*** [12]					
	Broccoli*					
F.V. 11.	**Mushrooms**					
F.V. 12.	**Cucumber*** [13]					
	Pumpkin					
F.V. 13.	**Tomatoes**					
F.V. 14.	**Capsicum*** [14]					
	Chillies					
	Roots and tubers					
F.V. 15.	**Potato*** [15]					
	Carrot* [16]					
	Tapioca					
	Yams* [17]					
	Beetroot					
	Sweet potato* [18]					
F.V. 16.	**Onion*** [19]					
F.V. 17.	***Sea foods***					
	Fatty fish					
	Tuna					
	Anchory					
	Sardine					
	Mackerel					
F.V. 18.	***Salt water fishes***					
	Shark					
	Pomfret					

Food variety list	Food items	Frequency			Food variety score	Phyto- chemical density score
		High (daily)	Medium (1- 6 times / Week)	Low (Less than once a week)		
	Saber fish **Milk fish** **Mullet** **Flat fish** **Spotted bat fish** **White sardine** **Thread fin** **Pony fish** **Sea pike**					
F.V. 19.	***Fresh water*** **Pearl spot** **Snake head**					
F.V. 20.	***Shell fish*** **Mussels** **Oysters** **Squids**					
	Clams					
F.V. 21.	***Crustaceans*** **Crab** **Prawn** **Lobsters**					
F.V. 22. F.V. 23. F.V. 24. F.V. 25. F.V. 26. F.V. 27.	***Animal products*** **Mutton, lamb, beef, veal** **Pork** **Chicken, duck** **Liver** **Brain** **Egg (all varieties)**					

Food variety list	Food items	Frequency			Food variety score	Phyto- chemical density score
		High (daily)	Medium (1- 6 times / Week)	Low (Less than once a week)		
	Fruits					
F.V. 28.	**Apple**					
F.V. 29.	**Grapes**					
F.V. 30.	**Mango, pineapple,**					
F.V. 31.	**papaya** [* 20]					
F.V. 32.	**Orange, lemon** [* 21]					
F.V. 33.	**Guava**					
F.V. 34.	**Raisins** [* 22]					
F.V. 35.	**Melons** [* 23]					
F.V. 36.	***Milk and milk products*** **Milk, cheese, Ice – cream**					
F.V. 37.	**Curd, butter milk**					
F.V. 38.	***Sugar and sugar products*** **Sugar, jaggery, honey, confectionary**					
F.V. 39.	***Nuts and oil seeds*** **Cashewnut, coconut, peanut** [* 24,] **sesame seeds** [* 25]					
F.V. 40.	***Fats and oils*** **Coconut oil** **Sunflower / safflower** **Gingelly oil** **Groundnut oil**					
F.V. 41.	**Ghee** **Butter**					
	Beverages					
F.V. 42.	**Tea, coffee, herbal tea**					
F.V. 43.	**Wine** [* 26]					
F.V. 44.	**Fresh fruit juices** [* 27]					

Food variety list	Food items	Frequency			Food Variety score	Phyto- chemical density score
		High (daily)	Medium (1- 6 times / Week)	Low (Less than once a week)		
F.V. 45.	***Fermented foods***[*] [28] **Idli, appam etc**					
F.V. 46.	***Herbs, spices*** **Mint**[* 29] **Coriander**[* 30] **Garlic**[* 31] **Ginger**[* 32] **Cumin**[* 33] **Pepper**[* 34] **Turmeric**[* 35] **Stalks – celery, spring onion, asparagus**[* 36]					

[**]**Phytochemical density Score**- Score 1 point for each food if eaten at least once a week, irrespective of serving size (WHO. 2002).

Original Phytochemical density score (WHO, 2002) consists of 63 items, of which 27 non familiar foods have been omitted; they are apricot, peaches, kiwi, rye, sorgum, avocado, artichoke, strawberries, figs, broccoli, red capsicum, rubharb, swede, pumpkin seeds, basil, oregano, parsely, thyme, rosemary, olive, chick pea, green tea, linseed, Hazel nuts, radish, leeks, pears. The modified checklist therefore contains only 36 items (marked as *)

Scoring was scaled down as follows : > 15 – High,5-15 – Average,<5 – Low

[*]**Food variety score**- Score of 1 point is given to each class of food only once if consumed at least once a week irrespective of serving size (WHO, 2002).

