

NUTRITIONAL STATUS AND IMPACT OF A MALTED FOOD SUPPLEMENT ON SELECTED INSTITUTIONALISED ELDERLY

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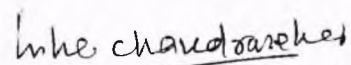
M.R.PREMALATHA

**A DISSERTATION SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR
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FOR THE REQUIREMENTS OF THE DEGREE OF
DOCTOR OF PHILOSOPHY**

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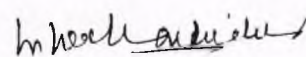
CERTIFICATE

This is to certify that the dissertation entitled '**Nutritional Status and Impact of a Malted Food Supplement on Selected Institutionalised Elderly**' submitted to the Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Food Science and Nutrition** is a record of original research work done by **M.R.PREMALATHA**, during the period of her study in the **Department of Food Science and Nutrition, Avinashilingam Institute for Home Science and Higher Education for Women, (Deemed University), Coimbatore** under my supervision and guidance and the dissertation has not formed the basis for the award of any Degree/Diploma/Associateship/Fellowship or similar title to any candidate of any other University and it represents entirely an independent work on the part of the candidate.



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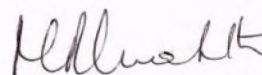


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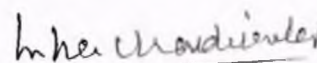
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DECLARATION

I hereby declare that the dissertation entitled '**Nutritional Status and Impact of a Malted Food Supplement on Selected Institutionalised Elderly**' submitted to the Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, in partial fulfilment of the requirements for the award of the **Degree of Doctor of Philosophy in Food Science and Nutrition** is a record of original research work done by me under the supervision and guidance of **Dr. (Mrs.) USHA CHANDRASEKHAR, M.Sc., Ph.D., (Purdue)**, Professor and Head of Department of Food Science and Nutrition and that it has not formed the basis for the award of any Degree/Diploma/Associateship/ Fellowship or similar title to any candidate of any other University.



Signature of the Candidate



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INTRODUCTION

INTRODUCTION

Greying population is one of the most significant characteristics of the twentieth century, and the first quarter of the twenty first century is to be called, "The Age of Ageing". What has been an extraordinary achievement during the last century will be one of the greatest challenges for the present century-ensuring quality of life of an unprecedentedly large elderly population (Vijayakumar, 1999 and WHO, 2000).

The terminology 'geriatrics', derived from the Greek word 'gerios' meaning old age and 'iatros' meaning medicine refers to the science of elderly. British Geriatric Society defines 'geriatrics' as that branch of general medicine concerned with the clinical, preventive, medical and social aspects of illness in the elderly' (Natarajan, 1998 and Sivaramakrishna, 2000).

The International Year of older persons, officially declared by the United Nations from October 1, 1998 to December 3, 1999 had the unifying theme 'Towards a society for all ages' and the communities all over the world were urged to promote independence, participation, care, self-fulfilment and dignity of the aged (United Nations, 1999). The Government of India has designated 2000 as the National Year of Older Persons (NYOP). NYOP is an unique opportunity to focus on ageing as a development issue (Kapoor, 2000).

The world's elderly population is increasing monthly by about one million persons. An interesting observation from United Nations Demographic Estimations states that in 1985, throughout the world there were 427 million persons aged 60 and over, constituting 8.83 per cent of the world's total

population. By the year 2025, these figures are projected to rise to 1,171 million, an increase of 174 per cent. In other words the elderly by the year 2025, will constitute 14.28 per cent of the world's population. Coming to the trends in developing countries, in 1985, 241 million persons (i.e. 56.5 per cent of the world's elderly) lived in developing countries and this proportion is further projected to reach 61.5 per cent by the turn of the century and 71.9 per cent by the year 2025 (Ghosh, 1998 and Vijayakumar, 1999).

The demographic shift of the global elderly has immense implications for India as the Indian society has been undergoing rapid transformation under the impact of several factors like industrialisation, urbanisation and education. Consequently, the traditional system of values are in a process of adaptation. Demographically speaking, in 1991 in India, the death rate had declined to 29.1 per 1000 and life expectancy increased to 59.4 years, whereas the birth rate had declined to 29.5 per 1000. As a combined effect of these changes, the proportion of elderly in India is growing at a rate faster than the general population (Tripathi, 1999). The life expectancy of males is projected to be 67 years in 2011-2016, whereas for females it is projected to be 69 years which is higher than that of males. The number of older persons has increased from 12 million in 1901 to 57 million in 1991. It is projected to be 100 million in 2013 and 326 million in 2050 (Tyagi, 2000).

United Nations defines populations with four to seven per cent elderly persons as 'mature' and seven and above as 'aged'. Census 1991 reports 6.58 per cent of the Indian population to be more than 60 years old, which is projected to be 7.08 per cent by 2001 and 8.18 per cent by 2011. Thus, Indian population is on the verge of being 'aged' (Karkal, 2000).

This magnitude highlights the necessity to provide social services and other benefits to senior citizens. Moreover, with the increased pace of industrialisation and urbanization, older persons are in a vulnerable position in family and community. In the coming decade more number of aged persons (60 and above) will belong to middle and upper income groups implying that there is a need for opportunities for more active, creative and satisfying life (Khan and Kaushik, 1999).

As the number of elderly increases, it poses considerable economic, social and health implications. This segment of the population will be physically fragile, economically unproductive and totally dependent on others. This is a formidable challenge. The most difficult task will be to prevent the conversion of this physiological ageing into pathological ageing with the imposition of chronic degenerative diseases like hypertension, diabetes, coronary heart diseases and malignancies which might then become the major killers of the elderly (Devadas, 2000). Evidence points to the importance of nutrition in the development, susceptibility and outcome of these diseases. There are, however problems in diagnosing undernutrition in the elderly because of physical and biochemical changes which may take place as part of normal ageing (Chandrasekhar, 2000).

Physical changes such as decreased visual acuity, joint problems, hand tremors and hearing problems may make the task of food preparation and eating more difficult for the elderly. Other risk factors which may affect nutritional status in the elderly include: isolation with an inability to go out shopping, loss of spouse, depression and bereavement, decreased mobility, dementia, anorexia due to disease, medications, poor dentition, alcoholism

and most important of all, acute illness. Since old people are disproportionately isolated, are on low income or disabled, socioeconomic factors and diseases are likely to have more influence on their nutritional status than age alone (Krishna and Samat, 1997; Chandrasekhar, 2000).

Care of the elderly as a complete science, is yet to emerge in India. Rapidly rising number of the 60-plus age group in demographic surveys, the increasing complexity of life, pressure on family and social relations, the mental problems of adjusting to these changes and all the other obvious limitations in finance, mobility and health often add to functional disability and require not only support systems on a planned basis but also rethinking on the whole subject of ageing (Ravindran, 1998). Therefore, as pronounced by the Director General of the World Health Organisation, 'Our goal should not be solely to extend lives in the physical sense, but also to ensure that added years are worth living with diminishing handicaps and disabilities, and with a greater degree of health security' (Tuli, 1996).

Taking care of the aged has become a pressing problem in India with the growth of nuclear and micro nuclear families in which case the earning members mostly are abroad. On the other hand in families where the adults are unemployed and have many mouths to feed, taking care of an elderly causes a substantial drain on the meagre family resources. Thus both in the affluent families and in the poverty stricken families elders are left to fend for themselves. This has paved way to the concept of residential institutions for the elderly. Old age homes are places of exile to some and a welcome option to others. If one is to celebrate longevity it must be accompanied by improvements in the quality of life and the development of efficient support systems for the elderly.

Chandrasekhar (2000) reports that those elderly men and women living with their children had a comparatively better food and nutrient intake than their counterparts staying alone or in old age homes. The lower food and nutrient intakes in those elderly who live alone could be attributed to the vacuum at home in terms of socialization, familial atmosphere and attention. In old age homes, lack of supervision and assistance at meal times may be an important factor resulting in poor food intake. In 'pay and stay' old age homes the types of foods served and the residence facilities are better than in free, charity old age homes. The monotony in the menu, an atmosphere alien to what the individual is used to, compounded with the absence of ones' kith and kin tend to adversely affect the food intake.

Thus, among the numerous environmental factors that modulate ageing, food and nutrient intake play a significant role. The inseparable triad of nutrition, ageing and health is the logical basis for appropriate management of problems that arise at the interface of the interdependent factors. Dietary alterations, even in later life, may be effective in reducing further progression of certain diseases and in some cases, may even improve nutritional status. A well balanced diet and adequate exercise can counteract some of the physiological changes attributed to ageing and promote successful ageing. Nutritional risks are inherent in an ageing population and must be monitored and modified to prevent malnutrition (Forbes, 1999).

There is an increasing consensus among scientists that both nutrients and non-nutrient components of the diet may play a significant role in several chronic and metabolic disorders such as cardiovascular diseases, cancer, cataract, diabetes, ageing etc. Many of these disorders have a long

latency period between dietary exposures, inception and disease manifestations. Diet can modify the pathophysiological processes and hence primary prevention through dietary modifications has great promise for determining the health and nutrition trends and pattern of diseases. Since last 50 years, foods are being scientifically investigated and evaluated for their disease prevention and therapeutic effects. In fact, food is now viewed as a miracle medicine and food based approaches viz., food and food technology including processing and fortification, for nutritional deficiencies and prevention of chronic diseases is the focus of attention (Krishnaswamy and Raghuramulu, 1998).

Malnutrition at subclinical or clinical levels, with or without degenerative diseases thus seems inevitable among the aged. Giving them a nutritious supplement prepared out of locally available foods in a form that poses no difficulty in consuming could contribute in a large measure to improve the nutritional status of the elderly and monitor specific disease conditions if any. Easy digestibility and the low bulk characteristics of malted food grain make it an ideal food for geriatric subjects (Sumathi *et al.*, 1995).

Finger millet or ragi (*Eleusine coracana*) malt, in low bulk, nutrient dense weaning foods has been well demonstrated and the technology is well adopted. Similarly, malted wheat has the highest amylase activity, bulk reducing ability and increased nutrient density. Use of such locally feasible malted cereal, millet combinations could not only provide a nutrient dense food supplement but might be an easily digestible, acceptable, calorie dense and effective proposition for geriatric supplementation, especially in institutions.

Considering the dimensions of increase in oldage population, and the need to establish viable oldage homes with inbuilt provision for the sociocultural, psychological and physical well being of the elderly, it was thought of interest to study the existing life pattern of elderly in selected institutions and develop a feasible cereal, millet supplement to suit their life patterns within the constraints of oldage homes. The broad objective of this study thus, was to assess the life pattern and nutritional profile of elderly from selected charitable oldage homes of Tamil Nadu and to evaluate the potential of a malted food supplement in the diets of the elderly. The specific objectives were:

1. To assess the life pattern of selected institutionalised elderly from charitable homes.
2. To study their nutritional and health profile.
3. To formulate and evaluate the quality and acceptability of a cereal, millet malted supplement.
4. To ascertain the efficacy of the formulated malted supplement on the nutritional well being of the selected institutionalised elderly.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

The review of literature pertaining to the present study titled 'Nutritional status and impact of a malted food supplement on selected institutionalised elderly' is discussed under the following headings:

- A. Ageing -Definitions, Demographic Transition and Theories
- B. Physiological Changes During Ageing
- C. Psycho Social Problems of the Elderly
- D. Ageing and ill Health
- E. Nutritional Supplements for the Elderly

A. Ageing - Definitions, Demographic Transition and Theories

1. Definitions

Ageing is a gradual development process of biological, psychological, sociological and behavioral changes that begins the moment an individual is born. Ageing signifies the progression of changes in the biochemical process which determine the structural and functional alteration with age in the cellular and noncellular tissues (Venkataraman, 1998).

According to Ghosh, (1998) ageing starts when the first calcific deposition occurs in the vessels and ligaments. At the molecular level, ageing manifests when the orderly sequence of the DNA in the double strands starts getting mixed up while being replaced or repaired.

From a sociological perspective, Natarajan (1999) defined old age as the age of retirement for it is at that time the combined effect of ageing, social changes and diseases are likely to cause a breakdown in health.

The World Health Organisation uses the following classification of age groups 60-74 years -elderly; 75-89 years -old and 90+ very old. Nevertheless any cut off points used to define the elderly are bound to be arbitrary because ageing occurs at different rates in different individuals and even in different physiological systems within the same individual (WHO, 1999).

2. Demographic Transition

Population pass through various stages termed as “epidemiological transition” which represent a shift from high mortality/high fertility to low mortality/low fertility and from a low proportion to high proportion of elderly. The world at present is passing through the third stage of epidemiological transition (United Nations Department of Public Information, 1999).

On the basis of age, population of a country can be divided into three groups namely children (0-14 years), productive and economically active group (15-59 years) and the aged (60 years and above). Aged group is further divided into categories ‘young old’ and ‘old - old’. People between 60 and 70 years come under young old category and those above 70 years come under ‘old-old’ category. Ageing of population occurs when there is an increase in proportion of old persons in the population. According to United Nations, a population may be defined as aged when the proportion of persons above the age of 64 in the population exceeds seven per cent (Jayashree, 1997).

An interesting observation from United Nations’ Demographic Estimations is that in 1985 there were 427 million persons aged 60 and over, constituting 8.83 per cent of the world’s total population. By the year 2025,

these figures are projected to rise to 1,171 million, an increase of 174 per cent. In other words the elderly by the year 2025, will constitute 14.28 per cent of the world's population. In 1985, 241 million persons aged above 60 years (i.e. 56.5 per cent of the world's elderly) lived in developing countries and this proportion is further projected to reach 61.5 per cent by the turn of the century and 71.9 per cent by the year 2025 (Vijayakumar, 1999).

Enhanced life span of human beings is one of the positive consequences of science and technology in general and health science in particular. As a result, close to three decades have been added to life expectancy at birth world wide since the turn of the 20th century (Kalache, 1999). With gradual and sustained increase in life expectancy, the number of elderly both relative and absolute, are increasing all over the world. This phenomenon is referred to as 'Population Ageing' (Jayashree, 1997 and Reddy *et al.*, 1999).

Population ageing is an obvious consequence of the process of demographic transition. Being ahead in the process, the developed regions of the world have experienced this situation and the developing regions are well on its way to face a similar scene (Rajan *et al.*, 1999). Many people in the developed countries are living upto the age of 70 years and over. The age structure of the population in the developed countries has so evolved that the number of old people is continuously on the increase. These trends are appearing in all countries where medical and social services are well developed and the standard of living is high (Kulkarni, 1999). From a demographic point of view, population ageing is a result of both mortality and fertility. Fewer children are born and more people reach old age (Kulkarni, 1999).

Currently there are about 580 million people in the world 60 years and over, and this figure is expected to rise to over 100 million within the next 20 years. By 2020, approximately 70 per cent of the population will be living in developing countries. These changes represent an unprecedented demographic revolution and require the immediate attention of policy makers worldwide. Compared to the speed at which populations in the developing world are ageing at present, the process in industrialized countries has been found ^{to be} much slower. It took 115 years in France for the proportion of older persons to rise from 7 per cent to 14 per cent and in Thailand, the same doubling will occur in the next 20 years. Concurrently, today's oldest population will age further, the very old aged (75 and over) being the population subgroup that will increase the most in virtually all industrialized countries (Kalache, 1999).

In Latin America, the projected increase in the older population is from 7.6 per cent of the total in 1995 to 14.2 per cent in the year 2025 (Bermudez and Dwyer, 1999) and in Cuba 13 per cent of the population were aged 60 years and over, 22.8 per cent were older than 50 years in 1998 (Hernandez and Porrata, 1999).

In India, the proportion of elderly has risen from 5.6 per cent in 1960 to 6.3 per cent in 1980 and is projected to be 7.2 per cent by 2000 and 9.5 per cent by 2020 (Rajan *et al.*, 1999). In absolute terms, in the year 1991 there were 55 million elderly persons in the country, 66.7 million in 1999 and the number is expected to touch 76 million by 2001 (Joshi, 1999).

The percentage of population above 60 years of age as per 1991 census is the highest in Kerala (8.8 per cent) and lowest in Assam (5.2 per cent). Kerala and Tamil Nadu will have more than 13 per cent of its population in the age group of 60 years by 2016 (Kulkarni, 1999).

WHO/SEARO (1992) reported that out of every seven elderly persons, one would be from India, by the year 2001. The above statistical description shows that growth rate of elderly population in terms of its absolute number and proportion is faster, which is a great challenge to the health systems. This has significant implications on socioeconomic factors and overall welfare of the elderly.

The demographic ageing of the population has serious implications both at the macro and the household level, as the country would soon be facing a progressive increase in the proportion of elderly persons when it becomes imperative to provide facilities and support for their well being (Joshi, 1999).

3. Theories of Ageing

Biological explanations of ageing process are divided into three major categories namely Genetic theories, Non genetic cellular theories and Physiological theories (Chadha, 1997).

a. Genetic Theories

The basic presumption of this approach is that there is some genetic programme that sets the upper limit of the life span of all species . Although loss of replicability may be a good model of the finite characteristics of cell

in vitro, it does not appear to be a complete model of ageing. The life span of cell populations in vivo may be very different (Hickey, 1992). The DNA damage theory, somatic mutation theory and cellular error theory of ageing are genetic theories (Chadha, 1997).

b. Non-genetic Cellular Theories

These theories concentrate on aspects of intra and inter cellular functions and on the effects of extra cellular substances on the effectiveness to function after these cells have been formed. Accumulation theories suggested by Shock (1977) attributed ageing to the accumulation of deleterious substances called toxins in the ageing organism. The free radical theory (Mahaffey *et al.*, 1993) proposed that molecular fragments containing a single unpaired electron makes them highly reactive to proteins, lipids, carbohydrates and chromosomal material in the cells and this probably leads to changes associated with ageing.

c. Physiological Theories

Chadha (1997) stated that this set of theories try to understand the effects of ageing on the whole body instead of dealing with merely the cellular origins of ageing. The homeostatic imbalance theory suggested that ageing is due to increased homeostatic failure and the reduced immunological capability of immune system in old age.

There are other biological perspectives of interest like the food restriction theories which suggest that varying caloric intake may be a useful tool for examining ageing changes (Fujita, 1992).

B. Physiological Changes During Ageing

Ageing is associated with profound changes in physical, mental, social and environmental factors. For example decreased physical activity, increase in body fat, decrease in lean body mass and consequently, decreased energy intake may be associated with physiological functions that affect metabolism, nutrient intake, physical activity and risk of disease (Piers, *et al.*, 1998).

1. Changes in Gastro Intestinal Tract

Ageing in many may be accompanied by changes which may impair the search for food and its subsequent intake, but such changes are complex and difficult to document. However, objective changes in smell and taste have been observed which may directly decrease food intake or alter the type of foods which are selected. With ageing, there may be a progressive loss in the number of taste buds per papilla on the tongue.

Taste is the chemical gatekeeper, protecting the internal milieu from potential toxic substances. In the taste papillae with ageing, secondary to the rate of taste papillae replacement, the ability to taste sweet, bitter, sour and salty declines in most, but not in all older persons. In general, ageing is associated with an increase in taste thresholds, with sweet taste being less affected than other modalities (Weiffenbach, 1991, Schiffman and Gatlin, 1993).

The irreversible decline in taste and smell acuity that occur in many elderly persons can contribute to inadequate food intake and nutrition that

are prevalent among the aged. The sensory changes alter with age such that sensory specific satiety is absent in those, 65 years old and over (Rolls, 1992). Although chemo-sensory deficits cannot be reversed, studies have shown that the addition of intense flavours to foods can compensate for perceptual losses and improve food palatability and acceptance (Schiffman and Warwick, 1993).

Dental health is important in old age. Surveys indicate that among the elderly bad breath was a common problem observed due to poor dental hygiene. Surveys also indicate that compared to urban more rural elderly were suffering from dental problems.

2. Changes in Body Composition

Changes in body composition seen with ageing include a decrease in lean body mass and an increase in body fat. These changes in body composition, including those in fat distribution, may be associated with changes in various physiological functions that affect metabolism, nutrient intake, physical activity and risk for chronic disease. There is alteration in bone density that results from a decreased mineral content which occurs with ageing (Hazzard, 1996).

Around age 40, bone mass begins to gradually diminish in both sexes, with a continuous loss over adult life at a mean rate of 1.2 per cent per year. Loss of bone mass is the result of changes in the mechanisms governing osteogenesis. The processes of resorption and deposition are uncoupled to a degree that interferes with the ability of osteoblast action to keep pace with osteoclast activity (Mahan and Stump 1996). Perry (1996)

reported that ageing is associated with increased bone turnover and 25 hydroxy vitamin D (25 OHD). In the case of post menopausal women, dietary calcium intake was a determinant of skeletal health (Andon *et al.*, 1991).

The normal bone loss that occurs with ageing in both sexes is related to deterioration of the collagen forming the organic matrix of bone as well as to gradual uncoupling of the remodelling process. Acceleration of the process that occurs in women after menopause is directly related to the lack of estrogen (Desai, 1999). Bone loss in men also accelerates in later years, but about 10 years later than in women, and it may be related to loss of androgen. Once middle age is reached, there is a progressive decline in stature, the result of thoracic kyphosis, compression of intervertebral discs and change in angulation of the femoral neck (Forbes, 1998).

3. Skin Changes

The skin often exhibits changes that denote the onset of senescence. Grey hair, lax skin, wrinkling, lentigines, vascular changes and dermal or epidermal degenerative changes are well known markers of both chronological and biological age. There is a decrease in the density of enzymatically active melanocytes; a loss of Langerhan's cells, mast cells and dermal blood vessels; biochemical and structural alterations in dermal collagen and elastin which make the connective tissue less soluble and more sclerotic; the rate of turnover of cells in the epidermis also decreases, the linear growth rate of both hair and nails decreases and the cell mediated immune response is diminished (The Hindu, 1998 and Natarajan, 2000). Triceps skinfold thickness of women is more, indicating that females have more subcutaneous fat than males, and the waist-hip ratio consistently remained lower in elderly women (De Groot *et al.*, 1991).

4. Alterations in Immune Response

Ageing is associated with impaired immune responses and increased infection related morbidity. Immune function in the elderly undergoes immunosenescence. During this period, decrease in antigen specific immune responses to infections and cell mediated immunity and increase in autoantibodies and autoimmune conditions are common (Forbes, 1998). The effect of physiological amounts of vitamins and trace elements on immunocompetence and occurrence of infection related illness was assessed in 96 independently living, healthy elderly individuals who were randomly assigned to receive nutrient supplementation or placebo. Nutritional status and immunological variables were assessed at baseline and at 12 months and the frequency of illness due to infection was ascertained. Subjects in the supplemented group had higher numbers of certain T-Cell subsets that supplementation with a modest physiological amount of micro nutrients improved immunity and decreased the risk of infection in old age.

Serum albumin values, decreased with increasing age in both men and women, and this association was independent of health status. The albumin-early mortality association suggests that serum albumin values are a predictor for subclinical diseases in the healthy elderly (Klonoff-Cohen *et al.*, 1992).

5. Changes in Ear, Nose and Throat Functioning:

Jain and Kumar (1998) discussed geriatric changes in ear, nose and throat. Auditory dysfunction (presbycusis) associated with ageing process includes several identifiable forms of degeneration of hearing.

Pathophysiological changes include, decreased oxygen use, reduced circulation and intracellular deposition of cholesterol lipids. Nasal obstruction, a common concern of the elderly is usually caused by a combination of factors. Atrophy of mucosa leads to dryness, mucous crusting and degeneration of connective tissue causing loss of cartilage support in region of nasal valve. Obstructive symptoms are generally worse at night when patient is in recumbent position and may interrupt sleep also. Generally accepted characteristics of the senescent voice include weakness, hoarseness, tremulousness and altered pitch. However, changes in voice and speech are more closely related to physiological age and a change in vocal quality may herald significant local or systemic disease. The ageing process also results in significant changes with the mucosa of the oral cavity, salivary glands, teeth, mandible, maxilla, temporomandibular joint and taste buds.

6. Changes in Blood Vessels and Mental Functioning

In old age, certain changes take place in the wall of the cerebral blood vessels. Arteriosclerosis is characterised by the thickening of the middle coat of the blood vessel (tunica media). This not only gets thickened but it also loses the power of normal flow of blood. Another condition of the blood vessel is atherosclerosis, where lipid material is deposited in the inner coat of the blood vessel (tunica intima), which causes fibrosis and calcification of blood vessels in susceptible cases in the elderly individuals, further narrows the lumen and causes reduction in blood flow. The arterial wall shows local loss of muscular coat in patches and the elastic net work breaks, which further reduces the strength of the wall of vessels (Sinha, 1991).

Physiological changes due to age, result in a slowing in mental functioning parallel to the physiological changes. Difficulty in learning, remembering, adapting to change are areas where ageing is seen to have an effect, but this depends upon the attitude of the individual, even though his power of assimilating new ideas and of doing unaccustomed tasks is reduced. He takes longer to think and his intellectual productivity is diminished. Another change is, liability to forget what he has recently experienced, and ability to change to adapt^{to a} new situation is also difficult (Devi, 1991).

In older people, the brain becomes smaller due to shrinkage. About 10 per cent reduction takes place after the age of 60 years. This may depend upon the medical care, nutrition and environmental effects on the individual. On an average, 30 per cent lumbar spinal motor neurons are lost, while some individuals retain their approximate normal number in the late stages of life. A reduction of 15-50 per cent neurons of cerebral hemisphere and 30 per cent purkinje cells of cerebellum takes place. The nerve cells of the basal, forebrain nuclei, substantial nigra and locus coeruleus can be reduced by as much as 40 per cent with the advancing age. The dendritic tree retracts and shrinks and hence synaptic contact is also affected. When the age further advances, approaching the verge of about 80, the size of the nucleolus and cytoplasmic RNA (Nissl's granules) get reduced and this reduction may range from 10-50 per cent depending upon the group of the nerve cells involved (Sinha, 1991).

7. Reduction in Physical Activity

Reduced physical activity is a notable feature of old age. But the energy cost of normal activities increases due to slowing down. Another

feature of ageing which restricts physical activity leads to varied degenerative and chronic diseases such as chronic obstructive airway diseases, angina and arthritis. Physical activity contributing to good physical and psychological status at all ages and inactivity associated with minor illness in the elderly often lead to loss of muscle tone and mass which permanently reduces the physical activity levels never to be regained again (Durnin and Lean, 1992).

Studies on elderly (Chandrasekhar and Bhooma, 1999) revealed that elderly in the age group of 60+ seldom engaged themselves in strenuous activities. Upto 80 per cent of elderly, both men and women preferred watching television whereas 12 per cent of men were engaged in gardening and around 15 per cent of women were engaged in house hold/old age home kitchen activities.

C. Psycho Social Problems of the Elderly

1. Ageism:

Ageing is a biological process, experienced by mankind in all times. However, concern for ageing of population is a relatively new phenomenon, which has risen due to significantly large increase in the number and proportion of aged persons in the society. Ageing is not only biological in nature but also a cultural process. Physical, social and emotional changes at this age require readjustment in interpersonal relations in different situations with the members of the family and society (Husain, 1997).

Ageism is stereotyping and discriminating against people because of their age. Whilst discrimination due to age exists at all ages, ageism is usually talked about in terms of older people. Old people are thought to be

senile, rigid in thought and manner, old fashioned in morality and skills. Ageism allows younger people to see old people as different from themselves (Ivers and Meade, 1999).

An unprecedented technological upheaval is causing cataclysmic transition in family life and social matrix the world over. This has been exerting a serious, negative impact on the aged population which has very little to fall back upon (Kuthiala, 1994 and Roe, 1989).

The aged in traditional societies occupied a prominent place and were venerated because they were repositories of wisdom, experience, custom and property rights. Their contributions in the field of education, socialization, social control, transmission of cultural values and social heritage to the future generation cannot be underestimated. In most Asian countries, in general and in India in particular, the elderly were considered an asset within the joint family structure wherein they were ensured of familial care and support. But gradually with the advent of industrialization, migration to the cities, more employment opportunities in urban sector, joint family structure began to change and switch over to the smaller nuclear family which was more mobile and more suitable to the needs of the new techno-sphere. The so called nuclear family became the standard, socially approved, modern models and an identifiable feature of all contemporary societies. This marked the sharp decline in the status and position of the aged in the family and shift of authoritarian power to the young (Singh, 1995).

2. Family Structure

The family has generally been considered the traditional primary source of social, economic, psychological and physical support for the elderly.

It is crucial even today. In developed countries, where the state has assumed responsibility for the welfare of the aged, there is growing evidence of family being called to assume responsibility (Pattanaik, 1999).

Developmental evolution has taken the female folk out of the home and transformed the family structure into a nuclear one. This has resulted in deprivation of care for the needy at home besides a considerable extent of social insecurity among the elderly (Rajan *et al.*, 1999).

3. Financial Insecurity

The biological, psychological and social problems in old age interact to accelerate the ageing process by speeding up the rate of decline. Economic insecurity arises, there is loss of self esteem and feelings of being neglected and unwanted at home. Financial dependence upon the younger generation compel to stay with them under one roof (especially in India). The two sides, thus, keep having problems with each other, though they do not like to admit, partly because of the emotional bond between parents and children and partly because of the perpetuating myth of respect and reverence towards the elders. There is almost always a generation gap between the two generations which precipitates the problems already existing between them (Chadha and Sinha, 1997).

4. Urbanisation

In pre-industrial times, people had no sudden break from the work they had been doing for decades. Those living off the land could adjust their activities to their physical capabilities. They continued to tend cattle, mend fences, go to market and help with harvest. In stable rural communities, the

experience and wisdom which older people had accumulated were widely respected. The time at which work stopped varied from person to person and usually coincided with biological ageing. Unlike their rural forefathers, retired industrial workers were obliged to stop work suddenly on a specific day. As the skills they had acquired over a working life were mechanised or become obsolete, so also their status declined. Retirement is thus largely a product of our times and because it still has strong associations with old age, it tends to be viewed negatively (Mulley, 1995).

5. Social Insecurity

The aged feel a sense of social isolation because of break from work relationships, demise of relatives and friends and mobility of children to far off places for jobs. The situation worsens when there is physical incapacity and financial stringency. Retirement from active service, declining work efficiency, prevalence of disease, feeling of loneliness and neglect, dependence on the successive generation are the factors catalytic to create psychological problems of the urban aged (Arora, 1993).