Original food variety checklist consists of 57 items. 11 food items unfamiliar in this region have been omitted. They are – quail, pigeon, kangaroo, rabbit, caviar salad, rye, yeast extract, kiwi, miso, Saurkraut, Tofu, Mineral water.

Modified checklist contains 46 items. (Given as FV1-46) The scoring has also been scaled down as follows : >24 – very good, 20-24 – Good, 16-20 – Fair, < 16 = Marginal.

APPENDIX XIII

ONE DAY FOOD WEIGHMENT FORM

Menu	Food stuff	Total raw ingredients (gm)	Total cooked food(gm)	Individual intake of cooked food (gm)	Individual raw intake* (gm)
Breakfast					
Lunch					
Dinner					
Any other					

$$* \text{ Individual raw intake (I.R.I)} = \frac{\text{Total raw ingredient}}{\text{Total cooked quantity}} \times \text{Individual intake of cooked food}$$

APPENDIX IV

CLINICAL ASSESSMENT SCHEDULE

(N.A.C –I.C.M.R)

CODE NO

_____ _____ _____

1.	Sex			
2.	Age			
3.	Height			
4.	Weight			
5.	Arm span			
I)	***General***			
6.	Appearance 0. Good 1. Fair 2. Poor 3. Very poor			
II)	***Eyes***			
A.	**Conjunctiva**			
7.	Xerosis 0. Absent, glistening and moist 1. Slightly dry on exposure for a minute, lack of luster 2. Conjunctiva dry and wrinkled 3. Conjunctiva very dry and Bitot's sports present			
8.	Pigmentation 0. Normal colour 1. Slight discolouration 2. Moderate browning in patches 3. Sever earthy discoluration			
9.	Discharge 0. Absent 1. Watery, excessive, lachrymation 2. Mucopurulent 3. Purulent			

B. Cornea			
10. Xerosis			
0. Absent 1. Slight dryness and diminished 2. Haziness and diminished transparency 3. Ulceration			
11. Vascularization			
0. Absent 1. Circumocorneal infection 2. Vascularization of cornea			
C. Lids			
12. Excoriation			
0. Absent 1. Slight excoriation 2. Blepharitis			
13. Folliculosis			
0. Absent 1. A few granules 2. Lids covered with extensive granules 3. Hypertrophy			
14. Angular conjunctivitis			
0. Absent 1. Present			
D. Functional			
15. Night blindness			
0. Absent 1. Present			
(N.B. – Exclude other dye diseses not associated with nutritional defects)			
III) *Mouth*			
A. Lips			
16. Condition			
0. Normal 1. Angular stomatitis, mild 2. Angular stomatitis, marked			

B.	**Tongue**			
17.	Colour			
	0. Normal 1. Pale but coated 2. Red 3. Red and raw			
18.	Surface			
	0. Normal 1. Fissured 2. Ulcered 3. Glazed and atrophic			
C.	**Muccal Mucosa**			
19.	Condition			
	0. Normal 1. Stomatitis			
D.	**Gums**			
20.	Condition			
	0. Normal 1. Bleeding and / or gingi vits 2. Pyurrhoea 3. Retracted			
E.	**Teeth**			
21.	Fluorosis			
	0. Absent 1. Chalky teeth 2. Putting of teeth 3. Mottled and discoloured teeth			
22.	Caries			
	0. Absent 1. Slight 2. Marked			
IV.	***Hair***			
23.	Condition			
	0. Normal 1. Loss of luster 2. Discoloured and dry			

	3. Sparse and brittle			
V.	***Skin***			
A.	**General**			
24.	Appearance			
	0. Normal 1. Loss of luster 2. Dry and rough or crazy pavements 3. Dry and rough or crazy pavements 4. Hyperkeratosis			
25.	Elasticity			
	0. Normal 1. Diminished 2. Wrinkled skin			
B.	**Regional**			
26.	Trunk			
	0. Normal 1. Collar – like pigmentation and dermatitis around the neck			
27.	Face			
	0. Normal 1. Nasolabial dyssebacea 2. Symmetrical sub-orbit pigmentation 3. Moon face			
28.	Perineum			
	0. Normal 1. Scrotal or puddendal dermatitis			
29.	Extremities			
	0. Normal 1. Symmetrical dermatitis with pigmentation of gove or stocking type			