6. Rural Living

A positive feature of aged population in rural India is that most of them are economically active, presumably because most of them are engaged in those sectors of economy in which there is no specific retirement. However, female labour participation is low in aged population with 15.82 per 100 persons at 60 + age as against 68.92 in the case of men. It means women withdraw themselves from the active labour force comparatively earlier and in this process lose their economic independence also. Micro level study

undertaken on aged population spread over four villages of Athur block, Dindigul district revealed that health problems and economic insecurity are the major problems being faced by the majority of the aged. In spite of their physical inability and mental agony, the aged males who belong to agricultural and nonagricultural labour class continue to work for earning their livelihood in the absence of any economic security during old age. Disengagement from work is very rare in the age group of 60-70 among the males. A high incidence of single member households among the aged rural women is indicative of distress and destitution (Prakash 1991 and Lalitha 1999).

However, Rao (1999) opines that the population of elders in the Indian villages are in a better shape. They are more content so far as emotional security and economic self reliance is concerned. Traditional value and family bonds are still very strong, unlike in the urban milieu.

7. Mental Status

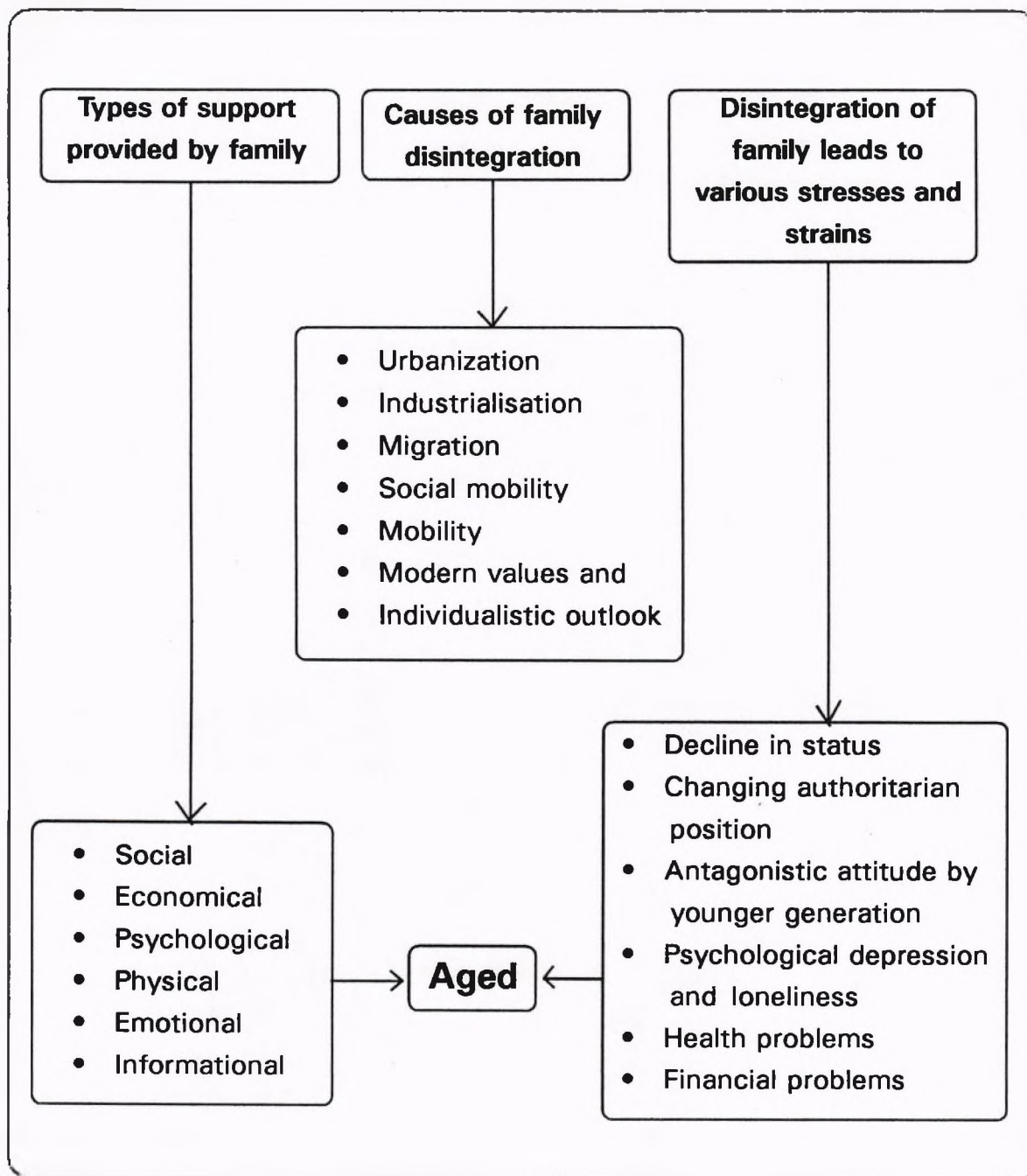
Old age brings a reduction in memory and subjects the aged to varied kind of mental illness. Old age comes with worry over finance, anxiety over health, feelings of being unwanted, isolated and lonely, feeling of guilt, irritation, untidiness, inability to adjust to changed conditions and decreased social contacts and participation. The old persons begin to feel that even his children do not look upon him with that degree of respect which he used to get few years earlier. The old person feels neglected and humiliated. This may lead to the development of psychology of shunning the company of others. Loneliness in turn may give rise to depression and may eventually lead to worsening of sickness (Husain, 1997).

8. Social Status

Sureender and Khan (1996) reported that in India the number of elderly widows are more than widowers. With the increase in the number of widows or widowers, more people are forced to live alone and also face social neglect. The widows are meted out a harsher treatment than widowers. For instance a widow cannot attend any social ceremonies, but a widower can, which again lead to the development of the psychology of shunning the company of the society.

A large percentage of the elderly female population is widowed as compared to the male population in the corresponding age groups since women marry men older than themselves, have a lower incidence of remarriage and have a lower mortality rate than men. If to this is added the number of the spinsters, divorced and separated, the percentage of single elderly women is quite large (Bose, 1996 and Lalitha, 1999).

The elderly feel that the world is rushing by and there is no visible role for them. They react in different ways to this diminishing role. Those who previously wielded little authority or influence perhaps feel it the least, but those who occupied positions of authority have considerable difficulty in coping. For many it is a bitter pill to swallow (Prakash 1999a). It is in the hands of the young to think about the plight of the aged in the contemporary society, as it is an interface of many interactive factors as depicted in Figure 1.



SOURCE: (PATTANAIAK, 1999)

FIGURE 1
PLIGHT OF THE AGED IN THE CONTEMPORARY SOCIETY

D. Aging and ill Health

Old age is not a disease. But the natural process of aging makes individual susceptible to multiple diseases and disabilities. Many diseases of old age are either preventable or treatable.

1. Common Health Problem

Obesity is the most common problem in persons 60 years or older and with the variety of junk foods growing at a faster rate, obesity has grown proportionately. Although gross obesity is uncommon among the very old, because persons who are morbidly obese are more likely to die earlier of complications of their obesity, it is still a serious disability in the elderly (Dodd, 1997). Likewise diabetes is a common disease that brings about devastating complications in the latter part of life. Many acute and chronic complications result due to diabetes affecting the vital organs of the body like the heart, kidney, brain and the eyes. The complications are directly related to the duration of diabetes rather than the severity (Kannan, 1997).

Coronary Heart disease (CVD) is one of the leading causes of death both in developed as well as in developing countries and is a major health problem in the elderly associated with the adoption of atherogenic dietary habits in majority of the populations (Beaglehole, 1992).

Constipation is one of the most common gastrointestinal complaints in the elderly. As one ages, the digestive system slows down a bit, making it harder to break down food and eliminate. In addition, hormonal changes during menopause can cause occasional bouts of constipation. Medications

such as diuretics, painkillers, tranquillisers and even antihistamines can bring about constipation (Dodd, 1999).

Piles (or haemorrhoids) are a very common, personal problem. Senior citizens form the largest segment of nearly 40 per cent of people affected by piles. Many do not consult doctors due to shyness or mostly, due to the painless nature of the disease. It is the persistence of the bleeding that forces them to seek medical attention. The problems that arise in the course of untreated piles are profuse bleeding, prolapse and thrombosis, ulceration, infection, gangrene and fibrosis (Baxi and Asrani, 1996).

As one gets older, the body becomes less able to respond to long exposure to heat or cold. In cold weather, some older people may develop accidental hypothermia, a drop in internal body temperature that can be fatal, if not detected and treated promptly. During hot and humid weather, a buildup in body heat can cause heat stroke or heat exhaustion in the elderly. This is especially true of those with heart and circulatory disease, stroke or diabetes (Anon, 1996).

The bones and joints of the human body, although designed to withstand a great deal of stress are subject to a variety of disorders. The most common ailment among the elderly being arthritis and related joint diseases caused by wear and tear over the years. There are mainly two types of arthritic diseases: Rheumatoid arthritis and osteoarthritis, of which osteoarthritis is the one commonly found in the elderly. The cause is simply wear and tear in the cartilage cushions of the joints, mainly weight bearing ones such as the ankles, knees and hips (Contractor, 1996).

Glaucoma, is a condition which causes an abnormal increase in the pressure within the eye. The outflow of the watery fluid in the eye is blocked and pressure inside the duct builds up. This can cause a permanent damage to the optic nerves, leading to loss of vision. Glaucoma damages nerve cells and fibres that enables one see the side (peripheral vision). As a result, side vision is gradually lost. Those above 55 years, relatives of glaucoma patients, people who are very near sighted and the diabetics are at a higher risk of this condition (Kannan, 1996).

Ageing has its own problems, it leads to lower reflexes, failing vision, forgetfulness and lack of balance, all this without actually falling sick. A major problem at this stage is an increased tendency to fall. Refusal to ask support or hesitation in using a walking stick only compound the problem. As far as falling goes, an older adult is almost like a child. The only difference is in the fact that a child is learning and the adult is 'delearning'. A child has strong bones, supple muscles and elastic arteries, whereas maturity brings with it brittle bones, wasted muscles and atherosclerotic arteries (which have lost all their elasticity). Presence of conditions like hypertension, sudden postural change, diabetes (peripheral neuropathy), ischaemic heart disease (cardiac arrhythmia), cervical spondylitis (vertigo), osteoarthritis and strokes only add to the risk (Goyal and Goyal, 1999).

2. Treatment and Drug Interaction

Treatment of disease in the elderly is as complicated as the diagnosis. The side effect of drugs rise both with the age and the number of drugs prescribed. This may be due to routine prescription of the adult dose to the

elderly. Another reason may be due to the decline in the functioning of kidneys. This leads to poor excretion and accumulation of drugs with unwanted side effects. Multiple diseases mean multiple prescriptions. This leads to more drug related side effects, interactions and omissions. Sometimes side effects of the drugs may be more than its beneficial effects. It is not necessary to have a pill for every ill. Many diseases in old age can be managed by non-drug regimens like diet, exercise, physical therapy and counselling (Natarajan, 1996).

E. Nutritional Supplements for the Elderly

Low food intake and increased incidence of physical diseases interferes with intake, absorption, metabolism and utilisation of nutrients leading to nutritional deficiencies in the elderly. These nutritional deficiencies can lead to impaired immune function. Several studies have proved the beneficial effect of nutritional intervention on elderly (Chandra, 1997). In general providing extra energy of multiple micronutrients or moderately large doses of single nutrients resulted in improved response.

A study of immune function in elderly persons in New Jersey showed that taking a daily multivitamin for one year resulted in a stronger immune system and higher blood levels of several vitamins. The researchers suggested that current recommendations for some micronutrients may be too low to support optimal immune function in healthy, independently living older adults (Bogden 1994).

Chandra, (1992), studied the effect of nutrient supplementation on the nutritional status and immunocompetence of healthy elderly and concluded

that supplementation with a modest physiological amount of micronutrients improved immunity and decreased the risk of infection in old age. Galan (1994) suggested that trace element and or vitamin supplementation could lead to substantial health benefits for the elderly in terms of improved morbidity and mortality.

Effective disease prevention among older adults is a combination of nutrition, physical activity, mental health and medical care. The basic approaches of dietary assessment, counselling and supplementation can reduce the likelihood of nutrient inadequacies and provide primary protection. Many common conditions of ageing can often be prevented or at least attenuated by prudent nutritional intervention. The routine recommendation of a basic multi vitamin and mineral supplement for healthy older adults is favoured by many scientists (Johnson and Kligman, 1992).

Nutritional deficiencies, frequently observed among the frail elderly have been associated with increased morbidity and dependency. A trial was conducted to assess the impact of nutritional supplementation on the functional status of frail elderly living at home. Fifty subjects > 60 years (mean 78 years old) at elevated risk of undernutrition (excessive weight loss or body mass index < 24 kg/m²) were randomized to a high energy dense supplement. Outcome measures, including changes in handgrip strength, general well-being score, perception of health and number of falls were measured. After 12 weeks, weight gain was greater in the supplemented group (2.1 to 2.3) vs 0.6 to 1.6 kg, P < (0.01). No functional measures differed except that the number of falls was lower among treated subjects as against controls. Frail elderly can gain weight through oral supplementation, indicating the

reversibility of weight loss in this group, but changes in functional status indicators may require, a longer period of supplementation (Gray-Donald *et al.*, 1995).

In a short term riboflavin supplementation study conducted at Guatemala, nine riboflavin deficient elderly Guatemalan subjects were given 10 mg of riboflavin everyday for three days wherein their erythrocyte glutathione reductase activity coefficient was normalized by the supplementation. However, they returned to a state of deficiency within two weeks while consuming their usual diets without supplementation. The high prevalence of riboflavin deficiency in elderly Guatemalan people was caused by inadequate intake of riboflavin rich foods such as milk products and that sufficient amounts of riboflavin need to be ingested regularly to maintain satisfactory riboflavin status (Boisvert, 1993).

Eighty four institutionalised elderly were given vitamin E, C, thiamine, riboflavin and vitamin B₆ supplement, for a month. At the end of the period serum vitamin E (only in men), serum ascorbate and erythrocyte thiamine pyrophosphate values had increased significantly. A significant improvement was also effected in the erythrocyte transketolase, glutathione reductase, aspartate aminotransferase activation coefficients (Asciuti-Moura *et al.*, 1993), Bendich *et al.*, (1997) reported that long term vitamin E supplementation had the potential to reduce the incidence of heart disease in elderly. Studies conducted on elderly by Grey *et al.*, (1995) and Gariballa and Sinclair (1998) consistently revealed an association between increased risk of coronary heart disease and low plasma concentration of antioxidants. Supplementation with antioxidants especially vitamin E on elderly women

agricultural labourers revealed that the peroxide levels are reduced after vitamin E supplementation. This reduction in peroxide values can be related to a delay in the process of ageing due to reduction in the free radicals due to ageing (Chandrasekhar, 2000).

There is also good evidence that adequate intakes of antioxidant nutrients including vitamin C, vitamin E and beta-carotene could substantially delay or prevent development of cataracts (Jacques *et al.*, 1997). There is also an increasing evidence that generous intakes of carotenoids such as lutein and zeaxanthin may reduce the risk of macular degeneration, the leading cause of age-related blindness in the United States (Snodderly, 1995 and Landrum *et al.*, 1997).

In those countries where for the best part of the year poor sunlight prevailed, lowered vitamin D status among the elderly was noticed. Reid (1993) reported that exposure to sunlight for a few hours each week was sufficient to improve the vitamin D status of the elderly. However, Morieras *et al.*, (1992) suggested that neither the effect of sunlight exposure on cutaneous vitamin D synthesis nor daily intake, supply sufficient vitamin D to maintain adequate 25 (OH) D values. Hence the elderly should increase the time of sunlight exposure with no or little clothing cover or take vitamin D supplements.

It is recognized that increased calcium intakes will help to build up optimum bone mass during childhood and adolescence and will also slow the rate of bone loss during ageing. These combined effects help to protect against the development of osteoporosis, a disease characterized by progressive bone loss during ageing, often culminating in bone fracture. Most people do

not consume enough calcium from diet alone, and calcium supplements have been shown to be effective in boosting calcium intake and maintaining or increasing bone density (Dickinson, 1998).

Researchers at the USDA Human Nutrition Research Centre on ageing at Tufts University studied bone density in almost 400 men and women over 65 years of age. The subjects were given 500 mg of calcium plus 700 IU of vitamin D per day, or a placebo, for a period of three years. The group that received calcium and vitamin D experienced a significantly lower rate of bone loss and fewer nonvertebral fractures, compared to the placebo group. The researchers concluded that supplementation with calcium and vitamin D may substantially reduce the risk of nonvertebral fractures among men and women 65 years old (Dawson-Hughes *et al.*, 1998). Literature also shows that at least for the population among post menopausal women, increased calcium intake can retard bone loss that leads to osteoporosis (Rosenberg, 1991).

A notable fact is that the elderly population have lower iron requirement to maintain adequate iron status than when they were younger and those with iron deficiency can increase their iron absorption to the same extent as young adults. However, in elderly because of a higher prevalence of disorders which interfere with efficient iron absorption, such as atrophic gastritis and post gastrectomy syndromes, a good proportion of elderly people have reduced dietary availability of iron. Supplementation with iron rich low cost locally available green leafy vegetables was carried out on 25 elderly subjects. Supplementation over a period of 100 days exhibited improved haemoglobin and serum iron levels in the elderly (Chandrasekhar, 2000).

Forty two elderly patients who had depressed polymorphonuclear cell (PMNC) zinc levels were supplemented with oral zinc sulphate (135mg) for four weeks. Plasma and PMNC zinc increased but the percentage of peripheral blood T - lymphocytes were unchanged. Plasma concentrations of vitamins A and E also remained constant. Around 25 to 30 per cent incidence of cellular zinc depletion in this patient population was confirmed and it was concluded that zinc concentrations can be brought back to within normal limits by oral zinc supplements, but with no effect on T-cell phenotypes (Goode *et al.*, 1993).

Seventeen subjects were supplemented for 28 days with 30mg zinc as zinc acetate daily. The mean concentration of zinc in serum and urine increased by 25 per cent and 2.5 fold, respectively. Zinc content of platelets and leukocytes did not change with zinc supplementation. The concentration of visceral proteins (albumin, prealbumin, transferrin and retinol-binding protein) and immunoglobulins (IgG, IgA and IgM) did not change with zinc supplementation. The data indicated that ageing per se does not necessarily imply poor zinc status (Swanson, *et al.*, 1988).

METHODOLOGY

III METHODOLOGY

The methodology pertaining to this investigation on “Nutritional status and impact of a malted food supplement on selected institutionalised elderly” is discussed under the following headings.

- A. Locale of the Study
- B. Selection of the Sample
- C. Methods and Tools used for the Study
- D. Development and Evaluation of the Malted Food Supplement
- E. Impact Evaluation of the Malted Food Supplement on the Selected Elderly
- F. Case Study on Six Elderly Women Suffering from Early Stages of Osteoporosis
- G. Analysis and Interpretation of the Data

A. Locale of the Study

Fourteen old age homes that render free service to the aged by way of free shelter and food with periodical medical check up were selected from Madurai, Aruppukottai, Virudhunagar and Tiruchirapalli (Figure 2).

B. Selection of the Sample

The authorities of the 14 charity old age homes selected were contacted, appraised of the objectives of the study and permission obtained to conduct the study. A total of 500 elderly could be identified in the age range of 60 to 85 years in the 14 old age homes, of whom 194 were men and 306 were women. Each home was visited two to three times to create rapport with the elderly residents before the start of the study. All the 500 elderly were personally interviewed.

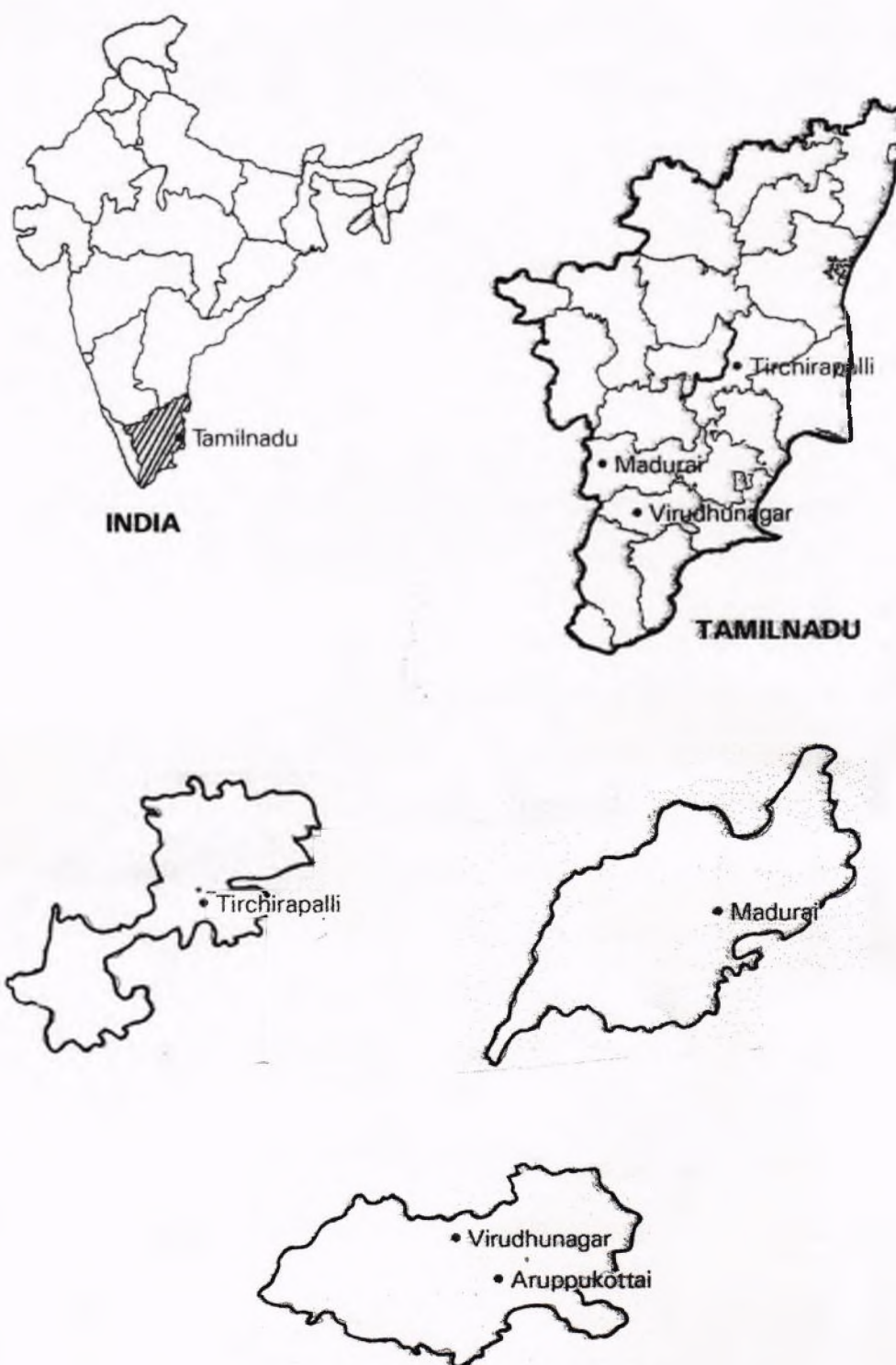


FIGURE 2 : LOCALE OF THE STUDY

Impact of the malted supplement was studied in selected elderly men and women from five old age homes of Madurai. The selection of the elderly for the evaluation of the supplement was done on the following basis.

- The authorities and the residents agreed to the biochemical tests to be carried out before and after supplementation.
- The selected elderly were not ailing from any disease that required medication.
- The selected old age homes were in and around Madurai which enabled the investigator to supply the supplement continuously at periodical intervals for 180 days and monitor the feeding.

Those elderly who were willing to take the supplement formed the intervention group and those who did not want to take the supplement formed the control group. To start with, a total of 135 formed the study group (experimental and control group). However, by the end of the supplementation trial the number came down to 119. The reasons were that six of them left the old age home to go and stay permanently with their kith and kin. Two from the control group succumbed to sudden onset of respiratory disorders. Eight of the subjects went to their relatives' homes for short stay during the study period. Thus out of 135 elderly, only 119 could be considered for study. Of the 119 elderly 87 formed the intervention group and 32 formed the control group. The research design of the study is given in Figure 3.

The cooks of these institutions were taught the various preparations possible with the supplement and also portion control so that each of the inmates got 80g of the supplement every day.

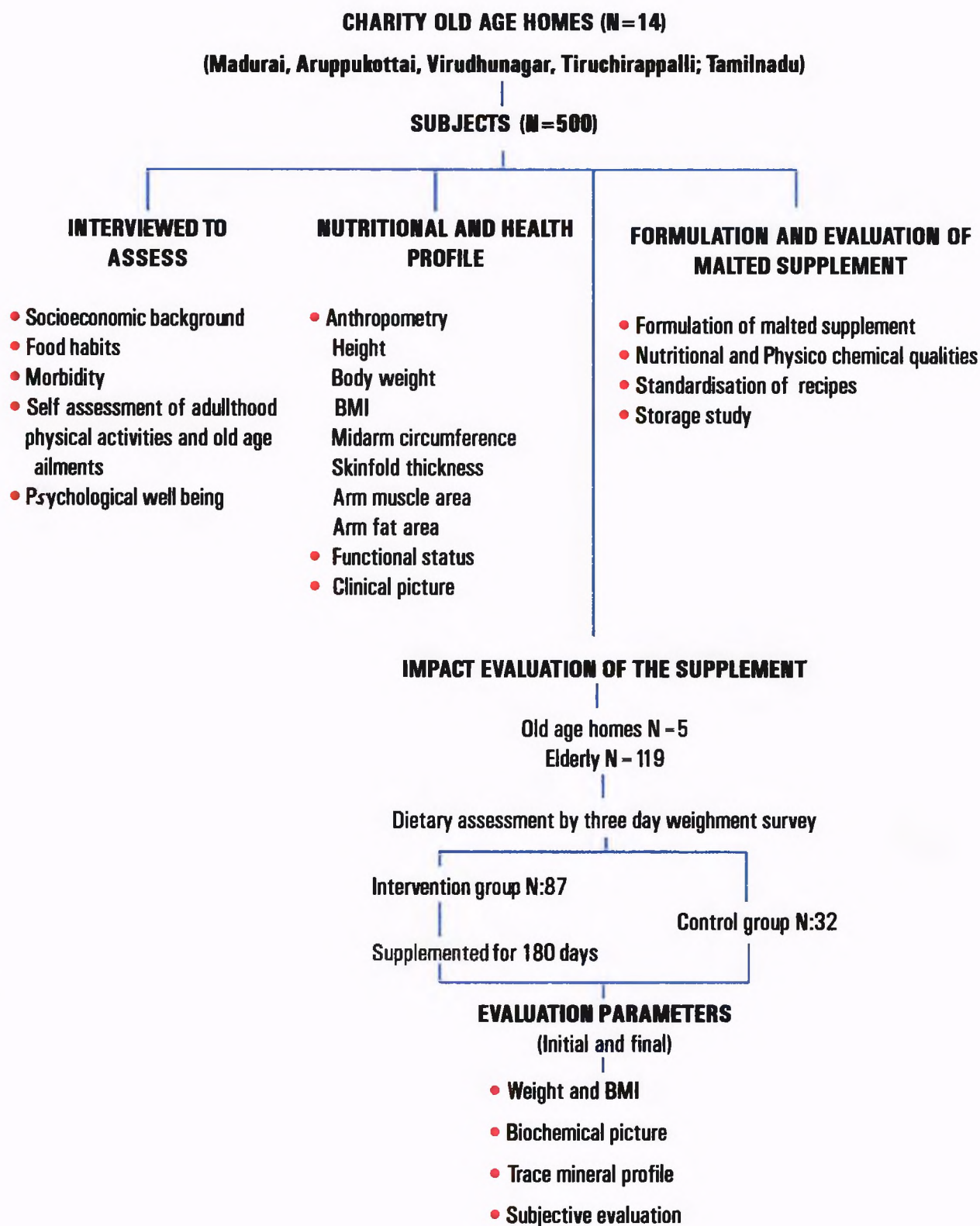


FIGURE 3
STUDY DESIGN

C. Methods and Tools Used for the Study

The following methods were used to collect the data.

1. Interview method
2. Anthropometric measurements- height and weight, mid upperarm circumference and skinfold thickness
3. Clinical examination
4. Biochemical and biophysical tests and
5. Food weighment survey

1. Interview Method

An interview schedule was specially designed to study the socio economic background of the subjects and the schedule was pretested on a group of 10 aged subjects to confirm the validity and reliability of the tool. In the light of the feedback, repetitive and less relevant questions were removed, supplementary questions were added wherever necessary and logical sequence of the questions was ensured. The schedule thus finalised for the purpose of data collection is given in Appendix I. *All the subjects knew the local language – Tamil.*

The particulars collected using the interview schedule were:

- Demographic particulars like age, marital status, family size, educational level, erstwhile occupation and income
- Reasons for joining the old age home, period of stay, views about institutionalisation, present leisure time activities and personal habits
- Details of physiological problems of the aged subjects

- Dietary practices of the elderly before and after joining the old age home and food beliefs and taboos
- Frequency of food purchased from near by shops
- Problems faced while eating food
- Erstwhile occupation and present health condition
- Psychological well being

Majority of the Indian population are illiterates and live in rural areas. Hence, any test standardised in a developed country may not be suitable for our population. The original Geriatric Depression Scale (Brink, 1985), consists of 30 questions. This scale was translated and standardised on normal elderly subjects and reduced to 20 items by Verma, *et. al.*, (1993) and the modified scale was used in this study (Appendix II). The answers have to be elicited as 'Yes' or 'No'. Most of the questions are marked positively except for question Nos 1, 7, 13, 17, 20 which are marked negatively. Higher the score greater is the depression. A score of 1 to 7 indicates Mild Depression, 7 to 14 indicates Moderate Depression while 14 to 20 indicates Severe Depression.

2. Anthropometric Measurements

Jelliffe and Jelliffe (1991) viewed anthropometric measurements as a valuable technique in the assessment of nutritional status. Wadolowska *et al.*, (1998) stated that nutritional anthropometry is recognised widely as an effective means of assessing nutritional status of the population. The measurements taken are used to assess either physical growth (a reflection of nutrient adequacy during development) or body composition (an indicator of the excess or deficit of energy and protein).

Nutritional anthropometry is the measurement of human body at various ages and levels of nutritional status. It is based on the concept that an appropriate measurement should reflect any morphological variation occurring due to significant functional and physiological changes. It is also used to assess an individual's response to nutritional rehabilitation (Rao and Vijayaraghavan, 1998). Kohrs and Narins, (1990) indicated that anthropometry is a useful, non-invasive way to evaluate nutritional status of the elderly. Longitudinal and cross sectional studies indicate that height decreases with age. This decrease is due to a general thinning of all weight bearing cartilages and the bent knee gait (Chumlea *et al.*, 1987). To circumvent the problem of shrinkage, alternative methods of estimating the height have been suggested by various researchers including arm span length, tibia length and knee height. But neither arm length nor knee height has been validated for all races and for all heights. Considerable controversy exists about the definition of desirable weight for elderly person. Research indicates that optimal weight for elderly may be different from that of younger individual (Kohrs and Tobben, 1990).

For determining body weight, a portable balance was used. Weight without footwear was determined for the subjects and recorded in kilograms to the nearest 0.5 kg. Height measurements were recorded in metric scale to the nearest 0.1 cm. Markings were made on the wall and the subjects were asked to stand barefoot with heels, buttocks, shoulders and back of the head touching the wall. Care was taken to ensure that the head of the aged person was kept erect with the arms hanging at the sides in a natural manner. A wooden scale was placed gently on the head perpendicular to the wall and the height was recorded. The body mass index (BMI) of the respondents were

calculated using the formula.

$$\text{BMI} = \frac{\text{Weight (in kg)}}{\text{Height}^2 \text{ (in metre)}}$$

Midupper arm circumference was measured on the left arm of the elderly subjects. At a point equidistant from the tip of acromion and olecranon on the back of arm directly in line with the elbow, with the arm hanging relaxed on the side, a nonstretch fibre glass tape was placed around the arm at the midpoint. The tape was held firmly but gently to avoid compression of the soft tissue and measurement was taken to the nearest 0.1mm. Skinfold measurements were taken at the same location on the arm with arm hanging relaxed at the side, a lengthwise double fold of skin was grasped between the thumb and forefinger about 1cm above the mark. Care was taken to ensure that only adipose tissue and no lean tissue was grasped. Harpenders' skinfold calipers were then placed over the fatfold at the point where mid arm circumference at a depth about equal to the thickness of the hold. A reading was taken three seconds after release of the calipers and recorded to the nearest 0.5 mm. Three readings were taken and results were averaged.

Based on the mid upper arm circumference and skinfold thickness, the arm area, arm muscle circumference and arm muscle area were found out using arm anthropometry nomogram (Robinson *et al.*, 1992).

3. Functional Assessment and Clinical Examination

Jelliffe and Jelliffe (1991) regards clinical examination as an essential aspect of all nutritional surveys. Clinical examination is the simplest and most practical method of ascertaining the nutritional status as we get direct information of the signs and symptoms of dietary deficiencies prevalent

among people (Swaminathan, 1999). Details regarding posture, gait, hearing, vision and speech were recorded with the help of a physician. The clinical examination schedule designed by ICMR with slight modifications was used to diagnose the various deficiency diseases and other disorders prevailing among the selected aged using a specially devised schedule (Appendix III).

4. Biophysical and Biochemical Tests

The need for biochemical assessment is indicated by the discovery of health problems (Gorstein *et al.*, 1994). Blood pressure was measured using a sphygmomanometer. A laboratory technician was employed to draw the blood for analysis. The biochemical tests were conducted on all the 119 elderly before and after the intervention programme. Cholesterol, creatinine, urea, haemoglobin and glucose were estimated in an automatic analyser (Roche-cobas mira Plus, Switzerland). Iron, copper and zinc content in serum were estimated using an atomic absorption spectrophotometer (Perkin Elmer model 380, USA). All the glasswares used for estimation of trace minerals were rinsed with deionised water and dried in the oven.

5. Food Weighment Survey

(a) The nutritional status of a population is influenced profoundly by diet. Diet survey provides information on the quantity and type of foods consumed by the people and brings out dietary inadequacies as judged by available standards (Swaminathan, 1999). Among the several methods of diet survey, food weighment method is considered to be accurate for assessing food consumption (Roe, 1989).

Food weighment method was adopted to measure the actual food consumption by the aged. Food weighment survey was carried out on the 119 elderly who participated in the intervention study for three consecutive days. The weight of the raw ingredients used for cooking, the weight of the cooked food and the weight of the foods consumed by the individual were noted, so that the equivalent raw ingredients consumed could be calculated. The nutrients consumed by the subjects were calculated from the quantity of raw ingredients (ICMR, 1999).

The nutrients computed were energy, protein, fat, calcium, iron, carotene, thiamine, riboflavin and vitamin C. This was compared with the recommended nutrient intake for the elderly (Pasricha and Thimmayamma, 1997).

(b) Aliquots of foods consumed for three consecutive days were collected for estimating the trace minerals (iron, zinc and copper). The food samples were subjected to wet ashing as follows:

The wet digestion method described by Jackson (1973) was adopted for the preparation of ash solution. The triple acid mixture used for wet digestion consisted of nitric acid, sulphuric acid and perchloric acid in the proportion 9:2:1. A known weight of the pureed food sample was taken in a 500 ml conical flask and the required amount of triple acid (about 100 ml) was added. After 48 hours of cold digestion at room temperature, the mixture was heated over a sand bath (85 - 95°C) till the solution became colourless. The colourless solution was filtered through glasswool into a 100 ml volumetric flask. The solution was made upto 100ml

with deionised water. Transferred the solution into sterile stoppered plastic bottles for storage till the analysis of trace minerals (Appendix IV).

D. Development and Evaluation of the Malted Food Supplement

The value of a processed food depends on its nutrient content and also on the amount of nutrients available to the body. The amount of calories in a quantity or volume of food preparation is called calorie density of the food. As people eat food more by volume than by weight, it is the calorie content per unit volume (one millilitre or one litre) of food that is generally more important than the calorie content per unit weight. The calorie density is especially important in the case of geriatric supplements as the elderly too cannot eat beyond a certain amount in one sitting.

The methodology used for preparation of the supplement should be simple so that it can be made even in homes or at community levels, the raw materials should be locally available and affordable by a large segment of the population (Malleshi, 1995). Malting is a traditional food processing technology which provides a means of improving the nutritional quality of grains and pulses. During germination several enzyme systems become active, vitamins are found to increase, whereas there is reduction in phytates and tannins. There is also an improvement in bioavailability of iron and decrease in oligosaccharide content (Malleshi, 1997). The germinated flour or Amylase Rich Foods (ARF) directly address the twin problems of dietary bulk and poor energy density, yet low in viscosity and dietary bulk. Fully malted mixes do have low dietary bulk and high acceptability (Gopaldas, 1991).

Finger millet locally known as ragi is mainly grown for the sake of the grain and it is a staple for ^alarge section of the population in Karnataka, Andhra Pradesh and Tamil Nadu. No other millet is as rich as finger millet in total minerals, calcium and iron. Malting of finger millet does not pose problems such as mould growth and off odour as is observed very often with jowar or bajra, during germination.

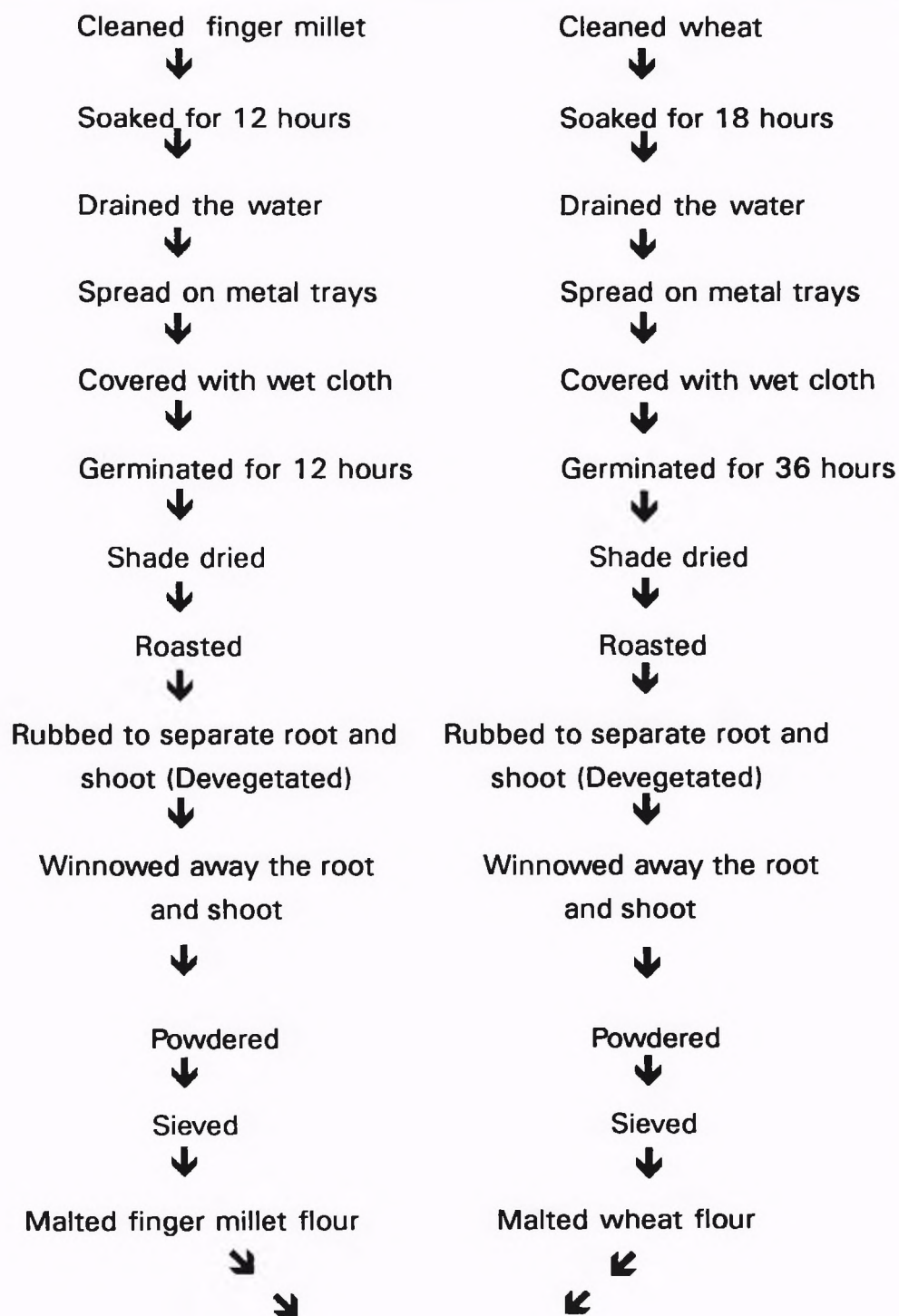
The people from villages have a preference for this millet as it is used for a number of preparations in their regular diet. Wheat being available throughout the year both in local shops and through Public Distribution System (PDS) is purchased by institutions for the preparation of breakfast foods like uppuma. Germinated wheat is rich in alpha amylase which breaks down long chain carbohydrates.

In the present study, malted wheat and malted finger millet were chosen for the preparation of a mixed cereal, millet malt food supplement which is easy to prepare and process in such a manner, so as to improve the bio availability of nutrients. All the old age homes selected for the study were charity homes. Hence it was essential that the supplement prepared was out of familiar, easily available, low cost foods so that they could continue to prepare and provide the supplement even after the completion of the study. Since the elderly were sceptical about the ingredients in the supplement, it had to be made clear that the supplement was prepared using malted wheat and finger millet and no pulse was added. They were reluctant to take a supplement with any type of pulse since they believed that it would cause flatulence. The nutrient content of the supplement could also bridge the gap in the energy and protein consumption of the elderly as compared to the

RDA. Keeping in view all the above advantages, the investigator chose malted wheat and malted finger millet, blended in an equal proportion to prepare the supplement for the elderly subjects. The standard procedure for malting the cereals and millets as suggested by Malleshi, (1995) was followed in this study.

1. Preparation of Malted Wheat and Finger Millet Supplement

Wheat and finger millet were purchased from local shops, winnowed to remove chaff, clay particles, dirt and stones. Figure 4 gives the step wise procedure involved in the preparation of the supplement. Plate I shows the preparation of malted food supplement.



SUPPLEMENT (1:1)

FIGURE 4

PROCESS OF PREPARATION OF MALTED FOOD SUPPLEMENT



PLATE I
STAGES IN THE PREPARATION OF MALTED FOOD SUPPLEMENT

2. Analysis of the Nutritive Value and Physicochemical Characteristics of the Malted Food Supplement

The supplement was subjected to routine nutrient analysis to estimate the moisture, energy, protein, fat, calcium, phosphorus, iron, zinc, copper, thiamine, riboflavin and niacin contents using standard procedures (NIN,1983 and Ranganna, 1995). The viscosity and gelatinisation temperature of the supplement was found out using rapid visco amylograph. The bulk density was also found out. The malted supplement was packed in 200 gauge low density polyethylene bags, heat sealed and stored for its keeping quality evaluation. The shelf life of the sample was assessed through organoleptic parameters, moisture content, peroxide value and total bacterial count over a period of 60 days.

3. Standardisation of Recipes with Malted Food Supplement

Using the supplement many common recipes of South Indian cuisine like pittu, kozhukkattai (steamed product), dosai and adai (unleavened, shallow fat fried products), sweet and salted porridges, pakkoda (deep fat fried savoury dish) which could form an easy food item of the daily menu of households or old age homes were standardised and evaluated for its acceptability. The methods of preparing the various recipes are given in Appendix V. The same recipes were also prepared and subjected to sensory evaluation periodically during the storage period. The acceptability trials were conducted with 20 panel members and 20 elderly. A five point score card was used to evaluate each of the recipe (Appendix VI).

4. Storage Study

The malt mix was packed in 200 gauge Low Density PolyEthylene bags(LDPE) in 500g lots, heat sealed and stored at ambient conditions for the

evaluation of its keeping quality. The shelf life of the sample was assessed through organoleptic tests, moisture content (Ranganna,1995), alcoholic acidity, peroxide value and total bacterial count. The developed recipes were evaluated initially only once by the elderly but the panel of judges evaluated the recipes developed periodically (once in 15 days) during the conduct of storage study of malted supplement.

E. Impact Evaluation of the Malted Food Supplement on the Selected Elderly

The malted food supplement was prepared by the investigator to ensure uniformity in the method of preparation and the proportion of mixing of the two malted foods. The malted supplement was supplied to the five old age homes every week. It was ensured that the supplement was consumed by the elderly every day throughout the study period. The investigator also monitored periodically the preparation of porridge at the old age homes and serving of the supplement to the elderly.

The nutrition/health status of the subjects was evaluated by anthropometric measurements such as height, weight and BMI, and biochemical tests such as haemoglobin, glucose, cholesterol, creatinine, urea, total protein, albumin, globulin, calcium, iron, zinc and copper. These tests were carried out before and after the supplementation.

The impact of supplementation on the health of the elderly was also evaluated subjectively by enquiring about their feeling of well being.

F. Case Study on Six Elderly Women Suffering from Early Stages of Osteoporosis

During the process of selection of elderly for this study the investigator came across six elderly women of 60-70 years of age with early symptoms of osteoporosis. It was thought of interest to supplement adequate quantities of the developed malted cereal, millet supplement to these osteoporotic elderly and assess its possible role in their diet. These six osteoporotic elderly women were not included in the main study but formed the subjects of the case study. The onset of osteoporosis in these six elderly women was confirmed by an orthospecialist and then they were placed in the case study. The malted supplement in this study had equal proportion of cereal and millet and provided 190 mg of calcium per 100 g mix. In order to increase the calcium intake of osteoporotic women (taking into consideration their old age home intake of 330-350 mg), the proportion of wheat:, finger millet was modified as 30:70, thus increasing the calcium content of the malted cereal millet supplement to 250mg/100g sample. This helped increase the total calcium intake of osteoporotic elderly women included in the case study to 600mg. The six osteoporotic elderly women were supplemented with 100g of the malted supplement in its altered composition in the form of porridge for a period of three months. Impact of the malted supplement on the osteoporotic status was evaluated through bone x-ray diagnosis and serum and urinary calcium levels before and after supplementation.

G. Analysis and Interpretation of the Data

The age, gender, anthropometric measurements, and biochemical indices of the supplemented group and the control group were tested for their comparability at baseline.

Multivariate logistic regression analysis was carried out to trace the association between socio economic variables and personal habits of their adulthood and the presence of chronic diseases during their old age.

The impact of the malted supplement was found out by comparing the various anthropometric and biochemical parameters of the elderly before and after the supplementation study using appropriate statistical tools.

RESULTS AND DISCUSSION

IV RESULTS AND DISCUSSION

This study on the 'Nutritional status and impact of a malted food supplement on selected institutionalised elderly' is discussed under the following headings:

- A. Profile of the Selected Institutionalised Elderly**
 - 1. Socioeconomic Background
 - 2. Dietary Practices
 - 3. Nutritional and Health Profile
 - 4. Psychological Well Being
- B. Nutritional and Health Profile of the Elderly Selected for the Supplementation Study**
- C. Quality Parameters of the Malted Food Supplement**
- D. Impact of the Malted Food Supplement on Selected Elderly**
- E. Impact of the Malted Food Supplement on Elderly Women Suffering from Early Stages of Osteoporosis - A Case Study.**

A. Profile of the Selected Institutionalised Elderly

The general profile of 500 elderly men and women residing in 14 charity old age homes of Madurai, Aruppukottai, Virudhunagar and Tiruchirapalli was elicited by interview method. This enabled the investigator to understand the educational, erstwhile occupation and economic levels, marital status, number of children, reasons for joining and period of stay in the old age home, leisure time activities, personal habits, present health status, food habits, beliefs and taboos and psychological well-being of the selected elderly. These information are presented in the following pages.

1. Socioeconomic Background

a. Age and Genderwise Classification

The age and genderwise distribution of the 500 elderly men and women is given in Table I and Figure 5.

TABLE I
AGE AND GENDERWISE DISTRIBUTION OF THE ELDERLY

N:500

Age (years)	Gender				Total	
	Men		Women			
	Number	Per cent	Number	Per cent	Number	Per cent
60-64	33	17	52	17	85	17
65-69	42	22	75	24	117	23
70-74	58	30	79	26	137	28
75-79	49	25	70	23	119	24
80-84	12	6	30	10	42	8
Total	194	100	306	100	500	100

Of the 500 elderly selected for the study, 194 were men and 306 were women. The number of women in the old age homes studied were more than men. This might be due to the fact that women had to leave the house when they were widowed or were unable to substantially contribute to family income or were unable to share the household chores. Another reason could be the increased longevity of women compared to men, for, the life expectancy at birth in India is 60.4 for males and 61.2 years for females (Datt and Sundaram, 1997). Among the elderly men, 30 per cent belonged to the age group of 70 to 74 years followed by 25 per cent in the

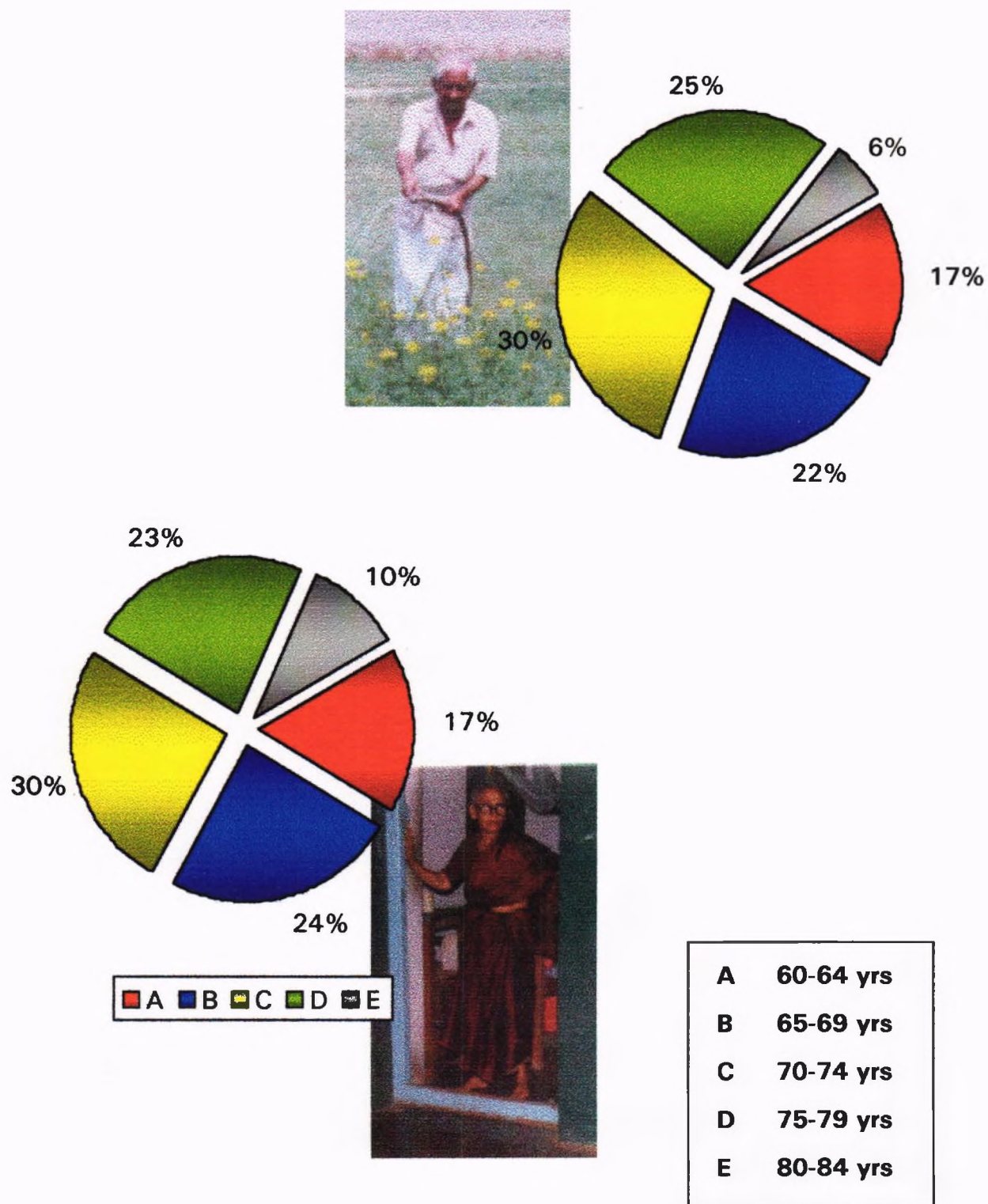


FIGURE 5
AGE DISTRIBUTION OF THE ELDERLY

75 to 79 age group, 22 per cent in 65 to 69 age group and 17 per cent in the 60 to 64 age group. Among the elderly women 26 per cent of them belonged to the age group of 70 to 74 years, followed by 24 per cent in the age group of 65 to 69 years. Twenty three and 17 per cent of the elderly women belonged to 75 to 79 years and 60 to 64 years respectively. The least number of the elderly men and women fell into the age category of 80 to 84 years. In all, 65 to 79 years was the age range of majority of the elderly studied.

b. Educational Status

The literacy level of the selected elderly is given in Table II.

TABLE II
EDUCATIONAL STATUS OF THE ELDERLY

N:500

Age (years)	Men				Women			
	Number		Per cent		Number		Per cent	
	Literates	Illiterates	Literates	Illiterates	Literates	Illiterates	Literates	Illiterates
60-64	30	3	15	2	30	22	10	7
65-69	30	13	15	7	27	48	9	16
70-74	27	30	14	15	22	57	7	19
75-79	15	34	8	18	19	51	6	17
80-84	6	6	3	3	4	26	1	8
Total	108	86	55	45	102	204	33	67

Of the 194 elderly men, 108 (55%) were literates and 86 (45%) were illiterates. Out of the 306 elderly women, 102 (33%) were literates and 204 (67%) were illiterates. Illiteracy was more common among the elderly women (67%) than men (45%). This is in line with the literacy trend found in

India, where the women's literacy level is lower than that of men. According to 1991 census, the percentage of literacy among women was 39.42 per cent as compared to 63.86 per cent among men (Ahuja, 1997, Misra and Puri, 1998). It was also observed that the percentage of literates increased as the age range decreased, which is in line with the changing national scenario over the last few decades. In a study conducted by Vasanthadevi and Premakumari (1998) on rural and urban aged it was found that 64.7 per cent of the rural aged and 40 per cent of the urban aged were illiterates.

c. Occupation and Economic Status

At the time of this study, all the elderly men and women were not employed. However, information regarding their occupation prior to joining the old age home was elicited. The details of their erstwhile occupation are given in Table III.

TABLE III
OCCUPATIONAL PATTERN OF THE ELDERLY **N:500**

Occupation	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Household Worker	7	3.61	211	68.95	218	43.60
Agri Labourer	43	22.16	54	17.65	97	19.40
Labourer	16	8.25	4	1.31	20	4.00
Skilled labourer	27	13.92	12	3.92	39	7.80
Street vendor	9	4.64	3	0.98	12	2.40
Petty shopkeeper	47	24.23	12	3.92	59	11.80
Professional	45	23.20	10	3.27	55	11.00
Total	194	100.00	306	100.00	500	100.00

Among the elderly men 24.23 per cent owned petty shops, followed by 23.20 per cent who were employed as clerks, school teachers and as wholesale grocery merchants. Agricultural operations were the main occupation for 22.16 per cent of them. Carpentry, masonry, tailoring and weaving were practised by 13.92 per cent of the selected elderly men. Coolies and household male servants were 8.25 per cent and 3.61 per cent respectively.

Majority of the elderly women (68.95%) were involved in household work and 17.65 per cent of women were working as agricultural labourers. Almost similar proportion of women were working as skilled labourers (3.92%), petty shop keepers (3.92%) and as school teachers (3.27%). Only few were working as labourers (1.31%) and street vendors (0.98%) selling fruits and vegetables.

The erstwhile occupations of the elderly were classified as sedentary, moderate and heavy, based on the physical activity involved in that job (Sathyanarayana, 1989). The details of the categorised occupation is given in Table IV.

TABLE IV
CATEGORIES OF THE OCCUPATION OF THE ELDERLY

N:500

Occupation	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Sedentary	99	51.03	233	76.14	332	66.40
Moderate	52	26.81	57	18.63	109	21.80
Heavy	43	22.16	16	5.23	59	11.80
Total	194	100.00	306	100.00	500	100.00

Most of the elderly (66.40%) were involved in sedentary work like domestic work and light agricultural work like sowing seeds or applying pesticides. Many women were either housewives or domestic servants and were classified as sedentary workers. Workers who were involved in non-mechanised agricultural work like ploughing and threshing, masons, street vendors carrying headload or pushing cartload of merchandise were classified as heavy workers. Weavers, gardeners, and carpenters using manual tools were classified as moderate workers as per the classification of Sathyanarayana (1989). The moderate (21.81%) and heavy workers (11.80%) formed 33.60 per cent of the elderly surveyed.

Based on the erstwhile income of the selected elderly, they were grouped as those belonging to low income (Rs.300 and below per month) and middle income (Rs.301 to Rs.1000 per month) groups. It was found that 327 (65.4%) belonged to low income group and 173 (34.6%) were of middle income group.

d. Marital Status and Number of Children in the Families of the Selected Elderly

Of the 194 men, 36 (18.56%) were bachelors and among the 306 women, 48 (15.69%) were spinsters. This reveals that less number of women remained unmarried than men. Among the married men 65 per cent of them were widowers and 86 per cent of the women were widows. The proportion of widows were more than widowers. This is in accordance with the report from the office of the Registrar General, India (1992) which states that the proportion of widows/separated in 60+ age group is as high as

66.4 per cent in urban areas and 61.1 per cent in rural areas as against that of widowers/separated which is 18.2 per cent and 22.3 per cent respectively. Another reason for more widows than widowers may be the difference in longevity of men and women. The life expectancy at birth in India was 60.8 years in 1992-93 with 60.4 for males and 61.2 for females (Datt and Sundaram, 1997). Thirty three of the married men and 65 of the married women did not have children. It was also observed that they did not adopt any child either.

Out of 194 men 158 and out of 306 women 258 were married. Table V gives the details of number of children in the families of the elderly who were married.

TABLE V
NUMBER OF CHILDREN IN THE FAMILIES OF THE ELDERLY **N:416**

Number of Children	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
No child	33	20.89	65	25.19	98	23.56
One child	33	20.89	69	26.75	102	24.52
Two children	33	20.89	58	22.48	91	21.87
Three children	31	19.61	36	13.95	67	16.11
Four children and more	28	17.72	30	11.63	58	13.94
Total	158	100.00	258	100.00	416	100.00

Table V reveals that 20.89 per cent of the married elderly men and 25.19 per cent of the married elderly women had no children. In each of the families of 20.89 per cent elderly men and 26.75 per cent elderly women there was only one child. In each of the families of 20.89 per cent and

19.61 per cent elderly men there were two and three children respectively. Similarly in the families of 21.87 and 16.11 per cent elderly women there were two and three children respectively. There were four children in 17.72 and 13.94 per cent families of elderly men and women respectively.

It is seen that only 23.56 per cent of the elderly did not have a child whereas others had one child or more. Irrespective of having a child or not these elderly had to seek the shelter of an old age home which proves the statement by Ghosh (1998) 'No children, no support is as untrue as more children more support'.

e. Reasons for Joining and Period of Stay in the Old Age Homes

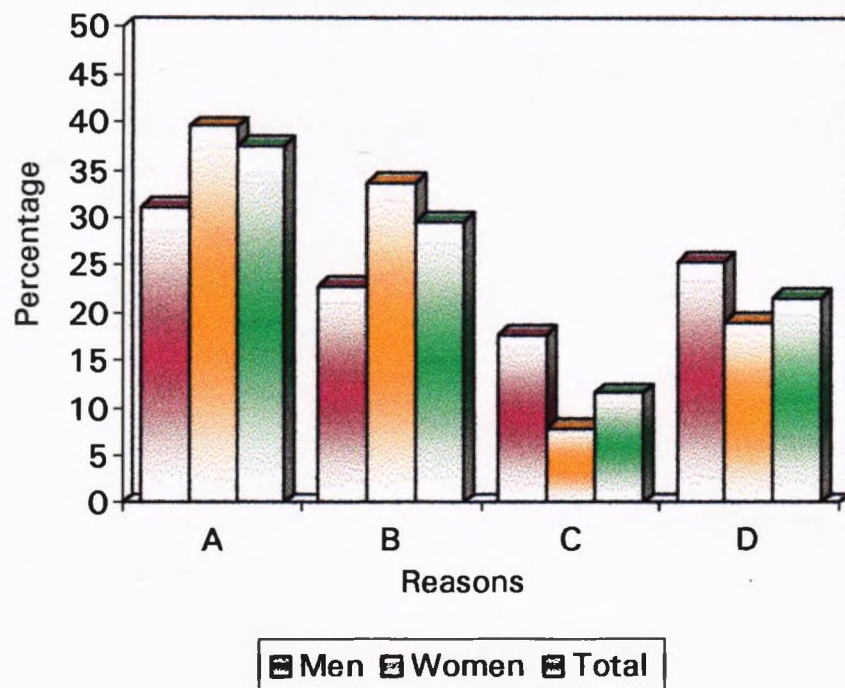
In the case of unmarried men and women 40 per cent of them had lived with their parents. When their parents died they continued to live on their own till they were able to earn or were healthy. But when they could not earn or fell ill they had to join an old age home. In the case of others, constituting 60 per cent of the unmarried elderly stayed with their siblings family till they could financially support the family or help in domestic work. When they were unable to support financially or when their health failed they had to join the old age home. These were the two reasons for the unmarried elderly joining the old age homes.