VI.	***Adipose tissue (to be judged by the examination of the arm over the biceps)***			
30.	Quantity			
	0. Normal 1. Deficient			
VII.	***Oedema***			
31.	Distribution			
	0. Absent 1. Oedema on dependent parts 2. Oedema on face and dependent parts 3. General anasarca			
VIII.	***Bones***			
32.	Condition			
	0. Normal 1. Stigmata of past rickets			
IX.	***Heart***			
33.	0. Normal 1. Apex just outside the nipple line 2. Enlarged			
X.	***Alimentary system***			
34.	Appetite			
	0. Normal 1. Anorexia			
35.	Stools			
	0. Normal evacuation 1. Diarrhoea			
36.	Liver			
	0. Not palpable 1. Palpable			
37.	Spleen			
	0. Not palpable 1. Palpable			
XI.	***Nervous system***			
38.	Calf tenderness			
	0. Absent 1. Present			

39. Paresthesia
    0. Absent
    1. Present

XII. ***Neck***
    0. Goitre
    1. Parotid enlargement

XllI. According to the clinical assessment, how would you rate the patient's nutritional status?

1. Well nourished			
2. At-risk of malnutrition			
3. Malnourished			

APPENDIX V

ESTIMATION OF HAEMOGLOBIN

Cyanmethaemoglobin method

PRINCIPLE

The Hb (Oxyhaemoglobin, Methaemoglobin, Carboxy haemoglobin) is converted to Cyanmethaemoglobin according to the following reaction.

Hb $\xrightarrow{K_3 Fe(CN)}$ Methaemoglobin

Methaemoglobin $\longrightarrow$ Cyanmethaemoglobin

The absorbance of Cyanmethaemoglobin is proportion to the Hb concenteration.

REAGENT

Drabkins solution : Dissolve 0.05g of KCN, 0.20g of Potassium ferric cyanide and 1.0g of sodium bicarbonate in 11ml of distilled water.

PROCEDURE

20 µL of blood is transferred with the help of Hb pipette into a test tube containing 5ml of Drabkins solution. It is mixed thoroughly and readily taken in a photo electric colorimeter at 546 nm. Optical density of standard haemoglobin solution is also measured using a colorimeter . Hb content of the sample is found out using the formula .

$$\text{Hb (gm/dl)} = \frac{\text{Optical density of sample}}{\text{Optical density of standard}} \times N \times 0.251$$

Where,

N = Concentration of standard Haemoglobin = 60 g/dl.

APPENDIX VI

ESTIMATION OF SERUM ALBUMIN
(Biuret and BCG method)

PRINCIPLE

The reaction between albumin from serum or plasma and the dye bromocresol–green produces a change in colour that is proportional to the albumin concentration.

REAGENT COMPOSITION

Albumin reagent	-	5 × 50 mL
Succinate buffer, (PH 4.2)	-	75 mmol/L
Bromocresol green	-	0.14 g/L
Albumin standard	-	1 × 3 mL
Albumin standard concentration	-	3 g/dL

The sealed reagents are stable up to the expiry date sealed on the label, when stored at room temperature and standard at 2 –8^{o} C.

PROCEDURE

	Blank	**Standard**	**Sample**
Reagent	1000 µL	1000 µL	1000 µL
Standard	-	10 µL	-
Sample	-	-	10 µL

- Mix and incubate for one minute.
- Measure the absorbance of standard and sample against reagent blank.

CALCULATION

$$\text{Albumin concentration (g/dL)} = \frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times 3$$

APPENDIX VII

SERUM IRON ESTIMATION

Intended use:- The IRN Method used on the Dimension clinical chemistry system is an in vitro diagnostic test intend for the quantitative determination of iron in human serum

Summary :- The IRN method is direct iron procedure using a surfactant to prevent protein precipitation. A serum blank is used to correct for differences in specimen turbidity Potential copper interference is minimized by the addition of thiourea.

Principles of Procedure :- Under acidic condition (pH 4.5) iron bound to the protein transferring is released in the presence of the reducing agent, ascorbic acid. The resulting product, Fe^{++} forms a blue complex with 3-(2-pyridyl)-5, 6-bis-2-(5-furyl sulfuric acid)-1,2, 4-triazine, disodium salt (Ferene). The absorbance of the complex, measured using a bichromatic (600, 700nm) endpoint technique, is proportional to the concentration of tranferin bound iron in the serum.

Test Steps

Sampling, reagent delivery, mixing, processing and printing of results are automatically performed by the Dimension system For details of this processing, refer to specific Dimension Operator's Guide.