The common reasons stated by the married elderly, for joining the institutions are shown in the Table VI and Figure 6.

TABLE VI**REASONS FOR JOINING THE INSTITUTION (OLD AGE HOMES)****N:416**

Reason	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Nobody to look after	54	34.18	102	39.53	156	37.5
Poverty in the house	36	22.78	105	33.72	123	29.57
Unable to earn any more	28	17.72	20	7.75	48	11.54
Son-in-law or daughter in-law refuses to take care	40	25.32	49	19.00	89	21.39
Total	158	100	258	100	416	100

The most common reason stated, by 37.5 per cent of the elderly, for joining the old age homes was that they had no one to take care of them. They were childless and thus had to join the old age homes. When there were more than two or three children and each child expected the other to take care of the old parents, which in many instances left the parents in lurch. In few cases the death of child/children and spouse made them seek the shelter of an old age home. Sheer poverty in the house was the next cause as informed by 29.57 per cent of the elderly. In most of the middle and lower income group families, high cost of living and lack of proper accommodation facilities posed several limitations on their capacity, if not willingness, to take care of the elderly. Financial stringency seemed to be the main reason as to why middle and lower income group families, inspite of their best intentions, found it difficult to maintain their elderly. This entailed additional expenditure on relatively expensive foods like milk and fruit and on medicines. It had been estimated that a person aged 75 used health and



- A. NOBODY TO LOOK AFTER
- B. POVERTY IN THE HOUSE
- C. UNABLE TO EARN ANY MORE
- D. SON-IN-LAW OR DAUGHTER IN-LAW REFUSES TO TAKE CARE

FIGURE 6
REASONS FOR JOINING THE INSTITUTION (OLD AGE HOMES)

social services eight times more than the normal adults. These extra expenses on the elderly start pinching the family budget (Khan and Kaushik, 1999). Only 11.54 per cent of the elderly were sent away from their homes because they were unable to earn any more. Those men or women who were engaged in private sectors did not come under pension scheme and thus after retirement they had no monthly income. This was one of the reasons that they were not welcome in their own homes. Partial or total economic dependence on the offspring may lead to a deletion of authority for the elderly, and quite often the son's or daughter's family tend to ignore, reject or view the elderly as a liability. Moreover migration of the younger generation from the rural to urban areas, for gainful employment, alienates the elderly who can neither bid effectively in the job market nor share their expertise, turning the elderly redundant in the eyes of their kith and kin. Doubtless, this adversely affects, the sense of worth and self-esteem and they wish to leave their homes or are sent to the old age homes by the children themselves.

Details regarding the period of stay in the old age home is given in Table VII.

TABLE VII
PERIOD OF STAY IN THE OLD AGE HOME

N:500

Period of stay (years)	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
< 5 years	123	63.40	192	62.75	315	63.00
5-10 Years	32	16.50	68	22.22	100	20.00
> 10 Years	39	20.10	46	15.03	85	17.00
Total	194	100	306	100	500	100

Majority of the respondents (63.00%) were in the old age homes for less than five years followed by those (20.00%) who had been in the old age home for five to ten years. Only 17.00 per cent were in the elderly home for more than 10 years. It is found that more elderly have joined the old age home in the recent years. It is an indication of the changing social milieu. Reports project that the proportion of elderly population supported by their children which was 80.80 per cent in 1971 to fall to 50.90 per cent by 2001 (Shah, 1995).

f. Leisure Time Activities

Having joined an old age home, most of the inmates spent their leisure time, in activities to suit their health conditions and aptitudes. Table VIII gives the details of leisure time activities of the selected elderly. Plate I shows the leisure time activities of the elderly.

TABLE VIII
LEISURE TIME ACTIVITIES

Activities	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
Reading	60	30.93	26	8.49	86	17.20
Listening to radio	72	37.11	77	25.16	149	24.80
Watching TV	76	39.17	70	22.87	146	29.20
Gardening	24	12.37	29	6.53	44	8.80
Helping in the kitchen	12	11.65	64	20.91	76	15.20
Working as watchman	8	7.77	-	-	8	2.96
Making paper covers	17	16.50	-	-	17	5.19
Cleaning the premises	14	13.59	22	7.18	36	7.20



GARDENING



MAKING OFFICE COVERS

PLATE II

LEISURE TIME ACTIVITIES



CLEANING



CUTTING VEGETABLES



WINNOWING RICE



CHATTING

The most popular pastime was watching television (29.2%) and listening to radio (24.8%). The next common pastime was reading newspapers and magazines. This was possible for those who had fairly good eyesight. Compared to men, more elderly women helped in the kitchen. They cut vegetables, winnowed food grains, cleaned vessels, prepared snacks or served food. Few women collected twigs and pieces of dry wood from the garden for firewood. Gardening was the leisure time activity preferred by 8.80 per cent of the elderly. The premises of the old age homes were kept clean with the assistance of 7.20 per cent of the elderly. In one of the old age homes studied those who were involved in gardening and keeping the premises clean were paid Rs.20/- per month by the missionaries running the home. In another home the inmates made office covers for which they were paid by the office which supplied them the raw materials for making covers. However, those beyond 75 years had a tendency to lie down and rest for a while after breakfast and lunch. They also took more time to carry out their personal work such as brushing the teeth, bathing, combing hair, folding their clothes and making the bed. Therefore, they did not have much time to spare for other activities. Verma and Kohli (1992) reported the leisure time activities of old people to be: lying down to rest (13.2%), watching TV (16.6%), reading (10%) and chatting with friends (6.6%). It was also observed that as age increased, people read lesser number of books and newspapers and saw fewer films because of the declining vision, loss of interest in the content of books and films and difficulty in sitting in one position for long.

g. Personal Habits

The personal habits of the selected elderly are outlined in Table IX.

TABLE IX
PERSONAL HABITS OF THE SELECTED ELDERLY

N:500

Personal Habits	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
None	63	32.47	245	80.07	308	61.60
Chewing betel leaves/Snuff	18	9.28	59	19.28	77	15.40
Smoking	63	32.47	2	0.65	65	13.00
Drinking	27	13.97	0	0.00	27	5.40
Smoking and drinking	23	11.86	0	0.00	23	4.60
Total	194	100.00	306	100.00	500	100.00

Among the elderly men only 32.47 per cent did not have any habits of smoking, drinking or using snuff powder. More men (63 out of 194) were in the habit of smoking cigarette followed by 27 men who were in the habit of taking alcoholic drinks. Twenty three (11.86%) men smoked and drank alcoholic drinks. The habit of chewing betel leaves with or without tobacco was found in 9.28 per cent of elderly men.

Majority of the elderly women (80.07%) did not have the habit of chewing betel leaves or using snuff. However, 19.28 per cent of them had the habit of chewing betel leaves and using snuff. Only 0.65 per cent of the elderly women smoked cheroot.

2. Dietary Practices

a. Before Joining the Old Age Home

A concise dietary history of the elderly before joining the old age home was elicited to understand their erstwhile dietary practices. Of the elderly, 422 (84.40%) had rice as the staple food whereas only 78 (15.60%) had mixed cereals such as finger millet, sorghum and rice. It was found that 301 (60.2%) of them consumed vegetables every day and 196 (39.2%) of them on alternate days. The vegetables were consumed in the cooked form and not in raw form (salads). The quantity consumed was in the range of 30-50 g which was less than the Recommended Daily Allowances. Only 46 (9.20%) of the selected elderly were vegetarians and the rest of them were non vegetarians. Those who had flesh foods twice a week formed 4.40 per cent, once a week formed 33.20 per cent and once a fortnight formed 1.60 per cent. However, majority (51.60%) of them took non vegetarian food only occasionally, that is either once a month or during festivals. It was also understood that the quantity consumed was about 100-200g as one or one and a half kilogram meat had to be shared with family members and relatives. The same type of sharing was expressed by those who took flesh foods more often.

b. After Joining the Old Age Home

There was not much variation in the dietary habits of the elderly after they joined the old age homes because the dietary pattern followed in the institutions were their main daily meal pattern. Though the menu followed was cyclic, as these homes were charity homes, the meal pattern was simple and consisted of breakfast, lunch, plain tea and dinner. The breakfast items

were mostly a cereal dish or porridge; lunch was rice with a curry, vegetable and butter milk; tea time was just plain tea or occasionally with snacks and often at dinner the lunch items were repeated or it was again a cereal dish with curry and butter milk.

The meals provided in the old age homes were sufficient in quantity. The foods were served using standardised laddles. Equal amounts of foods were served during the first round. Those who wanted a second helping asked for extra food. However, there were many who did not eat even what was served in the first round. This may be due to lack of appetite or boredom of consuming the same food for long or dislike for a food alien to what he/she was used to. The old age homes provided tea/coffee once or twice a day. During festivals they had more items in the daily menu. Occasionally snacks or meals were provided by philanthropists.

c. Frequency of Foods Purchased from Nearby Shops

Those who could spare the money (few received old age pension and others received money occasionally from visiting relatives) had the habit of going to the petty shops close by, for tea, coffee, bajji (slices of vegetables like raw banana, potato, onion or brinjal dipped in salted and spiced Bengal gram flour batter and deep fried), iddli (fermented rice and black gram dhal batter and steamed in moulds), dosai (pancakes prepared out of fermented rice and black gram dhal batter), biscuits, bread and bun. Table X gives details of food purchased by the elderly from the nearby shops.

It was observed that 17.53 and 16.49 per cent elderly men had the habit of buying coffee and tea respectively from the nearby petty shops every day, whereas 13.40 and 10.82 per cent men bought coffee and tea

TABLE X
FREQUENCY OF FOODS PURCHASED FROM THE NEARBY SHOPS
(in per cent)

Foods	Men			Women		
	Daily	Weekly	Occasionally	Daily	Weekly	Occasionally
Coffee	17.53	13.40	29.38	3.59	6.54	10.13
Tea	16.49	10.82	34.02	-	3.59	11.44
Snacks (Bajji, Vadai)	-	15.98	23.19	-	1.96	8.17
Egg	-	-	16.49	-	-	1.31
Fruits	-	7.73	13.40	-	1.31	6.21
Milk	-	20.62	23.71	-	-	-
Biscuit, Bun, Bread	-	6.70	11.86	-	2.29	8.17
Iddli, Dosai	-	5.67	20.62	-	1.96	6.54
Non vegetarian foods	-	2.06	11.34	-	-	3.59

respectively, once a week. However, 29.38 and 34.02 per cent men bought the same occasionally. Snacks like bajji and vadai were purchased once a week and occasionally by 15.98 and 23.19 per cent of men respectively. Eggs were purchased only occasionally by 16.49 per cent men. Banana was the fruit often purchased and when mangoes and guava were available in plenty during season they bought these fruits. Only 7.73 per cent men bought fruits once a week and 13.40 per cent men occasionally.

In the case of elderly women only 3.59 per cent of them purchased coffee everyday, 6.54 per cent purchased once a week and 10.13 per cent occasionally. Coffee, tea, snacks, fruits, baked foods, iddli and dosai were purchased weekly by 6.54, 3.59, 1.96, 1.31, 2.29 and 1.96 per cent of the elderly women respectively. Milk was not purchased at all. Occasionally coffee was purchased by 10.13, tea by 11.44, snacks by 8.17, baked foods by 6.54 and iddli or dosai by 3.59 per cent of the elderly women surveyed.

d. Problems Faced by the Elderly while Eating

As is common in old age many of them had difficulty in biting, chewing and swallowing food. Table XI and Figure 7 give the number of respondents who had such difficulties.

TABLE XI
PROBLEMS IN FOOD INTAKE BY THE ELDERLY

Personal Habits	Men		Women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
No problem	79	40.72	170	55.56	249	49.80
Difficulty in Biting	60	30.93	64	20.91	124	24.80
Difficulty in Chewing	45	23.19	48	15.69	93	18.60
Difficulty in Swallowing	10	5.16	24	7.84	34	6.80
Total	194	100.00	306	100.00	500	100.00

Almost half (49.80%) of the selected elderly did not have any difficulty in taking food. Due to lack of teeth or loose teeth, 24.80 per cent had difficulty in biting hard or crisp foods. Though the need to have dentures were found in many, only 12 men and 16 women wore dentures. This was because of lack of finance of their own and from other sources. Difficulty in chewing was expressed by 18.60 per cent and in swallowing by 6.80 per cent of the elderly in the cohort studied. When chewing is difficult, a person may not only reject certain foods but may also have less desire to eat. The individuals who are unable to masticate food due to old age is in jeopardy both physically and mentally. Prakash (1999a) and Prabhu (1999) reported that when dental health is poor, eating can become a chore, and restricted food intake can lead to poor nutrition.

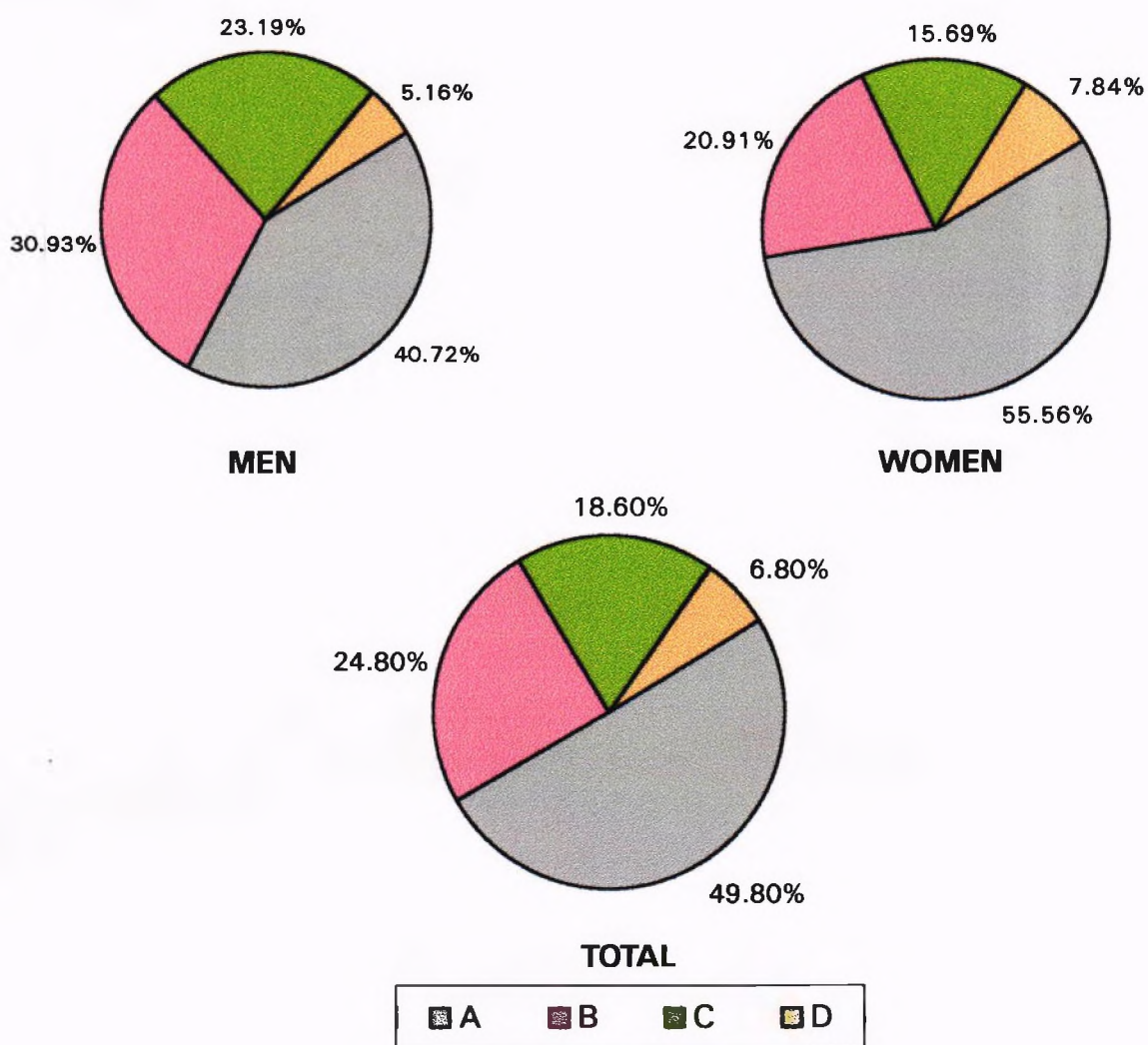


FIGURE 7
PROBLEMS IN FOOD INTAKE BY THE ELDERLY

e. Food Beliefs and Taboos

Most of the elderly men and women had their own concepts of foods as to which are the foods good or bad for health. Some of the food beliefs and taboos expressed by the cohort studied were relevant for all the age groups, whereas a few of them were specifically pertinent to the elderly. The details are given in Table XII.

TABLE XII
FOOD BELIEFS AND TABOOS OF THE ELDERLY

S.No	Food beliefs and taboos of the elderly	No	Per cent
General beliefs expressed by the elderly			
1	Millets are more nutritious than rice	378	75.6
2	Green leafy vegetables are good for health	456	91.2
3	Papaya, pineapple and jackfruit are hot foods and should be avoided by pregnant women	396	79.2
4	Bittergourd has deworming properties and is also good for diabetic patients	288	57.6
5	Onions, garlic and ginger are good for health	414	82.8
Beliefs pertinent to the elderly			
6	Finger millets cause bleeding of piles	305	61.0
7	Pulses are gas producing	416	83.2
8	Root vegetables are gas producing	366	73.2
9	Too much of milk would cause indigestion	317	63.4
10	Curd and buttermilk are cold foods, so should not be consumed with supper	335	67.0
11	Green leafy vegetables should not be eaten after supper as it would cause indigestion	416	83.2
12	Banana stem is good for health as it would prevent the formation of kidney stones	318	63.6
13	Frequent consumption of tea would cause nausea	308	61.6
14	Oily foods (fried foods) would cause indigestion and giddiness	313	62.6
15	Consumption of fresh fruit after sunset would cause cough and cold	341	68.2

Though 75.6 per cent of the elderly believed that millets were more nutritious than rice they could not explain why it was so. Similarly the importance of including green leafy vegetables was known to 91.2 per cent of the elderly. Reasons given by the elderly as to why green leafy vegetables were good for health were that it was blood forming, could relieve constipation and improved general health. The common belief among 79.2 per cent of elderly was that papaya, pineapple and jack fruit should be avoided by pregnant women. The reason stated was that these three fruits were hot foods and hence abortive. It was believed by 57.6 per cent of the elderly that tender bittergourd if consumed along with the seeds would have deworming effect. It was also advised as a beneficial food for the diabetic patients. Onions and garlic were believed to be good for health by 82.8 per cent of the elderly and they believed that onions and garlic purified blood and ginger promoted digestion.

The elderly had certain beliefs specific for their age group. Finger millet being a common millet of South India, it is used in many homes. Yet they believed that consumption of finger millet would cause constipation which in turn might trigger the bleeding of piles. The elderly felt that the consumption of pulses especially red gram and Bengal gram caused flatulence and that green gram was the only pulse which was easily digestible and caused no problem of gas production. Root vegetables were considered as gas producing by 73.2 per cent of the elderly. Many of them abstained from consuming potatoes and yam too often because they believed that these root vegetables caused flatulence. Sweet potato and cassava were consumed only occasionally and sparingly for the same reason. However they did not

consider colocasia, carrot and radish as gas producing root vegetables. Sixty seven per cent of them opined that consuming green leafy vegetables during supper should be avoided as it would cause indigestion. The common belief among 83.2 per cent of the elderly regarding consumption of banana stem was that it prevented the formation of kidney stones and that it should be consumed atleast once a week. The elderly (63.6%) felt that excess tea consumption would cause nausea and might adversely affect the liver. Many of the elderly (61.6%) were reluctant to consume curd or butter milk (the thin sour milk that remains after the removal of butter from the curd) at night as they believed those to be cold foods and might cause cold, cough or fever. As the age increased, the elderly (62.6%) believed that deep fried snacks, and foods to which fat was added liberally should be eaten sparingly. They believed that their digestive system cannot assimilate oily foods and would lead to indigestion and giddiness. Since 68.2 per cent of them believed that fresh fruits were cold foods, they deterred from consuming fresh fruits like guava and grapes after sunset.

3. Nutritional and Health Profile

a. Nutritional Profile

i. Anthropometric Measurements

Kohrs and Narins (1990) indicated anthropometry as a useful non-invasive way to evaluate the nutritional status of elderly. Table XIII gives the mean anthropometric measurements and BMI of the elderly men and women. Figure 8 shows mean height and weight of the elderly studied in comparison to the literature values.

TABLE XIII
ANTHROPOMETRIC MEASUREMENTS OF THE ELDERLY
MEN AND WOMEN

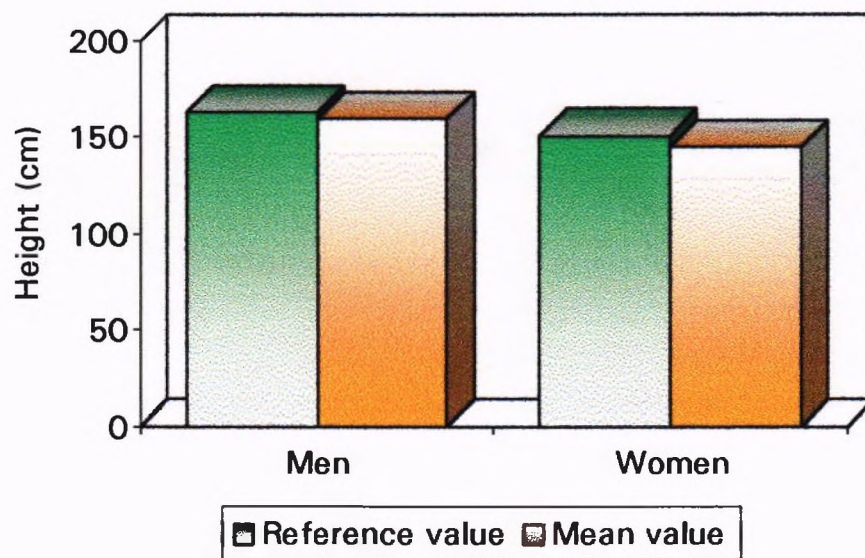
N = 500

Sl.No	Anthropometric measurements	Men N=194	Women N=306	Literature value *	
				Men	Women
1.	Height (cm)	159.68±6.33	145.05±6.56	162.6±6.70	150.4±5.95
2.	Weight (kg)	51.09±8.02	43.33±7.80	50.2±7.95	43.1±7.41
3.	BMI (kg/m ²)	20.08±3.28	20.58±3.37	20.91±1.67	20.75±2.75
4.	Mid arm circumference (cm)	23.55±2.47	23.13±2.99	23.5±2.53	22.4±2.95
5.	Skinfold thickness (mm)	8.67±2.48	9.46±7.88	6.63±2.86	9.65±4.78
6.	Arm area (cm ²)	44.83±9.66	43.19±11.06		
7.	Arm muscle circumference (cm)	20.86±2.40	20.45±2.98		
8.	Arm muscle area (cm ²)	35.84±8.73	34.55±9.91		
9.	Arm fat area (cm ²)	23.97±7.51	22.74±8.23		

* Naidu and Rao (1994)

The mean height of the elderly men was 159.68 ± 6.33 cm and that of the women was 145.05 ± 6.56 cm. The mean weights of men and women were 51.09 ± 8.02 kg and 43.33 ± 7.80 kg respectively. The mean heights of the elderly men and women reported by Naidu and Rao (1994) were 162.6 ± 6.70 and 150.4 ± 5.95 cm respectively. These values are slightly higher than those obtained in this study. The mean weights of adult men and women reported by Naidu and Rao (1994) were 50.2 ± 7.95 kg and 43.1 ± 7.41 kg respectively. These values ~~are~~ slightly lower than that found out in this study. The mean BMI values for elderly men and women in the present study were 20.08 ± 3.28 and 20.58 ± 3.87 respectively.

HEIGHT



WEIGHT

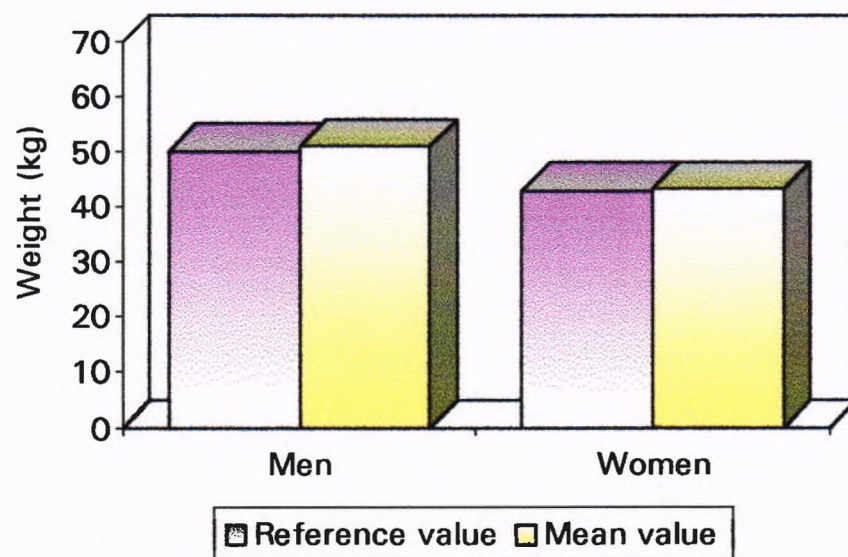


FIGURE 8

HEIGHT AND WEIGHT OF THE ELDERLY

The mean BMI of elderly women was slightly higher than that of elderly men. Chandrasekhar and Bhooma (1999) reported a similar trend in BMI of the elderly men and women. The mean skinfold thickness of the elderly women was 9.46 ± 7.88 mm and that of the elderly men 8.67 ± 2.48 mm. A higher skinfold thickness of women than men was also reported by Naidu and Rao (1994), Hermen *et al.*, (1998) and Chandrasekhar and Bhooma (1999). The higher triceps skinfold thickness among women may be due to more fat at subcutaneous sites than men (Degroot *et al.*, 1991). The mean arm area and mean arm muscle area of the elderly men were found to be higher than that of the elderly women. But the mean arm fat area of the elderly women was more than that of the elderly men .

Body Mass Index (BMI) is considered as a good indicator of percentage fat in the elderly. Bailey and Ferro (1998) have indicated that BMI permits conclusion to be drawn about generalised undernutrition in a community. The distribution of the elderly adults according to BMI classification suggested by James *et al.*, (1988), Ferro-Luiz (1992) and WHO (1999) is given in the Table XIV and Figure 9.

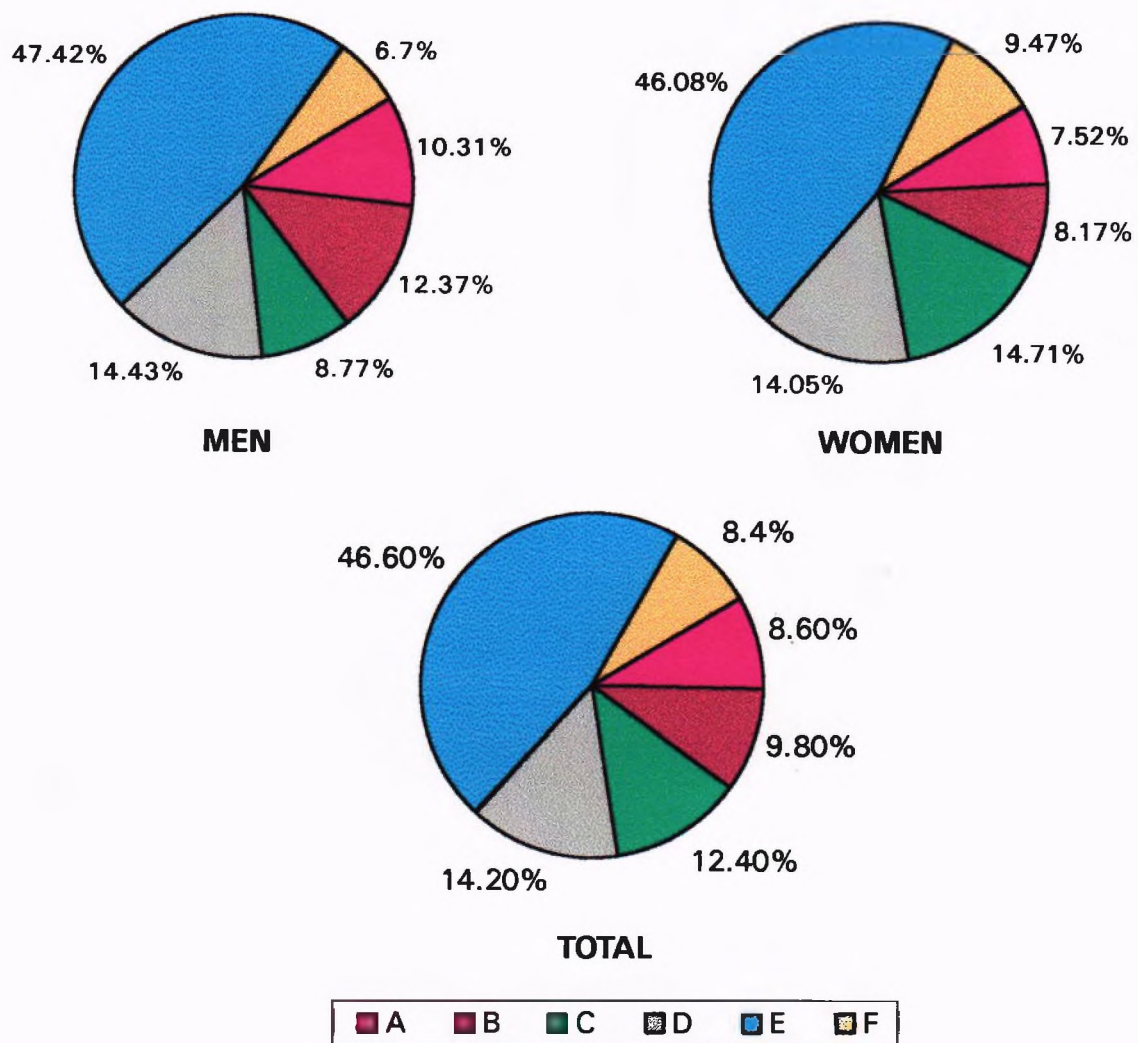
TABLE XIV
DISTRIBUTION OF ELDERLY MEN AND WOMEN ACCORDING
TO BMI CLASSIFICATION

N = 500

BMI	Category	Men		Women		Total	
		Number	Per cent	Number	Per cent	Number	Per cent
< 16	Grade III	20	10.31	23	7.52	43	8.60
16-16.9	Grade II	24	12.37	25	8.17	49	9.80
17-18.4	Grade I	17	8.77	45	14.71	62	12.40
18.5-19.9	Low weight normal	28	14.43	43	14.05	71	14.20
20-24.9	Normal	92	47.42	140	46.08	233	46.60
25-29.9	Obese	11	5.67	27	8.82	38	7.60
30+	Obese	2	1.03	2	0.65	4	0.80
Total		194	100.00	306	100.00	500	100.00

Only 47.42 per cent of elderly men and 46.08 per cent of elderly women belonged to normal BMI category (20.0 to 24.9). Among the elderly men and women, 14.43 and 14.05 per cent belonged to low weight normal category respectively (BMI 18.5 - 19.9). The remaining were distributed in Chronic Energy Deficiency (CED) categories of different grades viz. BMI 17.0 to 18.4 - mild CED - grade I, 16.0 - 16.9 moderate CED - grade II and < 16 - severe CED - grade III. Thus of the total elderly studied 8.60 per cent were in grade III CED, 9.8 per cent in grade II CED and 12.4 per cent in grade I CED.