The sample container (if not a primary tube) most contain sufficient quantity to accommodate the sample volume plus the dead volume; precise container filing is not required.

Test conditions

Sample size	50µl, (25 µl)
Reagent 1 volume	100 µl
Reagent 2 volume	25 µl
Diluent size	225 µl
Temperature	$37^{o}C$
Wave length	600 and 700nm
Type of measurement	Bichromatic end point

APPENDIX VIII

ESTIMATION OF BLOOD EOSINOPHILS
(DC detection method)

Differential Count (DC) detection method for blood cell count is used for analyzing eosinophil %.

Method

Blood sample is aspirated measured to a pre-determined volume, diluted at the specified ratio, then fed into each transducer. The transducer chamber has a minute hole called the aperture. On both side of the aperture, there are electrodes between which flows direct current. Blood cells suspended in the diluted sample pass through the aperture, causing direct current resistance to change between the electrodes. As direct current resist changes, the blood cell sizes is detected as electric pulses.

Blood cell count is calculated by counting the pulses, and histogram of blood cell sizes is plotted by determining the pulse sizes. Also, analyzing a histogram makes it possible to obtain various analysis data.

APPENDIX IX

DETERMINATION OF ESR
(WESTERGREN METHOD)

Aim

To determine the Erythrocyte Sedimentation Rate (ESR).

Method

Take 0.4 ml of 3.8% of sodium citrate solution in a clean and dry pencilline bottle and add 1.6ml of venous blood. Mixed well. A clean ESR pipette is taken and this anticoagulant blood drawn up to mark '0' without air bubbles. Then the pipette is placed vertically in an ESR rack and noted the time. After the end of the 1-hour take the reading of fall of the sedimentation of RBC.

APPENDIX X

BLOOD GLUCOSE ESTIMATION

(GOD – POD, End point assay)

Assay principle

Glucose oxidase (GOD) oxidizes glucose to gluconic acid and hydrogen peroxide. In the presence of enzyme peroxidase, released hydrogen peroxide is coupled with phenol and 4-amino antipyrine (4-AAP) to form coloured quinoneimine dye. Absorbance of coloured dye is measured at 505 nm and is directly proportional to glucose concentration in the sample.

$$\text{Glucose} + O_2 + H_2O \xrightarrow{\text{Glucose oxidase}} \text{Gluconic acid} + H_2O_2$$

$$H_2O_2 + \text{Phenol} + 4 - \text{AAP} \xrightarrow{\text{Peroxidase}} \text{Quinonimine dye} + H_2O$$

Reagents :

Glucose regent, glucose diluent, glucose standard, working reagent (glucose diluent + glucose reagent)

Serum / plasma must be separated from the cells within 30 minutes and stored at room temperature (15 – 30^{o}C) stable for 8 hours.

Procedure

Prepared the blank, standard and test solutions by adding the reagents in different test tubes as indicated below: -

Sl. No.	Reagent	Blank	Standard	Test
1.	Serum / plasma	-	-	100 µL
2.	Glucose standard	-	10 µL	-
3.	Working glucose reagent	1000 µL	1000µL	1000µL

Mix well and incubate at 37^{o}C for 10 minutes or at room temperature (15 – 30$^{o[}$C) for 30 minutes.

Program the analyser as per assay parameters.

1) Blank the analyser with Reagent blank.
2) Measure the absorbance of Standard followed by the Test.
3) Calculate the result as per the given formula.

Calculation

Serum / plasma (Glucose (Mg/dL) =

$$\frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times 100$$

APPENDIX XI

TOTAL CHOLESTEROL ESTIMATION
(CHOD – PAP method)

Principle

Cholesterol ester + 2 H_2O $\xrightarrow{\text{Cholesterol esterase}}$ Cholesterol + fatty acid

Cholesterol + O_2 $\xrightarrow{\text{Cholesterol oxidase}}$ Cholesterol – 3 – one + H_2O

$2H_2O$ + 4 – amino antipyrine + Phenol $\xrightarrow{\text{Peroxidase}}$ Quinoneimine + 4H2O

Reagents :

25 ml and 100ml buffered enzyme / chromogen, standard (200mg/dl).

All regents are to be stored at 2 – 8^{o} C, protected from light and contamination. Do not freeze.