Only 6.70 per cent (5.67 and 1.03%) elderly men and 9.47 per cent (8.82 + 0.65%) elderly women belonged to the obese category having BMI more than 25. Of the total elderly population studied 30.8 per cent (8.60 + 9.80 + 12.40 per cent) had a BMI lesser than normal which was a fairly large segment of the group.



- | | |
|----------------------|-----------|
| A. GRADE III | E. NORMAL |
| B. GRADE II | F. OBESE |
| C. GRADE I | |
| D. LOW WEIGHT NORMAL | |

FIGURE 9
BODY MASS INDEX OF THE ELDERLY

b. Functional and Clinical Assessment

The details of the functional assessment of the selected elderly is given in Table XV.

TABLE XV
FUNCTIONAL ASSESSMENT OF THE SELECTED ELDERLY

	Details	Men (N=194)		Women (N=306)		Total (N=500)	
		No.	Per cent	No	Per cent	No	Per cent
a	Posture						
	Normal	183	94.33	285	93.14	468	93.60
	Bent at waist	4	2.06	5	1.63	9	1.80
	Hunch	7	3.61	16	5.22	23	4.60
b	Gait						
	Normal	175	90.21	290	94.77	465	93.00
	Limping	8	4.12	4	1.31	12	2.40
	Shuffling	19	5.67	12	3.92	23	4.60
c	Hands						
	Normal	171	88.15	237	77.45	408	81.60
	Tremor	4	2.06	12	3.92	16	3.20
	Stiffness	19	9.79	57	18.63	76	15.20
d	Hearing						
	Normal	156	80.41	279	91.18	435	87.00
	Hard of hearing	38	19.59	27	8.82	65	43.00
e	Eyes						
	Normal sight	87	44.85	171	55.88	258	51.60
	Poor sight	107	55.15	135	44.12	242	48.40
f	Legs						
	Normal	142	73.19	270	88.24	412	82.40
	Slightly bent	16	8.25	33	10.78	49	9.80
	Varicose veins	36	18.56	3	0.98	39	7.80
g	Speech						
	Normal	141	88.15	234	89.54	375	75.00
	Slured	47	8.76	72	10.46	190	23.80
	Stammering	6	3.09	---	---	6	1.20

The posture of 468 (93.60%) was normal, but nine (1.80%) were bent at waist. As old age approaches, the vertebrae may compress into wedge shapes, forming what is often called "dowager's hump", the posture many older people get as they 'grow shorter' (Rolfes et al, 1998). Twenty three (4.60%) had hunch back. Majority (93.00%) had normal gait while walking though many of them walked slowly. Prakash (1999a) reported that coordination of the nervous and muscular systems that produces a forceful, confident stride is lost in elderly and they develop an uncertain and hesitant gait. Of the rest 23 (4.60%) of them had a shuffling movement due to stiffness or pain at the joints. Twelve limped, eight due to corn under the feet and four due to attack of poliomyelitis.

Tremor and stiffness were observed in the hands of 3.20 per cent and 15.20 per cent of the elderly. The rest of them (81.60%) had no such symptoms. While tremor was due to general weakness, the stiffness was mainly due to rheumatoid arthritis.

There is a gradual loss of hearing with age. Defects in hearing vary from wax in the external ear to degeneration of nerve cells in the inner ear (Jain and Kumar, 1998). Hearing loss in the group of elderly studied was found in 65 (13 per cent) of them. Patterson and Chambers (1995) reported that 25 to 30 per cent of older people have hearing impairment. But avoidance of factors such as excessive noise and ototoxic drugs reduce the incidence of hearing loss.

Only 51.60 per cent of the cohort studied had proper vision whereas 48.40 per cent of them complained of poor sight of varying extent. Diminished

visual acuity is a common problem among the aged. The reduction in vision may be due to cataract, age related macular degeneration or diabetic retinopathy. The legs of 412 (82.40%) elderly were normal. Forty nine (9.80%) of them had slightly bent legs which may be due to ageing process. The speech was normal in 375 (75.00%) elderly while 119 (23.80%) had slightly slurred speech. Six of the elderly men had stammering which was congenital.

The clinical picture of the selected elderly is given in Table XVI.

TABLE XVI
CLINICAL PICTURE OF THE SELECTED ELDERLY

Clinical Symptoms			Men (N=194)		Women (N=306)		Total (N=500)	
			No	Per cent	No	Per cent	No	Per cent
a	Temperature	Normal	175	90.21	295	96.40	470	94.00
		Elevated	17	8.76	7	2.29	24	4.80
		Hypothermia	2	1.03	4	1.31	6	1.20
b	Sweating	Normal	183	94.33	283	92.48	466	93.20
		Profuse	11	4.67	23	7.51	34	6.80
c	Nails	Normal	160	82.46	239	78.10	399	79.80
		Brittle	13	6.70	17	5.56	30	6.00
		Spoon shaped	2	1.03	2	0.65	4	0.80
		Discoloured	19	9.80	48	15.60	67	13.40
d	Edema	No edema	175	90.21	278	90.85	453	90.60
		Localised	19	9.79	28	9.15	47	9.40
e	Skin	Normal	156	80.41	239	78.11	395	79.00
		Dry skin	30	15.47	49	16.01	79	15.80
		Depigmentation	8	4.12	18	5.88	26	5.20
f	Teeth	Pearl white	45	23.20	72	23.70	117	23.40
		Caries/discoloured	100	51.55	127	41.62	227	45.40
		Plaque deposition	132	68.04	195	63.58	327	65.40
		Broken	75	38.66	83	27.17	158	31.60
g	Gums	Normal	107	55.15	173	56.54	280	56.00
		Receded	72	37.11	112	36.60	184	36.80
		Inflamed	15	7.73	21	6.86	36	7.20
h	Lips	Normal	179	92.27	278	90.85	457	91.40
		Cracked/dry	13	6.70	21	6.86	34	6.80
		Angular Stomatitis	2	1.03	7	2.29	9	1.80
i	Digestive functions	Normal	182	93.81	296	96.73	478	95.60
		Distended	12	6.19	10	3.27	22	4.40
j	Respiratory Symptoms	Normal	158	81.45	262	85.62	420	84.00
		Asthmatic	21	10.82	30	9.81	51	10.20
		Dyspnic	11	5.67	9	2.94	20	4.00
		Persistent cough	4	2.06	5	1.63	9	1.80

While 470 (94.0%) of the elderly had normal body temperature 24 (4.80%) had slightly elevated body temperature ranging between 99° to 100° F. Mild hypothermia, with the temperature ranging between 96.7 to 97.9° F was observed in 1.20 per cent. What may seem like a mere couple of degrees lower (about 96° F) than normal could have a devastating effect. Severe hypothermia causes irregular heartbeat leading to heart failure and death (Anon, 1999). Thirty four of the elderly were found to perspire profusely. This may be due to some underlying health problem such as fever, or pain in the joints.

Out of the 500 elderly 399 (79.80%) had normal nails whereas 30 (6.00%) of them had brittle nails and 67 (13.40%) had discoloured nails. The spoon shaped nails in four may be due to gross iron deficiency anaemia.

There was no edema in 453 (90.60%) of the elderly. But in 47 (9.40%) of them there was mild swelling at the ankles and feet. The underlying causes may range from cardiovascular disorders to kidney disorders.

The skin often exhibits changes that denote the onset of senescence. Lax skin, wrinkling, lentigines, vascular changes and dermal or epidermal degenerative changes are well known markers of both chronologic and biologic age. While 395 (79.00%) had normal skin, 79 (15.80%) of them had dry skin and 26 (5.20%) had depigmentation. The reasons may be a reduction in the sebaceous gland function and enzymatically active melanocytes.

Only 117 (23.40%) had pearl white teeth. There was plaque deposition on teeth in 327 (65.40%) elderly, caries/discoloured teeth in 227 (45.40%) of them and 158 (31.60%) had broken teeth. The oral cavity plays a vital role in the daily life of every individual. Dental problems in old age could be due to change in diet, decrease in oral hygiene self-care and

diminished salivary flow. Prakash (1999 b) reported that dental plaque is a dense plaque which is a dense aggregation of bacteria on the tooth surface is the cause for many dental problems. Diminished salivary flow, may cause xerostomia, that is dry mouth and increase the incidence of caries by diminishing natural cleansing and buffering effects of saliva. Teeth may become brittle with age. Brittleness generally results from diminished blood supply to the tooth causing fractured or broken tooth.

Though the gums of 280 (56.00%) of the elderly were normal, 184 (36.80%) had receded gums and 36 (7.20%) of them had inflamed gums. Prakash (1999 b) reported that most old persons exhibit gingivitis (inflamed gums) - the forerunner to destructive periodontal disease. A periodontal disease is a disease of the tissues that support and surround the teeth. It causes elongated teeth in elderly persons.

The lips of the majority (91.40%) of the elderly studied were normal. However, 6.80 per cent of them had cracked/dry lips. This may be due to mild fever or xerostomia. Angular stomatitis was found in nine (1.80%) of them. This may be due to reduced intake of vitamin B rich food or the effect of long period of poor food intake.

There was no manifestation of any digestive function disorder. However mild distension of stomach was observed caused due to constipation and resultant accumulation of gas in 22 (4.40%) of the elderly studied.

While no respiratory symptoms were observed in 420 (84.00%) of the elderly, 51 (10.20%) were found to be asthmatic, 20 (4.00%) were dyspnic and nine (1.80%) suffered from persistent cough. Shortness of breath on exertion, even with minimal exercise, is a common complaint of the elderly.

Ageing is associated with decline in heart function and changes in stiffness and elasticity of the lungs. This combination of functional change in two critical organs leads to a sharply limited reserve and even modest activity exceeds the capacity of the heart and lungs to meet increased oxygen needs. If this symptom remains unchanged, there is little cause for concern. However, development of shortness of breath at rest and in particular at night should be viewed seriously, particularly if it is associated with swelling of the feet and ankles (Prakash, 1999a). Some of the general health problems expressed by the elderly is given in Table XVII.

TABLE XVII
GENERAL HEALTH PROBLEMS AMONG THE ELDERLY

Problems	Elderly men		Elderly women		Total	
	Number	Per cent	Number	Per cent	Number	Per cent
a. Insomnia	74	38.14	111	36.27	185	37.00
b. Anorexia	40	20.62	76	24.84	116	23.20
c. Flatulence	41	21.13	64	20.91	105	21.00
d. Urination						
Normal	150	77.32	225	73.52	375	75.00
Polyuria/Nocturia	32	16.49	66	21.57	98	19.60
Scanty	12	6.12	15	4.90	27	5.40
Urinary incontinence	28	14.43	52	16.99	80	16.00
e. Bowel movement						
Every day	136	70.10	246	80.39	382	76.40
Once in 2 days	28	14.43	33	10.78	61	12.20
Constipation	30	15.46	27	8.82	57	11.40
Loose motion	11	5.67	18	5.88	29	5.80

Of the total elderly studied 37 per cent expressed that they had insomnia. This may be due to the natural ageing process, due to the habit of sleeping at day time or due to the thoughts of their family members. Anorexia was reported by 23.20 per cent of the elderly. This may be due to some underlying patho physiological condition or due to the longing for a familial surrounding and food that he/she was used to. Lack of exercise may be the major reason for flatulence as expressed by 21 per cent of the elderly followed by constipation and intake of certain foods especially pulses. Majority (75 %) of the elderly had normal urination. However, 19.60 per cent of the elderly expressed that they had polyuria/nocturia, which may be the result of diabetes or due to insomnia when the elderly have the urge to urinate often. Few (5.40%) of the elderly expressed that the volume of urine had reduced than before. Apart from some underlying disease condition the most probable reason would be insufficient water intake. Urinary incontinence is reported among many elderly, but they suffer silently and are shy to reveal the problem, as each one feels that he/she alone has this problem. In the cohort studied, 16 per cent reported to have the problem of urinary incontinence. Bowel movement was regular in 76.4 per cent of the elderly and only 11.4 per cent complained of constipation. Constipation may be the result of inadequate food intake and lack of exercise. Occasional loose motion was reported by 5.40 per cent of the elderly.

c. Socioeconomic Factors Associated with Degenerative Diseases

The details regarding physical exercise the elderly were involved in, during the best part of their life were collected. Those who walked or cycled long distances almost every day stated that it was either to reach their work spots, to purchase things for their homes/petty shops or to fetch water.

Those who walked were 298 (59.60%) and cycled were 16 (3.20%). Those who did not have to walk or cycle as a part of their daily life were 186 (37.20%). Personal habits of their younger days, like alcoholism, chewing betel leaves, smoking and using snuff were elicited and it was found that majority (61.60%) of them did not have any such habit, but 38.40% had one or more of these habits. The incidence of certain degenerative diseases among the elderly was elicited through personal interview by the investigator. The incidence of diabetes, cardiovascular diseases (CVD) arthritis, hypertension, cataract and asthma as reported by the elderly is presented in Table XVIII and Figure 10.

TABLE XVIII
INCIDENCE OF CERTAIN HEALTH CONDITIONS IN THE ELDERLY

(in per cent)

Age in years	Total No	Diabetes	CVD	Arthritis	Hypertension	Cataract	Asthma
60-64	85	14.12	3.53	16.47	12.94	43.53	1.18
65-69	117	8.55	5.13	15.38	18.80	47.01	6.84
70-74	137	16.06	9.49	21.90	16.79	39.42	11.68
75-79	119	6.72	5.88	28.57	13.45	47.90	4.20
80 and above	42	7.14	4.76	21.43	9.52	40.98	4.76
Total	500	11.00	6.20	21.00	15.20	44.00	6.40

The incidence of diabetes was found to be highest (16.1%) in the age group 70-74 years, followed by 14.1 per cent in 60-64 year group. The least incidence (6.7%) was found to be in 75-79 age group. The incidence of cardiovascular diseases (CVD) was also found to be highest (9.5%) in 70-74 age group, followed by 5.9 and 5.1 per cent in age group 75-79 and 65-69 respectively. The incidence of arthritis was 28.6, 21.9, 21.4, 16.5 and 15.4 per cent in the age groups 75-79, 70-74, 80 + , 60-64 and 65-69 in that

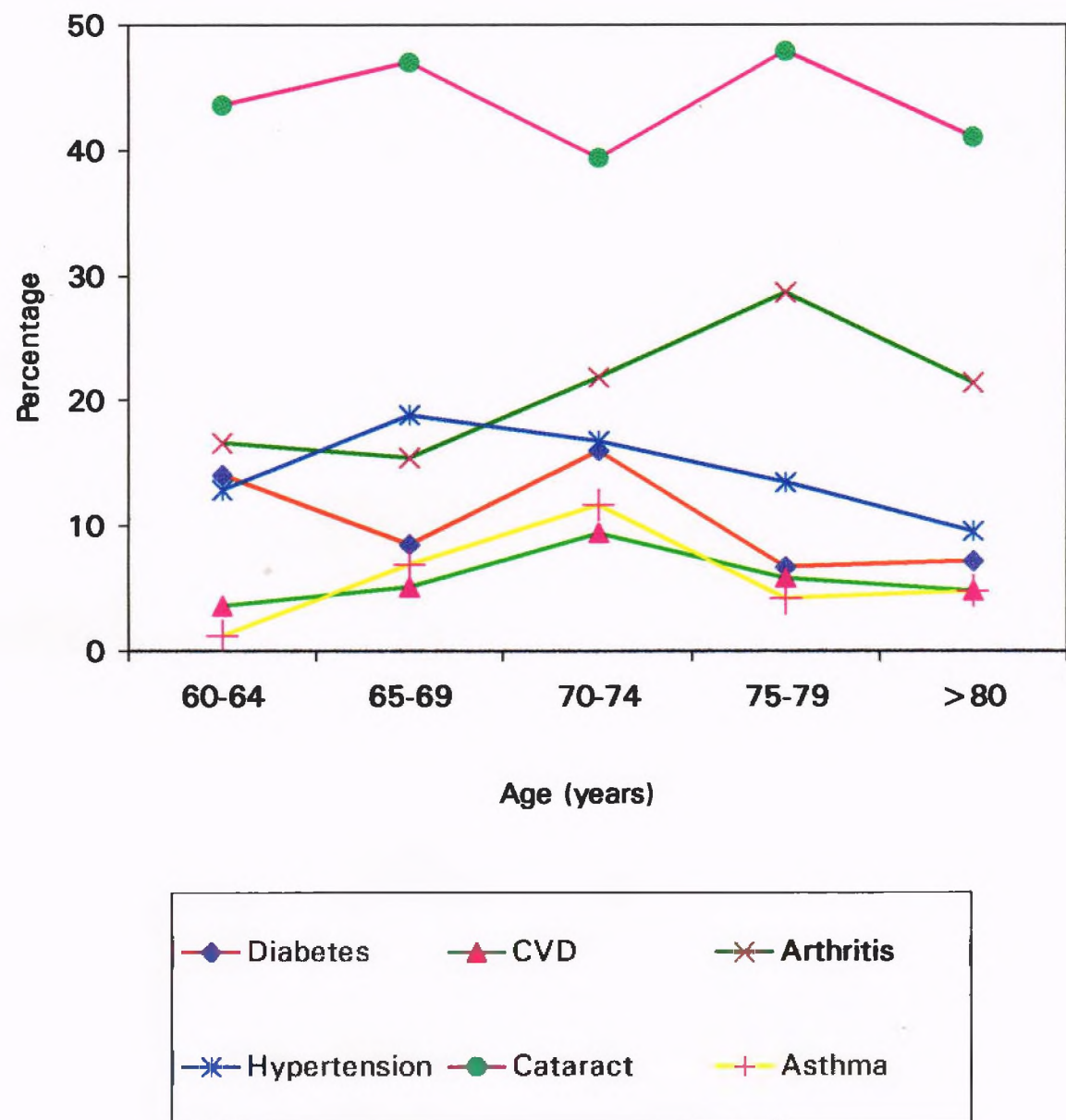


FIGURE 10
INCIDENCE OF CERTAIN HEALTH CONDITIONS IN THE ELDERLY

order. The incidence of hypertension was 18.8 per cent in 65-69 age group and 9.5 per cent in 80+ group. The incidence of cataract exceeded 39 per cent in all the age groups, with 47.9, 47.0, 43.5, 41.0 and 39.4 per cent in 75-79, 65-69, 60-64, 80+, 70-74 age groups in that order. The highest incidence of asthma was 11.7 per cent in 70-74 age group and the least 1.1 per cent in 60-64 age group.

Diabetes is a major chronic problem for a growing elderly population. It was found that in the present study, 11 per cent of the population were diabetics. Anderson (1999) reported that diabetes is a major chronic problem among the elderly and it is prevalent in 10 per cent of those over the age of 60. Rai and Barooah (1999) reported a 15 per cent prevalence in a group of elderly in the age group of 50-70 years. The incidence of cardiovascular disease was 6.2 per cent among the elderly. It was found that arthritis was the most common ailment comprising of 44 per cent of the elderly studied. Padda *et al.*, (1998) reported that 60.60 of the elderly in Amritsar had arthritis. Hypertension was reported by 15.20 per cent of the elderly. According to Padda *et al.*, (1998), hypertension was found in 16.62 per cent of the aged people. The incidence of cataract was 44.0 per cent among the elderly studied. Singh (1996) found visual problems in 37.38 per cent elderly whereas Niranjana and Vasundhara (1996) reported that cataract was found in 46 per cent of the elderly. It was noted that 6.40 per cent of the elderly surveyed had asthma. However, Padda *et al.*, (1998) reported that 12.61 per cent of the elderly studied had bronchial asthma. The socioeconomic factors which have probable association with the degenerative diseases are given in Table XIX.

TABLE XIX
SOCIO ECONOMIC FACTORS ASSOCIATED WITH DEGENERATIVE
DISEASES AMONG THE SELECTED ELDERLY

Variables	No.	(Incidence in per cent)					
		Diabetes	CVD	Arthritis	Hyper - tension	Cataract	Asthma
Age							
60-70	276	11.6	4.7	16.7	14.9	44.2	6.2
71 and above	224	10.3	8.0	26.3	15.6	43.8	6.7
Gender							
Women	306	9.1	4.2	19.6	13.4	46.4	6.2
Men	194	13.9	9.3	23.2	18.0	40.2	6.7
Socio economic status							
Low	327	2.1	4.0	22.6	7.3	41.6	8.6
Middle	173	27.7	10.4	17.9	30.1	48.6	2.3
Occupation							
Moderate/Heavy	168	0.6	4.8	21.4	7.7	35.7	9.5
Sedentary	332	16.3	6.9	20.8	19.0	48.2	4.8

The incidence of diabetes and cataract was found to be more in the 60 to 70 age group whereas cardiovascular diseases, arthritis, hypertension and asthma were more in the 71 + age group. Among the elderly men in the cohort studied, 13.9 per cent had diabetes whereas among elderly women it was only 9.1 per cent. Cardiovascular diseases were more prevalent (9.3%) among elderly men than in elderly women (4.2%). Pain in joints (arthritis) was expressed by 23.2 per cent elderly men and 19.6 per cent elderly women. Eighteen per cent elderly men and 13.4 per cent elderly women expressed that they had hypertension. Among the elderly women 46.4 per cent and among the elderly men 40.2 per cent had cataract. The incidence of asthma was reported by 6.2 and 6.7 per cent elderly women and elderly men respectively.

While the incidence of diabetes, CVD, hypertension and cataract was 2.1, 4.0, 7.3 and 41.6 per cent respectively in low socio economic group, the incidence was higher in the middle socio economic group with the corresponding figures of 27.7, 10.4 and 30.1 per cent respectively.

In the case of elderly who had led sedentary life during their adulthood, the incidence of diabetes, CVD, hypertension and cataract was higher than those who were involved in moderate/heavy work. While this association seems logical for diabetes, CVD and hypertension, senile cataracts are caused primarily by oxidative stress induced by the random action of free radicals or by exposure to excessive ultraviolet light (photo oxidation). This is in contrast to cataracts seen in diabetes and galactosemia, which are the result of osmotic stress. Senile cataracts can also form in response to the accumulation of various products of ageing, which are eventually precipitated in the lens. Lens proteins, unlike most body proteins, do not undergo rapid turnover and remain in place for decades, subject to insult from oxidation and various environmental conditions.

Table XX gives the dietary factors, physical activities and personal habits associated with degenerative diseases among the elderly.

TABLE XX
DIETARY FACTORS, PHYSICAL ACTIVITIES AND PERSONAL
HABITS ASSOCIATED WITH DEGENERATIVE DISEASES
AMONG THE SELECTED ELDERLY

Variables	No.	Incidence(in per cent)					
		Diabetes	CVD	Arthritis	Hypertension	Cataract	Asthma
Inclusion of fruits and vegetables							
Daily	301	15.3	7.6	18.9	17.6	44.8	5.0
Alternate days	196	4.6	4.1	24.5	11.7	43.4	8.7
Weekly twice	1	0.0	0.0	0.0	0.0	0.0	0.0
Weekly once	2	0.0	0.0	0.0	0.0	0.0	0.0
Inclusion of non vegetarian foods							
Never	46	10.9	6.5	10.9	8.7	34.8	6.5
Weekly twice	22	27.3	22.7	9.1	40.9	50.0	0.0
Weekly once	166	21.1	8.4	19.3	25.9	53.6	4.8
Fortnightly	8	0.0	0.0	37.5	0.0	50.0	0.0
Occasionally	258	3.5	3.5	24.4	7.7	38.8	8.1
Staple food							
Rice	422	12.8	7.1	21.6	16.3	45.3	5.9
Mixed cereal	78	1.3	1.3	17.9	9.0	37.2	8.9
Physical activity							
Walking /Cycling	314	1.6	1.6	23.9	6.0	39.2	7.3
None	186	26.9	14.0	16.1	30.6	52.1	4.8
Personal Habits							
None	308	8.4	4.5	20.1	14.3	42.5	5.2
Chewing betel	77	9.1	3.9	20.8	9.1	44.2	9.1
leaves/Snuff	65	13.8	9.2	21.5	12.3	47.7	7.7
Smoking	27	29.6	11.1	25.9	37.0	55.6	14.8
Drinking	23	21.7	21.7	26.1	30.4	39.1	0.0
Smoking & Drinking							

Inclusion of vegetables in the daily diet was in the cooked form (as adjuncts for rice). It was also learnt that the quantity of vegetables consumed every day was in the range of 30-50g. Inclusion of fruits was based on the availability and purchasing capacity of the elderly. So, though it was reported that 301 of the elderly consumed protective foods everyday, these foods were consumed only in small quantities. Therefore the incidence of various diseases namely diabetes, CVD, hypertension and cataract was 15.3, 7.6, 7.6 and 44.8 per cent respectively. There was no incidence of any disease in the two categories namely, those who took protective foods weekly twice and those who took only once. This may be due to the fact that there were totally only three elderly in these two categories.

It was found that the incidence of diabetes, CVD and hypertension was highest among those elderly who took non vegetarian foods twice a week i.e 27.3, 27.7 and 40.9 per cent respectively.

The incidence of diabetes, CVD, arthritis, hypertension and cataract ~~was~~ found to be 12.8, 7.1, 21.6, 16.3 and 45.3 per cent respectively among the elderly whose staple diet was rice. The incidence of the same diseases was only 1.3, 1.3, 17.9, 9.0 and 37.2 per cent among those elderly whose earlier diet was mixed cereal based.

It was observed that among the elderly who were not physically active by way of walking or cycling long distances during their adulthood had an incidence of 26.9, 14.9, 30.6 and 52.1 per cent of diabetes, CVD, hypertension and cataract respectively.

Of the 500 elderly, 308 of them did not have the habit of chewing betel leaves, using snuff, smoking cigarettes and consuming alcoholic drinks. The incidence of diabetes, hypertension, cataract and asthma among them was 29.6, 37.0, 55.6 and 14.8 respectively.

The results of the multivariate logistic regression analysis that assessed the association of socio demographic variables such as age, gender, socioeconomic status, occupation, physical exercise and personal habits to the presence of certain health conditions are given in the following tables.

The socio demographic variables associated with diabetes are given in Table XXI

TABLE XXI
SOCIODEMOGRAPHIC VARIABLES ASSOCIATED WITH DIABETES

Variables	Odds Ratio	Std. Err	z	P > z 	((95% Conf. Interval)	
No physical exercise	11.04185	5.511888	4.811	0.000	4.15086	29.37284
Gender (Male)	2.059061	0.7098339	2.095	0.036	1.04768	4.04678
Socio economic status (Middle income)	5.868239	2.641522	3.931	0.000	2.42856	14.17969
Occupation (Sedentary)	7.365447	7.929288	1.855	0.064	0.8929689	60.75219

Those with no physical exercise were eleven times (Odds Ratio- 11.04) more susceptible to diabetes. Those who were involved in sedentary type of occupation and those who belonged to middle income group were seven times (Odds Ratio 7.37) and nearly six times (Odds Ratio 5.87) more susceptible to diabetes respectively. When controlled for physical activity, socioeconomic status and occupation, males had two times higher chances of becoming diabetic than women.

The association between certain socio demographic factors and cardiovascular diseases is presented in Table XXII.

TABLE XXII
SOCIODEMOGRAPHIC VARIABLES ASSOCIATED WITH
CARDIOVASCULAR DISEASES

Variables	Odds Ratio	Std. Err	z	P > z	(95% Conf. Interval)	
No physical exercise	10.31728	5.160847	4.666	0.000	3.87064	27.50097
Gender (Male)	2.451608	9550852	2.302	0.021	1.142469	5.260874

Lack of physical exercise seems to be a strong predictor for cardiovascular diseases and persons with no physical exercise are ten times (Odds Ratio 10.32) more prone to cardiovascular diseases. Neither age nor nonvegetarianism showed association with cardiovascular diseases. As with diabetes, males have two times (Odds Ratio 2.45) more chances of having cardiovascular diseases.

Table XXIII gives the details of sociodemographic variables associated with arthritis.

TABLE XXIII
SOCIODEMOGRAPHIC VARIABLES ASSOCIATED WITH ARTHRITIS

Variables	Odds Ratio	Std. Err	z	P > z	(95% Conf. Interval)	
Age (70 and above)	1.801894	0.401169	2.645	0.008	1.164716	2.787652
No physical exercise	0.6065818	0.1461487	-2.075	0.038	0.3781705	0.9726941

Neither occupation nor socioeconomic status and gender showed any association with arthritis. However, persons with no physical exercise had less chance for arthritis. Persons above 70 years age had 1.8 times (Odds Ratio 1.80) higher chances for arthritis. Table XXIV gives the sociodemographic variables associated with cataract.

TABLE XXIV
SOCIODEMOGRAPHIC VARIABLES ASSOCIATED WITH CATARACT

Variables	Odds ratio	Std. Err	z	P > z	(95% conf. Interval)	
No physical exercise	1.500396	0.2970808	2.049	0.040	1.01781	2.211797
Occupation (sedentary)	1.458227	0.301343	1.825	0.068	0.9725773	2.186383

Physical exercise and sedentary work were not associated with cataract. It was found that people with no physical exercise had 1.5 times more chances (Odds Ratio-1.50) and those who were involved in sedentary work had 1.46 times (Odds Ratio -1.46) more chances of getting cataract. Other sociodemographic variables did not seem to be associated with the formation of cataract indicating that cataract can affect persons of all walks of life.

Table XXV gives the sociodemographic variables associated with hypertension.

TABLE XXV
SOCIODEMOGRAPHIC VARIABLES ASSOCIATED WITH HYPERTENSION

Variables	Odd Ratio	Std. Err	z	P > z	(95% Conf. Interval)	
Chewing betel leaves/ Snuff/Smoking	0.6717623	0.3072063	-0.870	0.384	0.2741254	1.646198
Alcoholism	0.7280942	0.3194253	-0.723	0.469	0.3081437	1.72037
Smoking	2.50363	1.188922	1.933	0.053	0.9870796	6.35021
Drinking	1.591625	0.8265217	0.895	0.371	0.5751973	4.404177
No physical exercise	4.225343	1.292338	4.712	0.000	2.320163	7.695944
Socioeconomic status (middle income)	3.206545	0.9388581	3.980	0.000	1.806385	5.691992

Middle income group and persons with no physical exercise had more chances of having hypertension with odds ratios 4.2 and 3.2 respectively. Alcoholism showed marginally significant association with hypertension.

4. Psychological Well Being

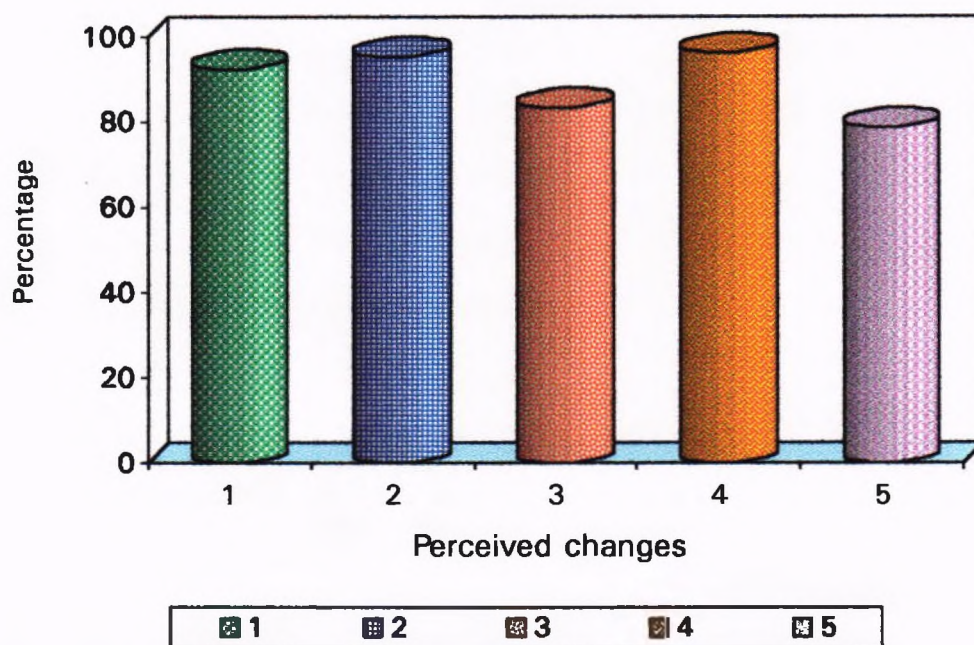
As many studies have proved that the physical well being of the elderly is greatly influenced by the psychological well being, an attempt was made to study the psychological well being of the elderly.

As age progresses the social and economic roles often diminish and their status tends to go down. The elderly people react in different ways to this diminishing role. However, those who live with their families consider themselves self sufficient and have a positive frame of mind in contrast to their counterparts living in institutions. During interview, elderly came out with their pitiable disposition in their immediate families and this information was pooled and presented.

Table XXVI and Figure 11 give the feelings of the selected elderly regarding their status in the family, prior to joining the institution.

TABLE XXVI
CHANGES IN STATUS IN THEIR FAMILIES AS PERCEIVED
BY THE ELDERLY

S.No	Changes	No .	Per cent
1.	Not respected by the family members	462	92.4
2.	Not involved in decision making	477	95.4
3.	Not discussing family matters	416	83.2
4.	Feeling isolated	481	96.2
5.	Not visited by friends and relatives	393	78.6



- 1 NOT RESPECTED BY THE FAMILY MEMBERS
- 2 NOT INVOLVED IN DECISION MAKING
- 3 NOT DISCUSSING FAMILY MATTERS
- 4 FEELING ISOLATED
- 5 NOT VISITED BY FRIENDS AND RELATIVES

FIGURE 11
CHANGES IN STATUS IN THEIR FAMILIES AS
PERCEIVED BY THE ELDERLY

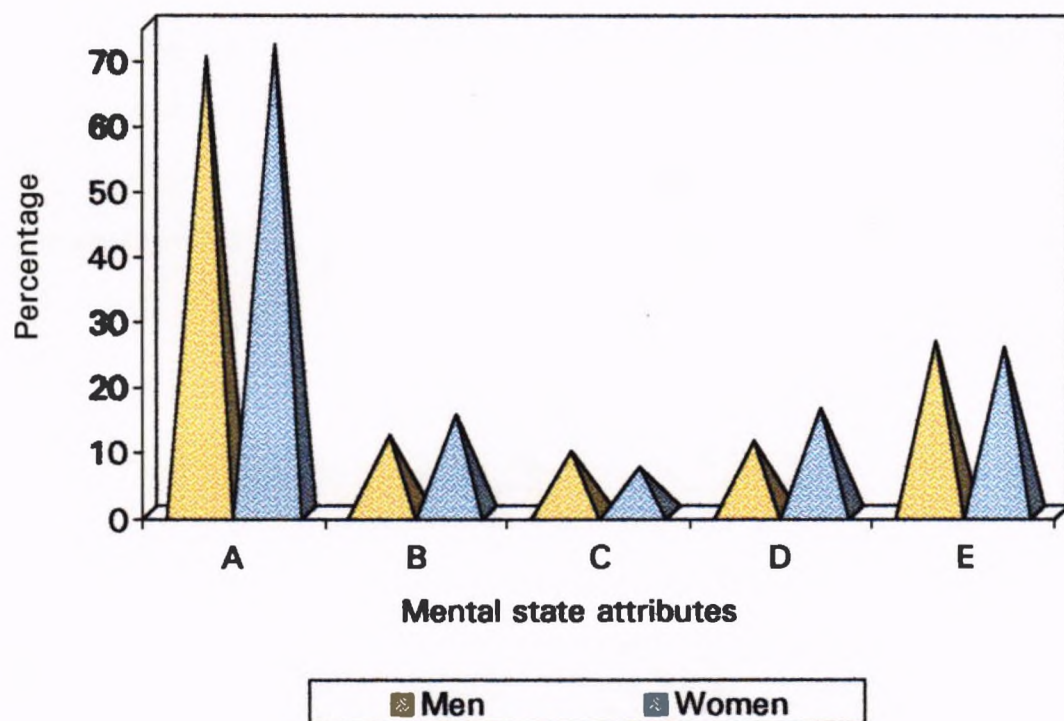
Of the various changes felt by the elderly with regard to their status at home, the feeling of isolation was the most common (96.2%). The elderly (95.4%) also felt that they were not involved in any decision making by the other family members. The concept that the family members did not respect the elderly was expressed by 92.4 per cent of them. Matters related to day to day events, family functions and details connected to the family members were not revealed to them was the feeling of 83.2 per cent of the elderly. Of the selected elderly 78.6 per cent felt that the frequency of social calls by friends and relatives to see them had reduced to a great extent.

The psychological well being is a reflection of the life satisfaction experienced by the elderly. In order to find out the psychological well being of the selected elderly, observations were made with regard to their mental status during the personal discussions with the elderly. The details are presented in Table XXVII and Figure 12.

TABLE XXVII
MENTAL STATE OF THE SELECTED ELDERLY

Mental state	Men (N= 194)		Women (N=306)		Total (N=500)*	
	No	Per cent	No	Per cent	No	Per cent
Friendly	136	70.10	220	71.89	356	71.20
Hostile	23	11.85	46	15.03	69	13.60
Confused	18	9.28	21	6.86	39	7.80
Agitated	21	10.82	49	16.01	70	14.00
Depressed	34	26.28	77	25.16	111	22.20

* Multiple responses



- A** FRIENDLY
- B** HOSTILE
- C** CONFUSED
- D** AGITATED
- E** DEPRESSED

FIGURE 12
MENTAL STATE OF THE SELECTED ELDERLY

It was found that 71.20 per cent of the elderly were friendly. This may be their natural disposition, due to the acceptance of their plight or because they are grateful for the support of the institution. There were 13.60 per cent of elderly who had a hostile attitude in general. They were also not friendly with the other inmates. The hostility may be due to psychological discomfort and alienation felt by the individual in a new set up (old age home) or due to the mental stress caused by loneliness, institutionalisation and feelings of depression (Jamuna, 1998).

The elderly who were observed to be confused and agitated were 7.80 and 14.0 per cent respectively. These may be the manifestation of several cognitive changes that may trouble the individual. A reduction in the ability to concentrate, capped by a feeling of a creeping forgetfulness. (particularly of recent events) and occasional lack of mental clarity. Though these changes occur as a result of normal ageing, the time and severity of onset of these changes may vary from person to person. Deprivation of privileges, harassment, physical and psychological ill treatment of the elderly by the family members or the longing to be with one's kith and kin may lead to depression. The investigator was able to observe that 22.2 per cent were depressed.

According to Musetti *et al.*, (1989) the clinical features of depression were an increase in the agitation and restless than retardation. The assessment of depression is essential in old age, since it is a common problem accompanying ageing. When the incidence of depression is ruled out, an accurate evaluation of other mental functions can be reliably made, for depression often influences performance of other functions too.

A geriatric depression scale developed by Verma *et al.*, (1993) for Indian population was used for assessment of depression in the selected elderly. The details of the geriatric depression assessment is given in Table XXVIII and Figure 13.

TABLE XXVIII
GERIATRIC DEPRESSION ASSESSMENT

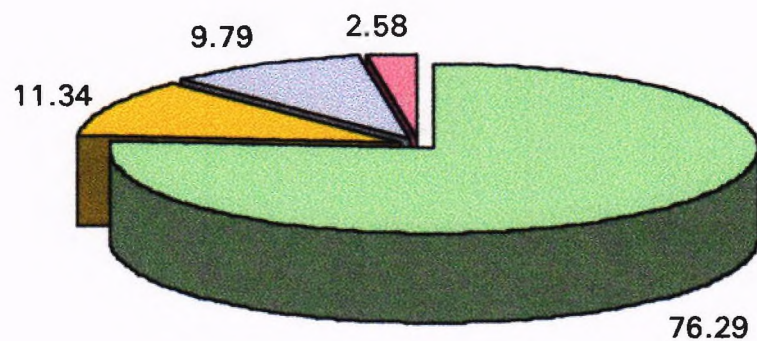
N = 500

Extent of depression	Men		Women		Total	
	No.	Per cent	No.	Per cent	No.	Per cent
No depression	148	76.29	212	69.28	360	72.00
Mild depression	22	11.34	48	15.69	70	14.00
Moderate depression	19	9.79	34	11.11	53	10.60
Severe depression	5	2.58	12	3.92	17	3.40
Total	194	100.00	306	100.00	500	100.00

When compared to the elderly men, more elderly women were found to be depressed. This is in accordance with the result of Jamuna (1998). It was found that 72 per cent of the elderly were not depressed. While 14 per cent of the elderly were mildly depressed, 10.60 per cent were moderately depressed and only 3.40 per cent had severe depression.

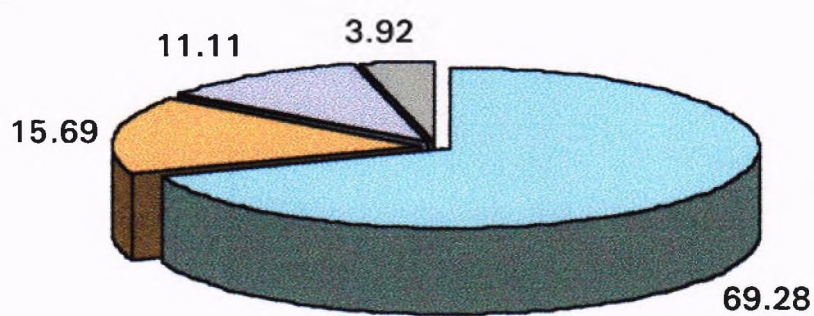
The investigator was able to observe only 22.20 per cent to be depressed whereas when the geriatric depression scale was administered it was found that 28 per cent of the elderly were depressed. Jamuna (1998) reported that 43 per cent and Limaye (1999) found that 35 per cent of institutionalized elderly to be depressed.

MEN



Not depressed	Mild depression
Moderate depression	Severe depression

WOMEN



Not depressed	Mild depression
Moderate depression	Severe depression

FIGURE 13
GERIATRIC DEPRESSION ASSESSMENT

From the foregoing picture of the 500 elderly studied from the charity homes, it emerges that individual life style during their adulthood reflects their geriatric profile. Clear association of early life habits with the prevalence of certain disease conditions in their old age and their general health and well being is indicative of the need for proper early life nutrition. Socioeconomic and cultural factors as determinants of health and well being is also evident. Psychological well being seems to be on the positive side, a factor that affects physiological well being at this stage of life cycle. However, a betterment of health and nutritional well being with adequate love and care could probably enhance their life pattern and make it more meaningful and productive. Nutritional adequacy of their diets coupled with adequate medical care and environmental sanitation could be one of the routes through which this could be channelized so as to add more productive years with dignity to their life.

B. Nutritional and Health Profile of the Elderly Selected for the Supplementation Study

Table XXIX gives the various mean anthropometric parameters of the 119 elderly selected for the supplementation study. The individual values for anthropometric measurements is given in Appendix VII.

TABLE XXIX
MEAN ANTHROPOMETRIC MEASUREMENTS OF THE ELDERLY

Mean anthropometric measurement	Male (N=51)	Female (N=68)
Height (cm)	159.83±6.71	143.87±7.39
Weight (kg)	49.35±7.39	40.35±7.95
BMI	19.37±3.04	19.64±3.39
Midupper arm circumference (cm)	23.64±2.51	22.32±2.87
Triceps skinfold thickness (mm)	9.05±3.03	11.32±2.91
Arm area (cm ²)	44.73±10.04	40.00±10.36
Arm muscle circumference (cm)	20.69±2.34	19.45±2.64
Arm muscle area (cm ²)	35.17±8.58	31.13±8.75

The mean height of the elderly men was 159.83±6.71cm and that of the elderly women was 143.87±7.39cm. The mean weight of the elderly men was 49.35±7.39kg which was lower than that of literature values. The mean weight of the elderly women was 40.35±3.39. These values fall within 'low weight normal' according to the BMI classification. Eventhough the calorie intakes of all the elderly men and women were lower than the ICMR allowances, they had a BMI within low weight normal range indicating the absence of CED. This may be attributed to the age dependent low BMR, better nutrition during their early and middle age and nutritional adaptation (Poehlman, 1993).

The mean mid upper arm circumference, arm area, arm muscle circumference, arm muscle area for elderly men were more than elderly women. However, the mean triceps skinfold thickness was found to be higher for the elderly women than the men. This is similar to the findings of Naidu and Rao (1994) and Chandrasekhar and Bhooma (1999). The higher triceps skinfold thickness among women may be due to more fat at subcutaneous sites than men. This finding is on par with that of Degroot *et al.*, (1991).

The BMI of the elderly selected for the study may be distributed as presented in Table XXX.

TABLE XXX
DISTRIBUTION OF THE ELDERLY ACCORDING TO THEIR BMI

BMI	Number	Per cent
< 16 (CED - grade III)	15	12.61
16-16.9 (CED - grade II)	16	13.45
17-18.4 (CED - grade I)	20	16.81
18.5 - 19.9 (Low weight normal)	13	10.92
20 - 24.9 (Normal)	47	39.49
25-29.9 (Obese)	8	6.72

It was observed that only 39.49 per cent of the elderly were in the normal BMI category (20-24.9) and 6.72 per cent in the obese category. There were 10.92 per cent elderly in the low weight normal category

(BMI 18.52-19.9). In the CED-grade I category (BMI 17-18.4) there were 16.81 per cent elderly. In CED-grade II (BMI 16-16.9) and CED- grade III (BMI < 16) there were 13.45 and 12.61 per cent respectively.

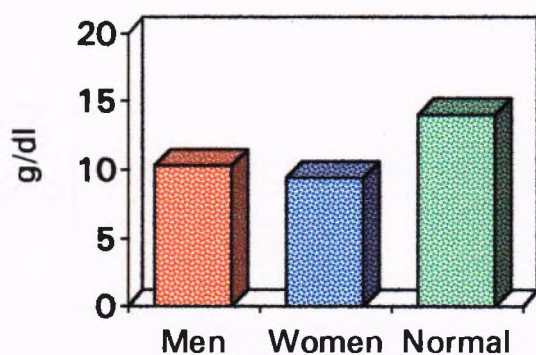
The results of the blood profile of the 119 elderly men and women at the beginning of the study are given in Table XXXI and Figure 14.

TABLE XXXI
BIOCHEMICAL PARAMETERS OF THE SELECTED ELDERLY

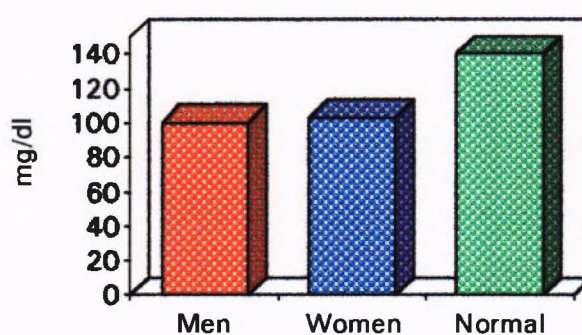
Parameter	Men (N=51)	Women (N=68)	Normal values*
Haemoglobin (g/dl)	10.30 ± 1.57	9.45 ± 1.35	12-14
Blood glucose (mg/dl)	100.22 ± 15.99	103.13 ± 14.17	115-140
Creatinine (mg/dl)	1.05 ± 0.14	0.96 ± 15	1.1-1.2
Cholesterol (mg/dl)	172.20 ± 29.67	187.47 ± 27.45	150-250
Urea (mg/dl)	27.41 ± 4.65	25.47 ± 4.86	20-40
Total protein (g/dl)	6.65 ± 0.35	6.65 ± 0.28	6-7.8
Albumin (g/dl)	3.97 ± 0.46	3.89 ± 0.37	3.2-4.5
Globulin (g/dl)	2.73 ± 0.38	2.75 ± 0.44	2.3-3.5

* Varley (1988)

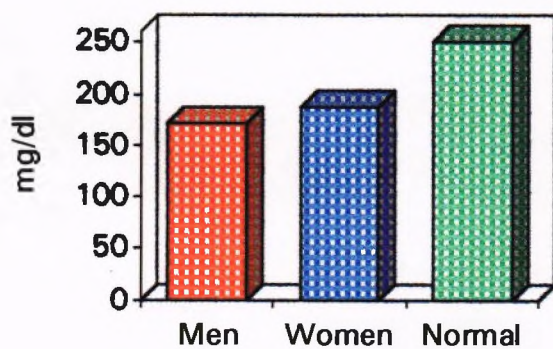
The average haemoglobin level was found to be 10.30 ± 1.57g/dl and 9.45 ± 1.35 g/dl of blood for elderly men and women respectively. The low haemoglobin levels observed in the elderly may be supported by the fact that haemoglobin levels do decrease with age (Baldwin, 1989). Moreover, the mean daily dietary intake of iron was found to be even less than the adult Recommended Dietary Allowance in both the elderly men and women which may be one of the reasons for the haemoglobin levels observed in the elderly. Both men and women elderly selected for supplementation study were moderately anaemic with haemoglobin level ranging from 9.45 to



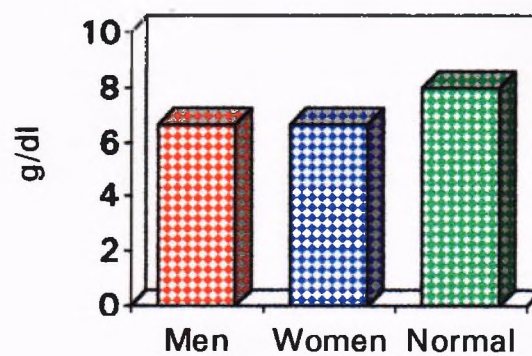
HAEMOGLOBIN g/dl



BLOOD GLUCOSE mg/dl



CHOLESTEROL mg/dl



TOTAL PROTEIN g/dl

FIGURE 14

BIOCHEMICAL PARAMETERS OF THE SELECTED ELDERLY

10.30g/dl. This may be attributed to the low iron intake observed, coupled with low bioavailability from cereal diet with less or no amounts of animal foods.

The blood glucose levels in both the elderly men and women were 100.22 ± 15.99 and 103.13 ± 14.17 mg/dl respectively. These values indicated that they had a blood glucose level well within the normal range of 115-140 mg/dl.

The creatinine values for the elderly men and women were 1.05 ± 0.14 and 0.96 ± 0.15 mg/dl respectively. These values are close to the normal values. Since creatinine is related to muscle mass, men have a higher value than the women (Treseler, 1988). In older adults the creatinine are slightly lesser due to the reduced muscle mass.

Mean cholesterol level of the subjects was found to be within normal range of 150 -250 mg/dl. This may be due to their dietary pattern which was primarily vegetarian. The women had a mean cholesterol level of 187.47 ± 27.45 and the men 172.20 ± 29.67 mg/dl. The women had higher mean cholesterol level than men. A similar finding is reported by Schaefer (1992) and Shah and Subbulakshmi (1999).

Serum urea level in both elderly men and women were 27.41 ± 4.65 and 25.47 ± 4.86 mg/dl respectively which was within the normal range of 20-40 mg/dl.

The total protein was found to be 6.65 ± 0.25 g/dl for the elderly men and women respectively. Men serum albumin value was found to be

slightly higher for elderly men (3.97 ± 0.46 g/dl) than for elderly women (3.89 ± 0.37 g/dl). The mean globulin value was 2.73 ± 0.38 g/dl for elderly men and 2.75 ± 0.44 g/dl for elderly women.

Table XXXII gives the serum mineral profile of the selected elderly.

TABLE XXXII
SERUM MINERAL PROFILE OF THE ELDERLY

Mineral	Men (N=51)	Women (N=68)	Normal values*
Serum calcium (mg/dl)	8.618 ± 0.501	8.44 ± 0.490	9.11
Serum iron (mcg/dl)	94.53 ± 15.84	82.91 ± 14.05	60.150
Serum copper (mcg/dl)	79.63 ± 7.86	79.03 ± 5.72	70.140
Serum zinc (mcg/dl)	72.18 ± 13.18	73.87 ± 13.0	80.155

* Swaminathan (1999)

Mean serum calcium levels of the selected elderly men and women were 8.618 ± 0.501 and 8.44 ± 0.490 mg/dl respectively. This may be due to the low intake of calcium by the elderly. Gopalan (1994) reported that Asian diets are predominantly cereal based and the phytin content of such dietaries may contribute for the poor bioavailability of calcium. Moreover, major sources of calcium such as milk and dairy products are generally beyond the reach of the poor. The intake of green leafy vegetables which are good sources of calcium are also generally found to be low. Spices such as mustard, cumin seeds, curry leaves and coriander which often figures in Asian dietaries are good sources of calcium, but they are taken in relatively small quantities. The low serum values of calcium as found in this study is in agreement with these facts. The diet pattern in the old age home is cereal based with limited access to milk and milk products besides less frequent use of greens.

The mean serum iron level of 94.53 ± 15.84 and 82.91 ± 14.05 mcg/dl for men and women respectively was closer to the lower limits of the normal range. This may^{be} due to the cereal based meal pattern in the old age homes with low intake of green leafy vegetables. The mean copper levels were found to be at the lower limits of the normal range of 70-140 mcg/dl. The mean serum zinc level of 72.18 ± 13.18 and 73.87 ± 13.0 mcg/dl was slightly less than the normal range of 80-155 mcg/dl.

Apart from the fact that the elderly selected for the supplementation study did not suffer from any chronic disease conditions, majority had acceptable BMI but their biochemical parameters including serum trace mineral values were in the lower range, probably an indication of subclinical levels of nutrients which if unchecked can lead to visible forms of malnutrition.

C. Quality Parameters of the Malted Food Supplement

The malted food supplement was prepared by mixing malted wheat flour and malted finger millet flour in equal proportion. The physical and nutritional qualities, recipe formulation, acceptability of the developed recipes and the results of the storage studies of the supplement is presented and discussed under the following headings;

1. Physical and nutritional quality
2. Recipe formulation and evaluation
3. Storage study
4. Selection and quantification of the recipe for the supplementation study
5. Cost benefit analysis

1. Physical and Nutritional Quality

Wheat and finger millet were malted by standardised procedures. (as indicated in methodology, Figure 4). The malting loss for wheat ranged from seven to nine percent and for finger millet six to nine percent.

Physical parameters of the malted food supplement are given in Table. XXXIII

TABLE XXXIII
PHYSICAL CHARACTERISTICS OF THE MALTED SUPPLEMENT

Parameters	Supplement
Colour	Light brown
Flavour	Pleasant and appealing
Taste	Highly acceptable
Density	0.4608
Gelatinisation temperature	65 to 68°C

The malted food supplement had a light brown colour and a highly acceptable flavour and taste. The appealing flavour and taste were due to the malting and the mild roasting of germinated wheat and finger millet. The density was 0.4608. The gelatinisation temperature was found to range between 65 and 68°C.

The visco amylographic behaviour of unmalted wheat flour: unmalted finger millet flour (1:1) and malted wheat flour: malted finger millet flour (1:1) was studied using a rapid visco amylograph Fig 15,16 and 17 the results obtained are given in Table XXXIV.

TABLE XXXIV
RAPID VISCO-AMYLOGRAPH ANALYSIS OF FLOUR SAMPLES

Sample	Onset gelatinisation temp ($^{\circ}\text{C}$)	Peak Viscosity (RVU**)	Temp at peak ($^{\circ}\text{C}$)	Hot paste viscosity (RVU)	Cold paste viscosity (RVU)	Area (SNU*/MIN)
Unmalted flour	73.35	120	94.90	56	111	1094.8
Malted flour	71.15	67	94.45	37	69	681.9

* SNU - Stirring Number Unit

** RVU - Rapid Visco Unit

The changes in flour behaviour was observed from 50°C^{and} the equipment was set as follows. Rise in temperature was 6.3°C / minute, holding time at peak temperature was seven minutes and set back temperature was also set at a reduction of 6.3°C / minute. The onset of gelatinization of the two flours started at five minutes, but the gelation temperature for malted flour was 2.2°C lesser than control. The peak viscosity for malted flour was 67 RVU (rapid visco unit) and it was almost half that of plain flour (120 RVU), the time and temperature being constant.

Unmalted finger millet flour and unmalted wheat flour mix (1:1)

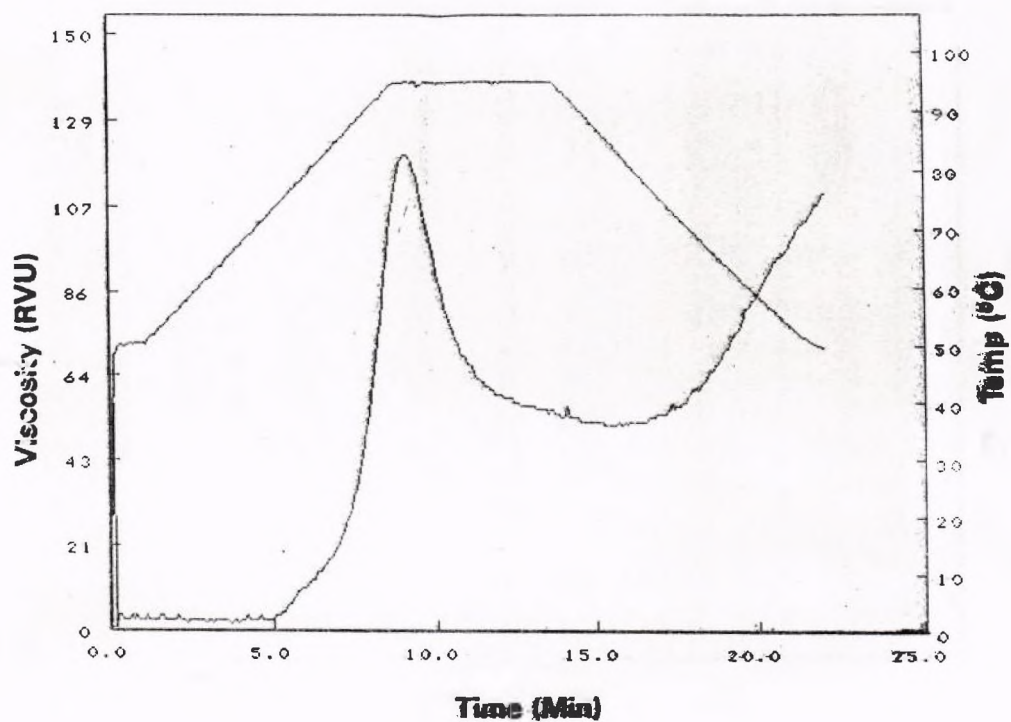


FIGURE 15

Malted Food Supplement

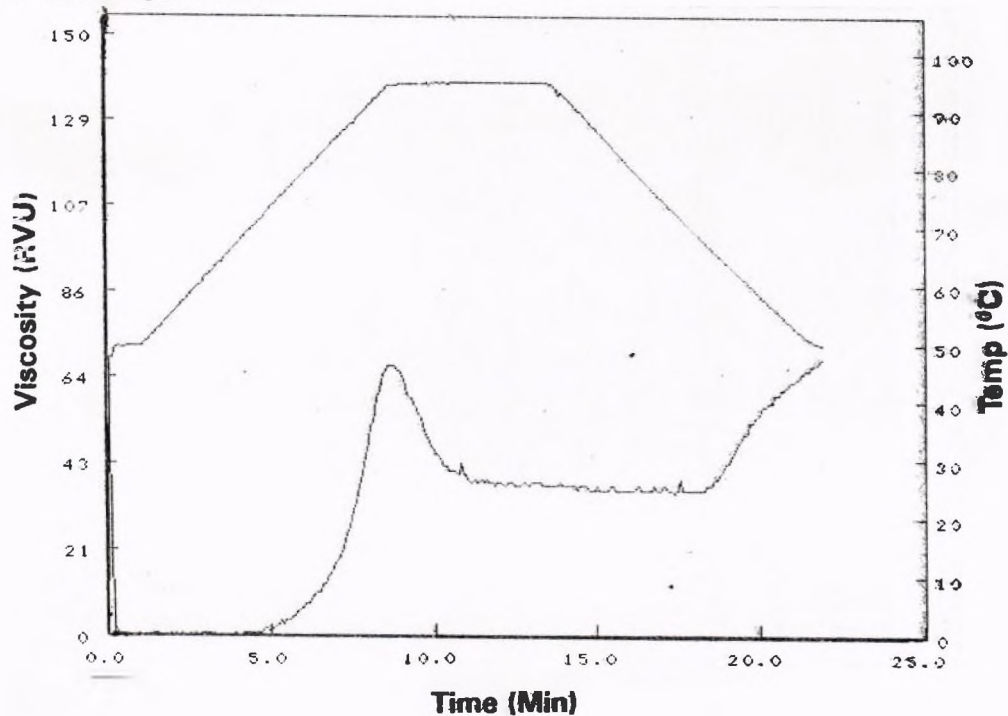


FIGURE 16

RAPID VISCO-AMYLOGRAPH ANALYSIS OF THE MALTED FOOD SUPPLEMENT AND UNMALTED FINGER MILLET AND WHEAT MIX

Effect of Malting on Viscosity of Unmalted Mix and Malted Food Supplement

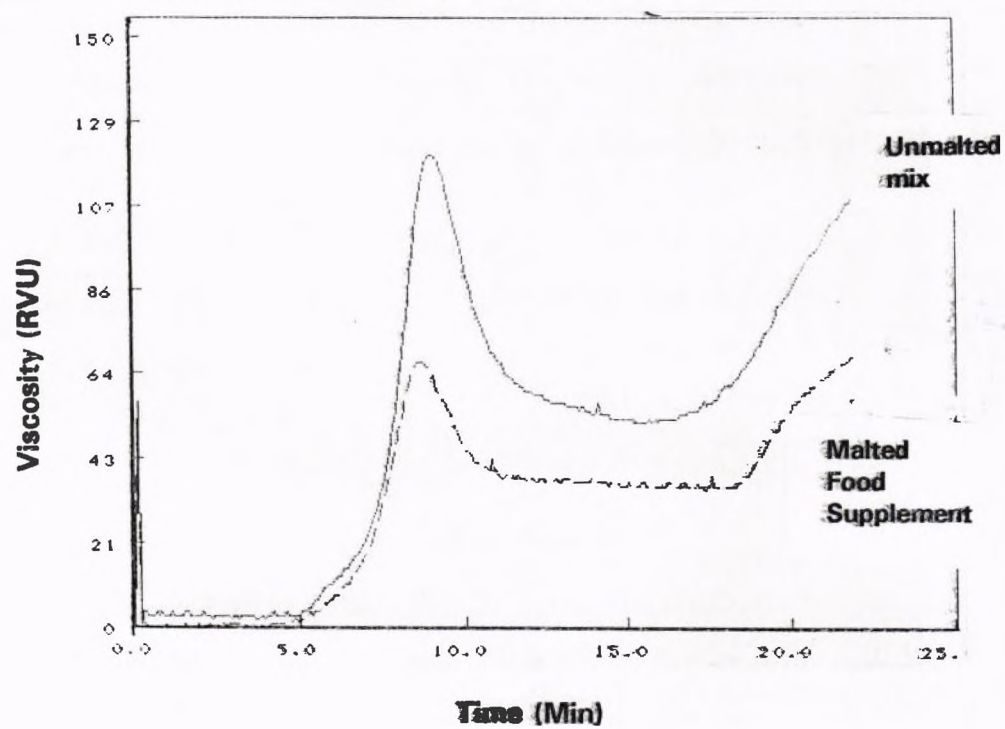


FIGURE 17

The hot paste viscosity during the holding time of seven minutes was 56 RVU for plain flour and 37 RVU for malted flour. The set back or cold paste viscosity for plain flour was 111 RVU and malted sample was 69 RVU at 50°C. The RVU was higher in peak viscosity for the plain flour. These changes may be attributed to the hydration and heat treatment during malting.