Assay procedure

Prepare the blank, standard and test solution by adding the reagents in different test tubes as indicated below :

Sl. No.	Reagent	Blank	Standard	Test
1.	Monoreagent	1000 μL	1000 μL	1000 μL
2.	Distilled water	10 μL	-	-
3.	Standard	-	10 μL	-
4.	Sample	-	-	10 μL

Mix, incubate for 15 minutes at 20 – 25^{o}C or for 10 minutes at 37^{o}C. Measure optical density (O.D) at 500 nm within 60 minutes against Reagent Blank.

Calculation

Concentration of cholesterol in sample (mg/dl)

$$= \frac{\text{O.D. of sample}}{\text{O.D. of standard}} \times \text{Concentration of standard}$$

APPENDIX XIV

MINI NUTRITIONAL ASSESSMENT

MNA

Last Name : _____ First Name: _____ M.I. _____Sex: _____ Date : _____

Age:_____ Weight Kg: _____ Height Cm: _____

Complete the form by writing the numbers in the boxes. Add the numbers in the boxes and compare the total assessment to the Malnutrition Indicator Score.

ANTHROPMETRIC ASSESSMENT

1. Body Mass Index (BMI) (weight in kg/)/height in m)^2 a. BMI<19 = 0 points b) BMI 19 to <21 = 1 point c) BMI 21 to <23 = 2 points d) BMI ≥ 23 = 3 points	Points ☐
2. Mid arm circumference (MAC) in cm a) MAC<21 = 0.0 points b) MAC 21 ≤ 22 = 0.5 points c) MAC>22 = 1.0 points	☐
3. Carf circumference (CC) in cm d) CC<31=0 points e) CC ≥ 31= 1 point	☐
4. Weight loss during last 3 months f) weight loss greater than 3 kg(6.6lbs) = 0points g) does not know = 1point h) weight loss between 1 and 3kg (2.2 and 6.5lbs) = 2 points i) no weight loss = 3 points	☐

GENERAL ASSESSMENT

5. Lives independently (notin a nursing home or hospital) a) no = 0 points b) yes = 1 point	Points ☐
6. Takes more than 3 prescription drugs per day a) yes = 0 points b)no = 1 point	☐
7. Has suffered psychological stress or acute disease in the past 3 months a) yes = 0 points b)no = 1 points	☐
8. Mobility a) bed or chair bound = 0points b) able to get out of bed/chair but does not get out = 1point c) goes out = 2 points	☐
9. Neuropsychological problems a) severe dementia depression = 0 points b) mild = 1point c) no = 2 points	☐
10. Pressure sores /skin ulcers a) yes = 0 points b)no = 1 point	☐

DIETARY ASSESSMENT

11. How many meals do you eat daily? a) 1 meal = 0 points b) 2 meals = 1 point c) 3 meals = 2 point	☐
12. Selected consumtion markers for protein intake - Atleast one serving of dairy products (milk, chees, yogurt) per day? Yes/ No	☐
- Two or more servings of legumes or eggs per week? Yes / No - Meat, fish or poultry every day? Yes/ No a) If 0 or 1 yes = 0.0 points b) if 2 yes = 0.5 points c) if 3 yes = 1.0 points	
13. Do you consume two or more servings of fruits or vegetables per day? a) no = 0 points b) yes = 1 point	☐
14. Has food intake declined over the past three months due to loss of appetite, digestive problems, chewing or swallowing difficulties? a) Severe loss of appetite = 0 points b) Moderate loss of appetite =1point c) No loss of appetite = 2 points	☐
15. How much fluid (water, juice, coffee, tea, milk….) is consumed per day?(1cup = 8 oz) a) less than 3 cups = 0.0 points b) 3 to 5 cups = 0.5 points c) More than 5 cups – 1.0 points	☐
16. mode of feeding a) unable to eat without assistance = 0 points b) self fed with some difficulty = 1 point c) self fed without any problem = 2 points	☐

SELF ASSESSMENT

17. Do they view themselves as having nutritional problems? a) major mal nutrition = 0 points b) does not know or moderate malnutrition = 1 point c) no nutritional problem = 2 points	☐
18. In comparison with other people of the same age, how do they consider their health status? a) recognized = 0 points b) doesnot know = 0.5 points c) as good = 1.0 points d) better = 2.0 points	☐

ASSESSMENT TOTAL (max.30 points)

MAL NUTRITION INDICATOR SCORE		
≥ 24 POINTS	well nourished	☐
17 to 23.5 points	at risk of mal nutrition	☐
< 17 points	mal nourished	☐