The cold paste viscosity of the malted flour was less than that of unmalted flour indicating that more solids (flour) can be added in porridge like preparations giving calorie density and low viscosity.

Table XXXV shows the nutrients present in 100g of the supplement

TABLE XXXV
NUTRIENT COMPOSITION OF 100g MALTED SUPPLEMENT

Nutrients	Malted supplement - 100 gram
Energy (K.cal)	345
Protein (g)	10
Calcium (mg)	190
Phosphorus (mg)	300
Iron (mg)	7.1
Zinc (mg)	3.05
Copper (mg)	0.71
Manganese (mg)	24.53
Thiamine (mg)	0.45
Riboflavin (mg)	0.13
Niacin (mg)	1.60

The energy content of 100g malt supplement was 345 Kcal. The protein content of the supplement was 10g. The calcium content was 190mg. Phosphorus, iron, zinc, copper, manganese, thiamine, riboflavin and niacin were found to be 300, 7.1, 3.05, 0.71, 24.53, 0.45, 0.13 and 1.60mg per 100g respectively in malted supplement.

Malted supplement developed in the present study fulfills the requirement suggested for cereal weaning foods (specification for processed cereal weaning foods - First revision IS : 656-1969) thus making it eligible for use as a supplementary food for young children. It also fills the calorie gap of 300 to 400 Kcal normally observed in preschool children. The energy content of the developed malted supplement was found to be 345 Kcal and the protein content 10g. Being a malted supplement apart from improved digestibility the availability of nutrients, especially minerals is also enhanced, thus making it an ideal food supplement for the elderly as well.

2. Recipe Formulation and Evaluation

Ten common recipes of South Indian cuisine were prepared from the malted supplement and evaluated. Acceptability of various recipes prepared with the malted supplement was ascertained through both laboratory panel studies and elderly group evaluation. The panel members and the elderly group evaluated the quality attributes of each recipe for its appearance, colour, texture, flavour and taste organoleptically using a five point scale.

a. Laboratory Trials

The mean scores given by the panelists for the quality attributes of the recipes prepared with the malted supplement is given in Table XXXVI and the mean overall scores is shown in Figure 18.

TABLE XXXVI

ACCEPTABILITY OF RECIPES PREPARED USING THE MALTED SUPPLEMENT

(Evaluation by lab panel)

Recipes	Quality attributes					
	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Porridge (Salted)	4.9	4.9	5.0	5.0	4.9	24.7
Porridge (Sweet)	4.9	4.9	5.0	5.0	5.0	24.8
String hoppers	4.7	4.8	5.0	4.9	5.0	24.4
Pittu	4.9	4.9	5.0	4.9	5.0	24.7
Adai	4.9	4.8	5.0	4.9	4.9	24.5
Adai (Sweet)	4.9	4.8	5.0	4.9	5.0	24.6
Kozhukattai	4.9	4.8	5.0	4.8	4.9	24.4
Kozhukattai (Sweet)	4.9	4.8	5.0	4.8	4.9	24.4
Dosai	4.9	4.8	4.9	4.8	4.9	24.3
Pakkoda	5.0	5.0	5.0	4.8	5.0	24.8

All the 10 recipes prepared out of the malted supplement were found to have an overall acceptability of more than 24.4 out of 25.0.

The mean scores obtained by salted porridge for appearance, colour, flavour, texture and taste were 4.9, 4.9, 5.0, 5.0 and 4.9 respectively with an overall acceptability of 24.7. The flavour and taste were found to have scored maximum. The flavour, texture and taste of the porridge sweetened with jaggery/sugar were given the maximum score of 5.0, whereas the appearance and colour obtained 4.9 each leading to an overall acceptability of 24.8. The stringhoppers which are generally prepared with rice flour is of white colour. Since the colour of the stringhoppers prepared out of the

Porridge (salted)

24.7



Porridge (sweet)

24.8

Pittu

24.7



String hoppers

24.4

Adai (salted)

24.5



Adai (sweet)

24.6

Kozhukattai (salted)

24.4



Kozhukattai (sweet)

24.4

Dosai

24.3



Pakkoda

24.8

FIGURE 18

**OVERALL ACCEPTABILITY OF RECIPES PREPARED USING THE MALTED
SUPPLEMENT (MAX. POSSIBLE SCORE:25)**

supplement was brown in colour, it influenced the preference of the panel member and the mean score obtained were 4.7 for appearance and 4.8 for colour. However, the mean score obtained for taste was 5.0, for flavour 5.0 and for texture 4.9. The overall acceptability score was 24.4. The mean score obtained for colour, appearance flavour, texture and taste for pittu were 4.9, 4.9, 5.0, 4.9 and 5.0 respectively. The overall acceptability was 24.7.

The colour of the adai, a shallow fat fried item was deep brown in colour due to the browning of the sugars that were formed during malting. Thus the mean score obtained for colour was 4.8. The mean score obtained for flavour was 5.0, and the other attributes like appearance, texture and taste obtained a mean score was 4.9 each. The overall acceptability score was 24.3. Sweet adai also had a deep brown colour and the mean score obtained for appearance, flavour, texture and taste were 4.9, 5.0, 4.8 and 4.9 respectively. The overall acceptability score was 24.6.

The mean scores obtained for colour and texture for kozhukkattai were 4.8 each. The mean scores obtained for appearance, flavour and taste were 4.9, 5.0 and 4.9 respectively. The overall acceptability score was 24.4. The overall acceptability score for sweet kozhukkattai was 24.4 with mean scores of 4.9, 4.8, 5.0, 4.8 and 4.9 for appearance, colour, flavour, texture and taste respectively.

The mean scores given by the panelists for appearance, colour, flavour, texture and taste of dosai were 4.9, 4.8, 4.9, 4.8 and 4.9 respectively. The overall acceptability score was 24.3.

The mean scores obtained for appearance, colour, flavour and taste of pakkoda were 5.0 each and for texture 4.8. The score for overall acceptability was 24.

b. Evaluation by Elderly

The results of the organoleptic evaluation of the recipes prepared out of the malt supplement by the selected elderly is given in Table XXXVII.

TABLE XXXVII
ACCEPTABILITY OF RECIPES PREPARED FROM THE MALTED SUPPLEMENT
(BY THE SELECTED ELDERLY)

Recipes	Quality attributes					Overall Acceptability
	Appearance	Colour	Flavour	Texture	Taste	
Porridge (salted)	4.9	4.9	5.0	5.0	5.0	24.8
Porridge (sweet)	4.9	4.9	5.0	5.0	5.0	24.8
Stringhoppers	4.8	4.8	5.0	4.7	5.0	24.3
Pittu	4.9	4.9	5.0	4.7	5.0	24.6
Adai	4.9	4.8	5.0	4.7	5.0	24.6
Adai (sweet)	4.9	4.8	5.0	4.7	5.0	24.4
Kozhukkattai	4.9	4.8	5.0	4.6	4.9	24.2
Kozhukkattai (sweet)	4.9	4.8	5.0	4.6	4.9	24.2
Dosai	4.9	4.7	4.9	4.7	4.9	24.1
Pakkoda	5.0	5.0	5.0	4.5	5.0	24.5

The quality attributes namely appearance, colour, flavour and taste for all the recipes had mean scores between 4.7 and 5.0. The mean scores obtained for texture for the porridges (salted and sweetened) were found to be the highest. The mean score obtained for stringhoppers, pittu, adai, adai (sweet) and dosai was 4.7 each. Kozhukkattai and sweet kozhukkattai obtained a mean score of 4.6 each for texture. The mean score obtained for texture of pakkoda was the least (4.5). The low score was due to the crisp texture of pakkoda which was found by many elderly to be difficult to bite and chew. The elderly found the taste of all the recipes appealing and gave the maximum score of 5.0 for the porridges, stringhoppers, pittu, adai (sweet) and pakkoda and a score of 4.9 for adai, kozhukkattai, kozhukkattai (sweet) and dosai.

Among the 10 recipes prepared out of malted supplement the score for overall acceptability of the porridges was the maximum (24.8) when compared to that of other recipes. This may be due to the ease of consumption of the porridges.

3. Storage Study

The storage study conducted to find out the keeping quality revealed that the malted supplement had a shelf life of more than two months and there was no insect infestation upto three months. The changes in moisture content, alcoholic acidity, peroxide value and the microbial count during the storage periods are presented in Table XXXVIII.

TABLE XXXVIII
CHANGES IN MEAN MOISTURE CONTENT, ALCOHOLIC ACIDITY,
PEROXIDE VALUE AND MICROBIAL COUNT DURING STORAGE

Parameters	Storage period (days)				
	1	15	30	45	60
Moisture content (g/100g)	8.00	8.00	8.25	8.40	8.65
Alcoholic acidity (g/100g)	0.08	0.08	0.09	0.09	0.10
Peroxide value (mmoles/kg fat)	0.07	0.09	0.11	1.60	1.85
Microbial count (cfu/g)	0.07×10^4	0.07×10^4	0.09×10^4	1.02×10^4	1.04×10^4

The initial mean moisture content of the malted food supplement was eight per cent which increased to 8.65 per cent at the end of the storage period of 60 days at room temperature (33 - 37° C). These values were lower than that (13% moisture) laid down by ISI^(BIS) (Malleshi, 1995) and that (14% moisture) laid down by PFA, 1979 (Gopaldas, *et al.*, 1992). The initial mean alcoholic acidity of the malted food supplement was 0.08 per cent which increased to 0.10 per cent at the end of the storage period. These values are within the specification of the Indian Prevention of Food Adulteration ACT (PFA). The peroxide levels was 1.85 milli moles/kg fat at the end of storage period. The peroxide value is within the PFA standard of 10 milli mole/kg fat. These results indicate that the supplement had a shelf life of 60 days without any quality deterioration. Such storability opens the possibility of producing the malted food supplement as a commercial venture. It is so possible only when the product has a reasonably long shelf life, for there is a time lag between the production and use due to transport, storage, purchase

and the period the consumer is likely to take to fully utilize the supplement. The subjective examination revealed no colour, flavour and taste changes in the malted food supplement at the end of the storage period. The food products that were formulated with the malted food supplement were prepared and evaluated by the panel members once in 15 days till the end of the storage period.

The overall acceptability of the products prepared during the storage period is given in Table XXXIX.

TABLE XXXIX
OVERALL ACCEPTABILITY OF THE PRODUCTS PREPARED
DURING THE STORAGE PERIOD

Products	Mean overall acceptability scores				
	Days of storage				
	Day 1	15	30	45	60
Porridge (salted)	24.7	24.7	24.7	24.6	24.6
Porridge (sweet)	24.8	24.8	24.8	24.8	24.6
String hoppers	24.4	24.4	24.4	24.2	24.2
Pittu	24.7	24.7	24.7	24.6	24.5
Adai	24.5	24.5	24.5	24.5	24.5
Adai (sweet)	24.6	24.6	24.6	24.6	24.6
Kozhukattai	24.4	24.4	24.4	24.4	24.4
Kozhukattai (sweet)	24.4	24.4	24.4	24.3	24.3
Dosai	24.3	24.3	24.3	24.1	24.1
Pakkoda	24.8	24.8	24.8	24.8	24.8

The mean overall acceptability score for porridge (salted) reduced from 24.7 to 24.6 after 45 days of storage. In the case of porridge (sweet)

a reduction in the mean score from 24.8 to 24.6 was observed only at the end of the storage period of 60 days. In the case of stringhoppers and pittu the change in overall score was observed on the 45th day. The mean scores obtained for adai (24.5) and sweet adai (24.6) did not change throughout the storage period. The scores for kozhukkattai, kozhukkattai (sweet) and adai changed only on the 45th day. In the case of pakkoda no reduction of mean overall acceptability score was observed throughout the storage period.

4. Selection and Quantification of the Recipe for the Supplementation Study

Among the ten recipes prepared out of the malted supplement, porridge received the maximum score when evaluated by the elderly. Moreover, it was easy to prepare porridges in a large scale particularly in the charity old age homes. Other recipes were also prepared periodically to break the monotony of consuming the supplement in the same form. Shelf life experiments also proved the storage stability of the malted supplement.

In order to find out the quantity of porridge that could be comfortably consumed by the elderly in one sitting, the elderly were divided into four groups (I, II, III and IV) and they were given porridge prepared out of 60, 80, 100 and 120 g of supplement respectively. The details of intake and expressions of the elderly regarding the optimum/excess/deficit quantity of the porridge served to them is outlined in TableXL.

TABLE XL
MEAN INTAKE OF MALTED SUPPLEMENT IN ONE SITTING

Groups	Quantity of supplement used for porridge preparation (g)	Quantity consumed (g)	Excess / deficit as expressed by the elderly
I	60	60	Deficit
II	80	80	Sufficient
III	100	75	Excess
IV	120	80	Excess

The elderly members of group I expressed that they could take more of the porridge than what was served, whereas the elderly of group II expressed that the quantity served was more than what they could consume in one sitting. It was found that on an average $(80 + 75 + 80) / 3 = 78\text{g}$ could be consumed. Hence 80g of supplement was decided to be the optimum quantity to be given to the elderly.

The energy content of 80g supplement amounts to 276 Kcal, protein content to eight grams, the calcium content to 152mg, phosphorus, iron, zinc, copper, manganese, thiamine, riboflavin and niacin contents to 240, 5.68, 2.44, 0.57, 19.62, 0.36, 0.104 and 1.28mg respectively. The feeding trial was conducted by giving 80g of supplement to the selected elderly every day for 180 days.

5. Cost Benefit Analysis

The cost and major nutrients namely energy and protein present in 100g of the malted supplement and other supplementary foods commercially available in the market and commonly consumed, by those elderly who can

afford these, were compared. The cost of the malted supplement and the commercially available supplementary foods were calculated based on the prevailing prices in Coimbatore in October 2000. TableXLI gives the cost benefit analysis of the malted supplement. Figure 19 depicts the comparative cost analysis.

TABLE XLI
COST BENEFIT ANALYSIS OF THE MALTED SUPPLEMENT

Supplements	Nutrients				Cost (in Rs)	
	Energy (Kcal)		Protein (g)			
	in 100g	in 80/30g	in 100g	in 80/30g	Per 100g	in 80/30g
Malted supplement	345	276 (in 80g)	10	8 (in 80g)	1.20	0.96 (for80g)
Supplementary food I	444	133 (in 30g)	20	6 (in 30g)	27.00	8.10 (for30g)
Supplementary food II	400	120 (in 30g)	18	5.4 (in 30g)	18.00	5.40 (for30g)

It was found that the price of malted supplement was only Rs.1.20 per 100g whereas supplementary foods I and II cost Rs.27.00 and Rs.18.00 per 100g respectively. The low cost of the malted supplement may be due to the fact that finger millet is a low cost locally available millet and wheat grown in the northern part of the country is available at a subsidized rate in the Public Distribution System. The technology used to prepare the malt is also a simple one not requiring large/modern machinery. All these factors contributed to the low price of the malted supplement.



FIGURE 19
COST COMPARISON - PREPARED MALTED SUPPLEMENT
VS COMMERCIAL SUPPLEMENTS

In terms of nutrients available from the malted supplement in one sitting it was found that the energy available from 80 g of malted supplement was 276 Kcal and protein eight grams. In the case of commercially available supplementary foods it is the normal practice to dissolve about 30g of the supplementary food in warm milk/water for consumption in one sitting. This amount provided only 133 Kcal and six grams of protein in the case of the supplementary food I and 120Kcal and 5.4g protein in the case of supplementary food II. Thus, the nutrient contribution per sitting by the commercially available supplementary foods was less than that of the malted supplement. But, the cost was nearly nine times (8.4) more for supplementary food I and six times more for supplementary food II.

Thus, the developed malted supplement had satisfactory quality attributes, good shelf life, nutrient content to give adequate energy and other minerals and above all was cost effective making it a viable product for introduction in the diets of the elderly. Feasibility of its use in varied forms of preparations in charitable old age homes also emerges.

D. Impact of the Malted Food Supplement on Selected Elderly

The impact of the malted supplement was studied in 119 elderly of whom 87 formed the intervention group and 32 the control group. The various criteria studied for comparison were anthropometric and biochemical parameters.

1. Comparability between Groups at Base Line

The various demographic variables (age and sex), anthropometric measurements (weights and BMI) and biochemical variables of the control

and supplemented group were tested for comparability. Table XLII gives the comparability on demographics between the treatment groups at baseline.

TABLE XLII
COMPARABILITY ON DEMOGRAPHICS BETWEEN SUPPLEMENTED AND CONTROL GROUPS AT BASELINE

Demographic variables	Group				Total		P-value
	Supplemented		Control				
	Number	Per cent	Number	Per cent	Number	Per cent	
Age group 60-65	24	27.6	6	18.8	30	26.1	
65-70	27	31.0	14	43.75	41	34.5	0.72528
70-75	19	21.8	6	18.8	25	21.0	
75	17	19.5	6	18.8	23	19.3	
Gender Men	36	41.4	15	46.9	51	42.9	0.69245
Women	51	58.6	17	53.0	68	57.1	

The supplemented group and the control groups were comparable at baseline on demographic characteristics namely age and gender.

In order to trace the exclusive impact of supplementation, the comparability before starting the supplementation, the anthropometric and biochemical variables of the group chosen for supplementation and the control group were compared at baseline. Table XLIII gives the comparability on anthropometric and biochemical variables between the group chosen for supplementation and control group at baseline.

TABLE XLIII
COMPARABILITY OF ANTHROPOMETRIC AND BIOCHEMICAL VARIABLES
BETWEEN SUPPLEMENTED AND CONTROL GROUPS AT BASELINE

Variables	Group						P-value
	Supplemented			Control			
	Mean	SD	No	Mean	SD	No	
Weight (kg)	44.09	8.36	87	44.52	10.34	32	0.001
Body Mass index	19.50	3.22	87	19.60	3.31	32	0.618
Hemoglobin (g/dl)	9.56	1.56	87	10.50	1.25	32	0.836
Blood glucose (mg/dl)	101.47	15.19	87	103.0	14.59	32	0.885
Creatinine (mg/dl)	0.99	0.15	87	1.02	0.16	32	0.391
Cholesterol (mg/dl)	179.63	28.60	87	184.4	31.32	32	0.451
Urea (mg/dl)	25.51	4.51	87	29.44	5.13	32	0.001
Total protein (g/dl)	6.63	0.33	87	6.70	0.24	32	0.212
Serum albumin (g/dl)	3.91	0.47	87	3.96	0.21	32	0.405
Serum globulin (g/dl)	2.74	0.45	87	2.74	0.30	32	0.405
Calcium (mg/dl)	8.52	0.45	87	8.50	0.61	32	0.744
Iron (mcg/dl)	87.27	17.00	87	89.5	12.38	32	0.433
Zinc (mcg/dl)	74.24	13.15	87	70.16	12.48	32	0.124
Copper (mcg/dl)	79.66	7.05	87	78.28	5.61	32	0.274

Both the group to be supplemented and the control group were comparable at baseline with respect to anthropometric and the biochemical variables considered for the study, except for body weight and urea level. With regard to body weight, it was slightly more (0.43kg) for the control group compared to the supplemented group. Being control group this difference may not interfere with the impact of supplementation. As far as urea level is

concerned, the individual variation due to ageing process would have been more and that would have been reflected in their urea level. But the values obtained at the baseline for urea for both the groups were well within the normal value.

The blood pressure of all the 119 elderly was also checked and it was found that they were normotensive as their systolic blood pressure was between 120 and 160mm Hg and diastolic pressure was between 80 and 95mm Hg.

2. Food and Nutrient Intake Pattern of the Elderly in the Two Groups

Before the start of the study, a food weighment survey was conducted to understand the food and nutrient intake pattern of the elderly.

a. Meal Pattern

The meal pattern in the selected five old age homes, on the days the food weighment survey was conducted, is given in Table XLIV.

TABLE XLIV
MEAL PATTERN IN THE SELECTED OLD AGE HOMES

Meal	Items
Breakfast	Main foods : Pongal¹/wheat kali²/wheat uppuma³/finger millet kali /iddly/rice porridge/rice pittu⁴. Adjuncts: Brinjal sambar/lime pickle/mango pickle/green gram dhal curry/onion chutney/brinjal chutney/carrot poriyal⁵/sugar
Lunch	Main food : Rice Gravy: Lady's finger/drumstick/brinjal/chow chow sambar⁶/red gram dhal curry/egg curry/pulikulambu⁷ Side dishes: Yam/broad beans/brinjal/cluster beans/cabbage/ potato poriyal/avial⁸ Rasam⁹ Butter milk
Tea	Tea/ Biscuits/cowpea sundal¹⁰
Supper	Main foods : Rice/wheat kali Gravy : Pulikulambu/drumstick sambar/ Side dishes: Beans/brinjal/yam/carrot/cabbage/cluster beans poriyal Thuvayal¹¹ Rasam

Note:

1. Savoury dish prepared using raw rice and green gram dhal.
2. Semi solid porridge made out of wheat flour
3. Seasoned semisolid preparation using semolina/broken wheat
4. Moistened rice flour cooked by steaming.
5. A side dish of cooked and seasoned vegetable.
6. Sambar is a gravy prepared using red gram dhal and any vegetable
7. Prepared with or without vegetables, the main ingredients being onions and a thick extract of tamarind.
8. A side dish prepared out of many vegetables (even upto 11 vegetables) green chillies and coconut.
9. Pepper water
10. Soaked, cooked, seasoned pulse/dhal.
11. Roasted dhals, coconut and dry chillies ground to a paste

The meal pattern in the old age homes was found to be similar to that found in any household of low socioeconomic group. One of the notable aspects of the menu in all the old age homes was that green leafy vegetables were seldom used and the frequency and quantities of vegetables in the menu were less than optimum.

b. Food Intake Pattern:

The food intake of the elderly determined by three day weighment survey is given in Table XLV.

TABLE XLV
MEAN DAILY FOOD INTAKE OF THE SELECTED ELDERLY

Food (g/day)	Recommended intake* (g/day)		Elderly men n=51		Elderly women n=68	
	Male	Female	Mean intake	Per cent deficit or excess	Mean intake	Per cent deficit or excess
Cereals	325	270	320	-1.54	205	-24.07
Pulses	40	40	31	-22.5	28	-30.00
Green leafy vegetables	100	100	10	-90.0	10	-90.00
Other vegetables	75	75	32	-57.3	30	-60.00
Roots and tubers	50	50	35	-30.0	30	-40.00
Fruits	30	30	-	-100	-	-100
Milk and milk products	200	200	35	-82.5	30	-85
Fats and oils	20	20	15	-25.0	12	-40
Meat, fish, egg	30	30	-	100	-	-100
Sugar and jaggery	20	20	15	-25	15	-25

* Pasricha and Thimmayamma (1997)

Adequate dietary intake is fundamental for good health. There is no doubt that good nutrition contributes to the health and well-being of the elderly and to their ability to recover from illness (Gariballa and Sinclair, 1998). Inadequate nutrition ranks as one of the major problems of old age (Wadhwa and Sharma, 1997). In the present study it was observed that the cereal consumption of men (320g) was deficient by only 1.54 per cent. However, there was a cereal consumption deficit of 24.07 per cent in the case of women. In pulse intake there was a deficit of 22.5 per cent for men and 30 per cent for women. The consumption of green leafy vegetables was found to be deficient by 90 per cent for both men and women. One of the reasons stated by the authorities for the rare use of greens in the menu in the old age homes was the long time required for cleaning the greens and the differences in the preferences of the elderly. The elderly insisted that they would eat only a particular type of green leafy vegetables cooked the way they liked and refused to take any other variety of greens. The only green leafy vegetable included in the menu was cabbage. Other vegetables including roots and tubers were also consumed 40 per cent less than the recommended levels. The source of milk in the diet was by way of coffee, tea or buttermilk. Milk being an expensive food item was used sparingly in coffee or tea. Therefore, the milk intake was found to be 85 per cent less than the required amount.

The fats and oils consumed were found to be less than RDA by 25 per cent for men and by 40 per cent for women. In the case of sugar and jaggery there was a deficit of 25 per cent for both men and women. Brahman (1994) reported a decreasing trend in the consumption levels of cereals and millets with age, which constituted the bulk of Indian dietaries and a lower consumption of pulses and protective foods such as green leafy vegetables, fruits and milk. Mehta and Thakore (1996) also reported reduced food

consumption among the aged. These findings are in accordance with that of this study. Another feature noted in the food intake was the inclination of 12 per cent of the selected elderly to skip a meal especially supper occasionally. Natarajan *et al.*, (1993) reported that 82.9 per cent elderly had three meals, 13.8 per cent had two meals and 3.3 per cent had one meal per day indicating a tendency among few elderly to reduce the number of meals per day. However, in this study it was only an occasional feature and not a regular one.

c. Nutrient Intake Pattern

Table XLVI and Figure 20 gives the mean daily nutrient intake of the selected elderly as calculated from the food intake data. Individual values for nutrient intake are given in Appendix VIII.

TABLE XLVI
MEAN DAILY NUTRIENT INTAKE OF THE ELDERLY

Nutrients	RDA*		Elderly men		Elderly women	
	Male	Female	Mean intake	Per cent deficit or excess	Mean intake	Per cent deficit or excess
Energy (K cal)	1973	1704	1847±213	-6.39	1568±2.15	-7.89
Protein (g)	55	45	46.35±6.22	-15.73	39.4±6.17	-12.44
Iron (mg)	42	38	22.48±3.39	-49.48	16.62±3.00	-56.32
Calcium (mg)	886	865	281.63±66.14	-73.25	203±59.2	-76.53
Vitamin C (mg)	40	40	36±38.12	-10.00	39±37	-2.5
Thiamine (mg)	1.2	1.2	1.06±0.15	-11.67	0.88±0.11	-26.67
Riboflavin (mg)	1.1	1.1	0.13±0.45	-86.36	0.35±0.10	-68.18
Niacin (mg)	NA	NA	15.82±2.35	-	14.36±2.11	-
Vitamin A Retinol (mcg)	998	996	282±245	-71.74	218±292	-72.69

* Pasricha and Thimmayamma, (1997)

NA - not available

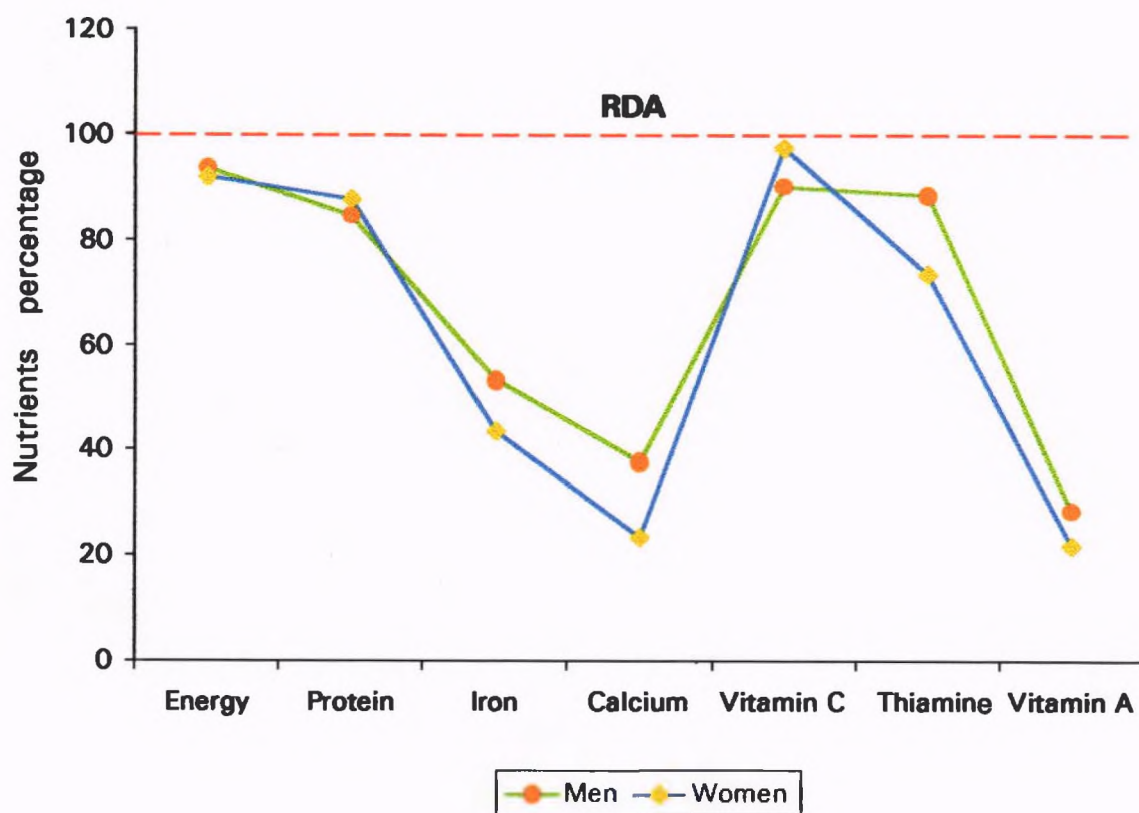


FIGURE 20
MEAN DAILY NUTRIENT INTAKE OF THE ELDERLY

It was found that both elderly men and women had a nutrient intake lesser than that recommended by Pasricha and Thimmayamma (1997). In a study conducted by NIN (Annual Report 1993-94 and 1994-95) on 140 elderly individuals (94 men and 46 women) aged between 60 and 85 years, it was found that the mean energy intake was 1550 ± 492 Kcal among men and 1337 ± 376 Kcal among women. Other nutrients were also low compared to RDA for adults. A similar finding was reported by Khan (1998), Chandrasekhar and Bhooma (1999), Pushpamma *et al.*, (1999) and Devi and Khader, (1999). However, in a study of South Indian elderly, all the nutrients excluding calcium were found to be low, when compared with RDI, in 90 per cent of the elderly studied (Natarajan *et al.*, 1993). A similar trend of reduced intake of energy and nutrients (calcium, iron, vitamins A and C) among the elderly in several northern Manitoba communities and reduced macronutrient and energy intake of elderly men and women in 19 towns from 12 European countries has been reported by Morrison *et al.*, (1996). Again a significant decrease in the intake of thiamine, riboflavin, vitamin C and iron has also been reported (Amorim Curz *et al.*, 1996). However, Howarth (1990) reported that the mean intakes in the elderly for most nutrients were equal to or above the recommended levels, in Dunedin, New Zealand and Steen (1991) reported a similar finding among the elderly population in different parts of Sweden. But these countries are affluent countries, hence the food intakes of the elderly may be more than optimum.

d. Nutrient Intake Pattern due to Supplementation

The total intake of nutrients in the supplemented group when the malted supplement was given was calculated. The details are given in Table.XLVII.

TABLE XLVII
TOTAL NUTRIENT INTAKE OF THE ELDERLY MEN AND
WOMEN DURING THE INTERVENTION PERIOD

Nutrients	RDA		Actual intake		Supplement (80g)	Total intake	
	Men	Women	Men	Women		Men	Women
Energy (K cal)	1973	1704	1847	1568	276	2123	1844
Protein (g)	55	45	46.35	39.4	8	54.35	47.40
Iron (mg)	42	38	22.48	16.6	5.68	28.16	22.28
Calcium (mg)	886	865	281.7	203	152	433.7	355.00
Thiamine (mg)	1.2	1.2	1.06	0.88	0.36	1.42	1.24
Riboflavin (mg)	1.1	1.1	0.45	0.35	0.104	0.554	0.454

It was found that through supplementation, the energy, protein and thiamine requirements were met. The calcium and iron intake improved but did not meet the requirement. As observed in earlier studies (Nutrition News, 1987 and Dahiya and Kapoor, 1994) the bioavailability of the nutrients especially minerals is increased after malting. Therefore, the absorption of nutrients from the supplement must have been enhanced. Thus, there was an overall improvement in the nutrient intake especially energy, filling the calorie gap which in turn will have nutrient sparing action particularly with improved bioavailability.

e. Trace Mineral Intake of the Selected Elderly

After tracing the meal pattern followed in the five old age homes, 30 of the most commonly cooked food items were collected from the old age home kitchens and subjected to wet digestion with triple acid and analysed for iron, zinc and copper using the atomic absorption spectrophotometer. The iron, zinc and copper contents of the cooked foods as provided in the old age homes are given in Table XLVIII.

TABLE XLVIII
IRON, ZINC AND COPPER CONTENT IN COOKED FOODS

Cooked Food Items	Iron mg/100g	Zinc mg/100g	Copper mg/100g	Cooked Food Items	Iron mg/100g	Zinc mg/100g	Copper mg/100g
Rice	0.68	0.622	0.128	Egg curry	1.44	0.022	0.014
Rice porridge	0.42	0.419	0.116	Lime pickle	0.85	0.093	0.192
Wheat upma	0.31	0.755	0.104	Mixed vegetable curry (Kurma)	1.07	0.148	0.085
Wheat kali	0.92	0.360	0.102	Yam masiyal	1.06	0.340	0.104
Ragi kali	1.6	0.422	0.300	Carrot poriyal	0.93	0.32	0.094
Venpongal	0.58	0.370	0.310	Beans poriyal	2.01	0.194	0.084
Rice pittu	0.44	0.212	0.122	Cluster beans poriyal	0.98	0.281	0.095
Iddli	0.82	0.356	0.126	Cabbage poriyal	0.78	0.183	0.021
Sambar	1.13	0.624	0.380	Raw plantain poriyal	1.25	0.026	0.014
Brinjal curry	0.97	0.181	0.062	Mixed vegetable curry (Avial)	0.87	0.132	0.064
Brinjal poriyal	0.49	0.164	0.063	Ladies finger poriyal	0.34	0.226	0.910
Bengal gram curry	1.49	1.126	0.540	Potato curry	0.42	0.326	0.124
Broadbeans poriyal	0.83	0.041	0.092	Cowpea sundal	1.38	3.84	0.631
Chutney (coriander/curry leaves)	2.31	0.158	0.093	Pappad	3.98	2.039	0.901
Bengalgram dhal curry	1.07	1.036	0.913	Rasam	0.64	0.942	0.015

The iron, zinc and copper content of the various recipes given as analysed was used as a ready reckoner to calculate the trace mineral intake of the elderly directly from the cooked foods consumed by them. The iron, zinc and copper intake of the selected elderly thus calculated is given in Table XLIX.

TABEL XLIX
IRON, ZINC AND COPPER INTAKE OF THE SELECTED ELDERLY

Trace mineral	Elderly men N=51	Elderly women N=68	RDA (mg/day)
Iron (mg)	24.70 ± 3.76	18.55 ± 3.23	42(men)* 38(women)
Zinc (mg)	9.53 ± 2.22	8.11 ± 2.01	15.5**
Copper (mg)	1.26 ± 0.28	1.03 ± 0.11	2.2**

* Pasricha and Thimmayamma (1997)

** Report of the Expert Group of ICMR (1990)

The mean intake of iron was 24.70 ± 3.76mg by elderly men and 18.55 ± 3.23 by elderly women which was lesser than that of RDA. However, their values for intake as analysed from the cooked foods were (Table XLVIII) slightly higher than what was calculated by weighment survey. This may be due to the contribution of iron by spices and condiments that go into the various preparations. In the case of zinc the intake was 9.53 ± 2.22mg for elderly men and 8.11 ± 2.01 for elderly women. The mean copper intake was 1.26 ± 0.28 and 1.03 ± 0.11 for men and women respectively. The intake of both zinc and copper were found to be lower than that of RDA.

Iron, zinc and copper contributed by 80g of the malted supplement was 5.68, 2.45 and 0.57mg respectively. Thus, by the consumption of the supplement, the intake of trace minerals also increased.

3. Impact of Supplementation on the Nutritional Profile of the Elderly

a. Changes in Weight and BMI

The impact of the malted supplement on the weight and body mass index of the supplemented group as against the control is given in Table L and Figure 21.

TABLE L
MEAN WEIGHT AND BODY MASS INDEX BEFORE AND
AFTER SUPPLEMENTATION

Parameters	Supplemented group (N : 87)			Control group (N : 32)		
	Initial	Final	Difference	Initial	Final	Difference
Weight (Kg)	44.09 ± 8.36	46.01 ± 8.23	1.91 ± 2.87 ^a	44.52 ± 10.34	43.81 ± 10.01	-0.70 ± 1.25 ^b
Body mass index	19.50 ± 3.22	20.35 ± 3.10	0.85 ± 1.43 ^a	19.60 ± 3.31	19.31 ± 3.29	-0.28 ± 0.54 ^b

For a parameter, two groups with different (a, b) superscripts are statistically significant at 1% level.

The initial mean weight of the supplemented group was 44.09±8.36kg which increased to 46.01±8.23kg at the end of the supplementation period. The mean increase in weight was 1.91±2.87kg. In the case of the control group, there was a slight reduction of 0.70±1.25kg in weight at the end of the study period.

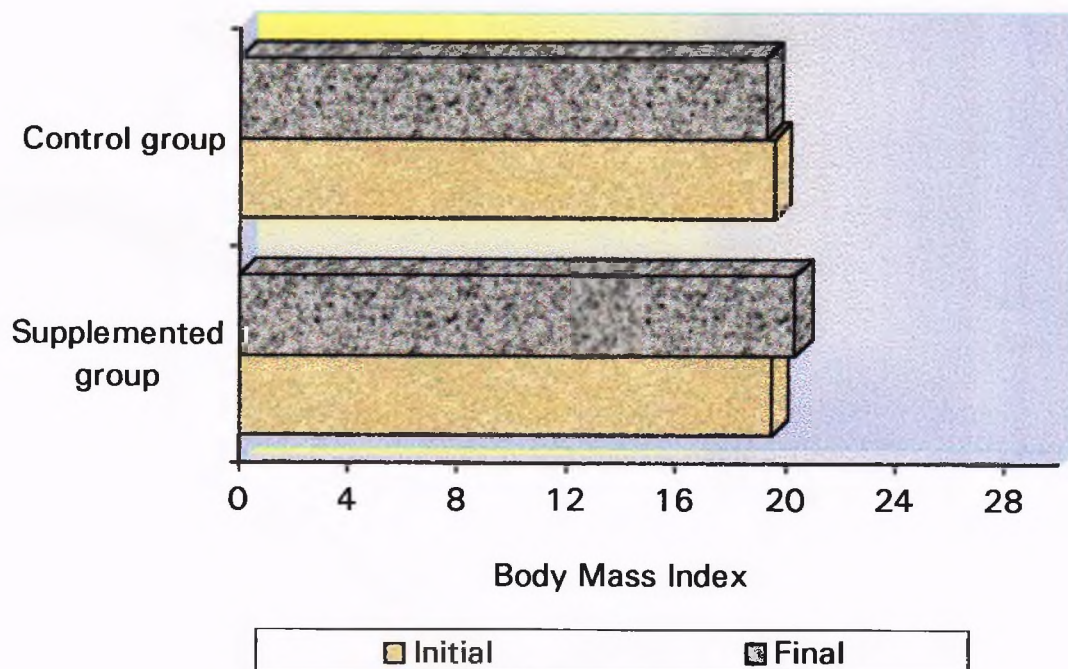
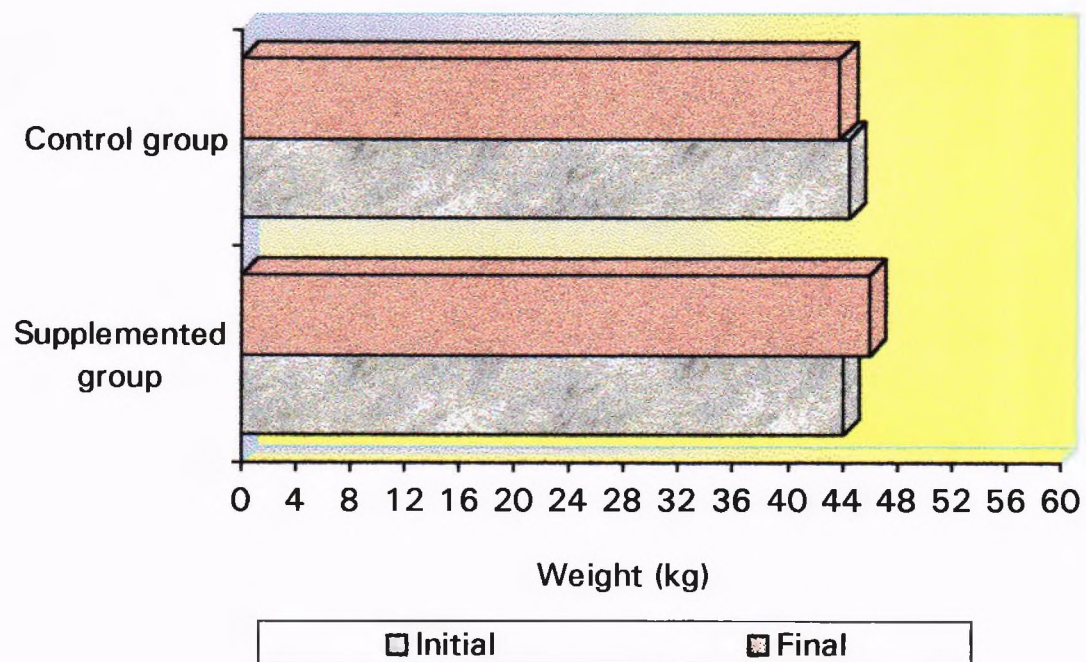


FIGURE 21
MEAN WEIGHT AND BODY MASS INDEX BEFORE
AND AFTER SUPPLEMENTATION

The Body Mass Index which was 19.50 ± 3.22 at the beginning of the study increased to 20.35 ± 3.10 at the end of supplementation period recording an increase of 0.85 ± 1.43 . However, in the case of control group the mean Body Mass Index changed from 19.60 ± 3.31 at the start of the study to 19.31 ± 3.29 by the end of the study period recording a reduction of 0.28 ± 0.54 . These results indicate that the malted supplement had a beneficial effect in maintaining the weight and BMI of the elderly studied.

Percentage of elderly who evinced improvement/reduction in BMI at the end of the study period is presented in Table LI.

TABLE LI
IMPROVEMENT/REDUCTION IN BMI DUE TO SUPPLEMENTATION

BMI	Supplemented group		Control group	
	Number	Per cent	Number	Per cent
Improved	67	77	5	16
Maintained	14	16	8	25
Reduced	6	7	19	59
Total	87	100	32	100

It was found that the BMI of 77 per cent of the elderly in the supplemented group as against 16 per cent in the control group had improved. Fourteen per cent of the elderly in the supplemented group had the same BMI at the end of the study period whereas 25 per cent in the control had the same BMI. While the BMI of only seven per cent of the elderly in the supplemented group decreased, the BMI of 59 per cent of the elderly in the control group decreased. Thus in the supplemented group a total of 93 per cent of the elderly either maintained or had a higher BMI after supplementation whereas during the same period only 41 per cent in the control group maintained or had a slight improvement.

Table LII gives the shift in BMI category of the elderly after supplementation.

TABLE LII
SHIFT IN BMI CATEGORY OF THE ELDERLY AFTER SUPPLEMENTATION

BMI	Supplemented group				Control group			
	Before		After		Before		After	
< 16	12	13.80	6	6.90	3	9.37	4	12.50
16-16.9	11	12.64	5	5.74	5	15.62	5	15.62
17-18.4	13	14.94	16	18.39	7	21.88	7	21.88
18.5-19.9	11	12.64	15	17.24	2	6.25	3	9.38
20-24.9	34	39.08	39	44.83	13	40.63	11	34.37
25-29.9	6	6.90	6	6.90	2	6.25	2	6.25
Total	87	100.00	87	100.00	32	100.00	32	100.00

In the supplemented group, the per cent of elderly in the normal BMI category (20-24.9) increased from 39.08 per cent to 44.83 per cent. Due to supplementation 17.24 per cent of elderly shifted to low weight normal category (BMI 18.5-19.9). There was a reduction in the group of elderly in severe CED (BMI < 16) and moderate CED (BMI 16-16.9) category after supplementation. The number of elderly in the obese category (BMI 25-29.9) remained the same.

In the control group the number of elderly in three BMI categories namely 16-16.9, 17.84 and 25-29.9 remained the same. There was an increase in the severe CED (BMI < 16) and low weight normal (BMI 18.5-19.9) categories from 9.37 per cent to 12.50 per cent and from 6.25 per cent to 9.38 per cent respectively. Those in the normal category (BMI 20-24.9) reduced from 40.63 to 34.37 per cent.

b. Changes in Biochemical Parameters

The impact of the malted supplement on selected biochemical parameters of the supplemented group is given in Table LIII. The individual values are given in Appendix IX

TABLE LIII
IMPACT OF MALTED FOOD SUPPLEMENT ON SELECTED BIOCHEMICAL
PARAMETERS OF THE ELDERLY

BIOCHEMICAL PARAMETERS	Supplemented group (N : 87)			Control group (N : 32)			Normal * values
	Initial	Final	Difference	Initial	Final	Difference	
Haemoglobin (g/dl)	9.56 ± 1.52	10.58 ± 1.73	1.02 ± ^a 0.90	10.50 ± 1.25	10.43 ± 1.20	-0.6 ± ^b 0.35	12-14
Blood glucose (mg/dl)	101.47 ± 15.19	103.08 ± 12.96	1.61 ± ^a 7.93	103.00 ± 14.59	103.34 ± 14.12	0.34 ± ^a 5.30	115-140
Creatinine (mg/dl)	0.99 ± 0.15	0.94 ± 0.13	-0.05 ± ^a 0.13	1.02 ± 0.16	1.04 ± 0.17	0.03 ± ^a 0.10	1.1-1.2
Cholesterol (mg/dl)	179.63 ± 28.60	176.21 ± 25.62	-3.43 ± ^a 7.57	184.44 ± 31.32	186.53 ± 30.17	2.09 ± ^b 4.95	150-250
Urea (mg/dl)	25.15 ± 4.21	26.16 ± 4.35	1.01 ± ^a 2.79	29.44 ± 5.13	28.19 ± 5.43	-1.25 ± ^b 2.57	20-40
Total protein (g/dl)	6.63 ± 0.33	7.09 ± 0.33	0.46 ± ^a 0.37	6.70 ± 0.24	6.68 ± 0.36	-0.02 ± ^b 0.25	6-7.8
Serum albumin (g/dl)	3.91 ± 0.47	3.96 ± 0.36	0.04 ± ^a 0.48	3.96 ± 0.21	4.03 ± 0.58	0.07 ± ^a 0.57	3.22-4.5
Serum globulin (g/dl)	2.74 ± 0.45	3.14 ± 0.53	0.40 ± ^a 0.59	2.74 ± 0.30	2.75 ± 0.36	0.01 ± ^b 0.24	2.3-3.5

* Varley (1988)

For a parameter, two groups with different (a, b) superscripts are statistically significant at 1% level.

The initial mean haemoglobin value was 9.56 ± 1.52 g/dl for the elderly in the supplemented group which increased to 10.58 ± 1.73 g/dl at the end of the supplementation period. The initial mean haemoglobin value of the control group was 10.50 ± 1.25 g/dl. At the end of study period a reduction of 0.6 ± 0.35 g/dl in the haemoglobin value was observed in the control group. Improvements in the haemoglobin picture of the supplemented group was statistically significant in comparison to the control group and is indicative of the positive impact of the supplement which may be attributable to improved bioavailability due to malting. This positive trend suggests that longer periods of supplementation or making the malted supplement a daily dietary item may be beneficial in improving the iron nutriture of the elderly.

There was slight increase in the blood glucose level of the supplemented and the control groups which were well within the normal range both initially and finally.

The mean creatinine value of the supplemented group had a reduction by 0.05 ± 0.13 mg/dl and that of the control had increased by 0.03 ± 0.10 mg/dl. A similar trend was observed in cholesterol levels. There was a reduction of 3.43 ± 7.57 mg/dl in the supplemented group whereas there was an increase by 2.09 ± 4.95 mg/dl in control group. The mean blood urea level increased from 25.15 ± 4.21 to 26.16 ± 4.35 mg/dl in the supplemented group whereas it reduced from 29.44 ± 5.13 to 28.19 ± 5.43 in the control group. The changes in the cholesterol and urea levels were significant at one percent level and could probably be attributed to the positive impact of the supplement.

The mean total protein increased by 0.46 ± 0.37 g/dl in the supplemented group whereas it reduced by 0.02 ± 0.25 g/dl in the control group. The mean albumin level increased by 0.04 ± 0.48 g/dl in the

supplemented group and it was found to have increased by 0.07 ± 0.57 g/dl in the control group. The mean serum globulin of the supplemented group increased by 0.04 ± 59 g/dl and in the control group by 0.01 ± 0.24 g/dl. These changes in total protein, albumin and globulin level though were statistically significant, supplementation over longer periods of time is required to draw conclusive evidences.

Table LIV gives the changes in serum mineral profile of the elderly before and after supplementation.

TABLE LIV
SERUM MINERAL PROFILE OF THE ELDERLY

Serum Minerals	Supplemented Group (N : 87)			Control Group (N : 32)		
	Initial	Final	Difference	Initial	Final	Difference
Serum calcium (mg/dl)	8.52 ± 0.45	9.02 ± 0.43	$0.50 \pm^a_{0.21}$	8.50 ± 0.61	8.39 ± 0.61	$-0.11 \pm^b_{0.11}$
Serum iron (mcg/dl)	87.29 ± 17.00	95.34 ± 15.88	$8.06 \pm^a_{5.66}$	89.53 ± 12.38	86.50 ± 11.35	$-3.03 \pm^b$
Serum zinc (mcg/dl)	74.24 ± 13.15	84.24 ± 14.72	$10.59 \pm^a_{3.76}$	70.16 ± 12.48	69.13 ± 12.48	$-1.03 \pm^b_{4.89}$
Serum copper (mcg/dl)	79.66 ± 7.05	85.08 ± 9.67	$5.43 \pm^a_{4.76}$	78.28 ± 5.61	76.91 ± 7.98	$-1.38 \pm^b_{3.89}$

For a parameter, two groups with different (a, b) superscripts are statistically significant at 1% level.

The mean serum calcium level increased from 8.52 ± 0.45 mg/dl to 9.02 ± 0.43 mg/dl at the end of the supplementation period of 180 days, whereas there was a slight reduction of 0.11 ± 0.11 mg/dl in the mean serum

calcium level in the control group. The mean serum iron in the supplemented group was 87.29 ± 17.00 mcg/dl initially which increased to 95.34 ± 15.88 mcg/dl on supplementation, with a mean increase of 8.06 ± 5.66 mcg/dl. On the other hand, there was a decrease of 3.03 ± 4.95 mcg/dl in the serum iron levels of the control group.

The mean serum zinc level of the supplemented group at the start of the study was 74.24 ± 13.15 mcg/dl which increased to 84.24 ± 14.72 mcg/dl after 180 days of supplementation, with a mean increase of 10.59 ± 3.76 mcg/dl. In the case of the control group the initial serum zinc level was 70.16 ± 12.48 mcg/dl which reduced to 69.13 ± 12.48 mcg/dl showing a mean difference of 1.03 ± 4.89 mcg/dl. The initial level of 79.66 ± 7.05 mcg/dl of serum copper increased to 85.08 ± 9.67 mcg/dl at the end of the supplementation study recording an increase of 5.43 ± 4.76 mcg/dl. The mean serum copper level of 78.28 ± 5.61 mcg/dl reduced to 76.91 ± 7.98 mcg/dl in the control group at the end of the study period indicating a reduction of 1.38 ± 3.89 mcg/dl. These changes in the serum mineral levels between the two groups for calcium, iron, zinc and copper were statistically significant at one percent level. Analysis of cooked food for iron, zinc and copper showed an increase in the intake levels of these trace minerals. Supplementation further increased their intake which is reflected in the improvements of serum levels of these trace minerals after the supplementation period.

Within the limited period of supplementation (six months), the fact that the supplemented group had a significantly superior impact on their serum mineral profiles is indicative of the beneficial effect of the malted supplement on the mineral status of the elderly. Minerals are one of the major contributors to the well being of the elderly. Trace elements zinc and copper

are particularly essential for immunocompetence and ceruloplasmin level maintenance respectively. Calcium is fundamental to bone nutriture while iron is the integral constituent of haemoglobin (blood). As supplementation improved the profile of all these minerals it may be postulated that making the malted supplement a daily food item will in the long run help maintain positive mineral nutrition in the elderly.

c. Expressions of the Elderly after the Consumption of the Supplement

The opinion of the elderly regarding the cereal, millet malted supplement and how they felt after consuming the supplement is given in Table LV. Plate III shows the elderly enjoying the porridge.

TABLE LV
OPINION OF THE ELDERLY ABOUT THE MALTED FOOD SUPPLEMENT

Sl.No	Opinion	No.	Per cent *
1.	Feeling healthier	87	100.00
2.	Feeling energetic	80	91.95
3.	Does not want to rest after breakfast	49	56.32
4.	Does not feel tired as often as earlier	87	100.00
5.	Can work longer in the kitchen/garden	26	29.88
6.	Has improved appetite	29	33.33
7.	Has good sleep	32	36.78

* Multiple responses

All the members of the supplemented group opined that they felt healthier after taking the supplement. The elderly expressed that they felt this change in a week's time after the supplement was introduced. Eighty (91.95%) of the elderly expressed that they felt energetic all through the day.



PLATE III
THE ELDERLY ENJOYING THE PORRIDGE
(MALTED FOOD SUPPLEMENT)

They were able to carry out their personal work such as bathing and folding their clothes with ease and did not feel as if it were a chore. As is common among the elderly, many were in the habit of resting for a while after breakfast. Forty nine (56.32%) elderly in the supplement group expressed that they had the compulsion to rest after breakfast before they were given the supplement and over the period of supplementation it diminished to such an extent that they spent their time interacting with other inmates, joined those helped in the kitchen, listened to radio or went through newspapers and magazines. Everyone of the supplemented group expressed that they did not feel tired very often since the supplementation began. They said that they used to feel tired even after walking for a short distance, after a bath or after sitting for an hour or two, prior to supplementation. Those who helped in the kitchen or in the garden expressed that they were able to work longer and effectively without becoming tired. Twenty nine (33.33%) of them felt that their appetite had improved due to the consumption of the supplement. Thirty two (36.78%) of them said that they were able to sleep longer and better at night, that is they had longer spells of undisturbed sleep. These expressions of the elderly who participated in the supplementation study further indicates the positive health benefits and well being the supplement gave to the group of elderly studied.

E. Impact of Malted Food Supplement on Elderly Women Suffering from Early Stages of Osteoporosis - A Case Study

1. Calcium Intake of the Six Osteoporotic Elderly

Six elderly women suffering from early stages of osteoporosis were given 100g of malted food supplement in the form of porridge for a period of three months. One hundred grams of malted food supplement supplied 250mg of calcium. The supplementation was carried out along with the home diet. Calcium content of the home diet and the supplement was calculated to know the total calcium intake by the elderly women. Table LVI provides information on the mean intake of calcium by the six osteoporotic elderly women.

TABLE LVI
MEAN INTAKE OF CALCIUM BY THE OSTEOPOROTIC ELDERLY WOMEN

S.No	Calcium content of old age home diet (mg)	Calcium content of supplement	Total intake of calcium (mg)
1	350	250	
2	330		
3	368		
4	360		
5	352		
6	340		
Total/ Mean	2100/350	250	600

The mean calcium intake by the six elderly women as studied individually through the old age home diet ranged from 330 to 350mg per day. The malted food supplement supplied 250mg making the total intake 600mg of calcium. Since these women were suffering from initial stages of osteoporosis an extra 200mg of calcium above the requirement was provided through supplementation.

2. Changes in Serum and Urinary Calcium Levels of the Osteoporotic Elderly

The mean serum and urinary calcium levels of the selected elderly women before and after supplementation is given in Table LVII.

TABLE LVII
MEAN SERUM AND URINARY CALCIUM LEVELS
OF THE ELDERLY WOMEN

Details	Before supplementaion	After supplementation	Difference	't' - value
Serum calcium (mg/dl)	8.8± 0.43	9.3± 0.48	0.47± 0.35	2.64*
Urinary calcium (mg/dl)	209.8± 27.7	152.3± 31.2	57.5± 4.79	23.97*

* Significant at 1 per cent level

The mean serum calcium levels of the elderly women were found to 8.8 mg/dl and 9.3 mg/dl before and after supplementation respectively. The mean urinary calcium levels were 209.8 mg/dl before supplementation and 152.3 mg/dl after the supplementation. The high urinary excretion of calcium before supplementation may be mainly due to calcium not been deposited in the normal amounts in bones. But a decrease in excretion value after the supplementation, was observed, showing that considerable amount of calcium

has been deposited in the bones. This may be attributable to their increased intake of calcium due to supplementation and also the probable better utilisation of calcium from the malted supplement.

3. Bone X-Ray Pattern of the Osteoporotic Elderly Before and After Supplementation

Among the six elderly women, bone X-rays were carried out in four women and the observations of the X-rays (Plate IV - VIII) of the elderly women suffering from early stages of osteoporosis before and after the supplementation of malted food supplement are listed in Table LVIII.

TABLE LVIII
OBSERVATIONS OF BONE X-RAYS

Sl.No	Before supplementation	After supplementation
1	Thinning of the bone density	Slightly increased bone density
2	Thinning of the outer cortex	Slight thickening of outer cortex
3	Decreased trabecular pattern	Slightly increased trabecular pattern
4	Brittle bones with increased possibility of fracture	Decreased possibility of fracture

After three months of supplementation, certain positive trends in bone X-rays towards reducing the incidence of osteoporosis was observed. Improvements were observed with reference to bone density, thickening of the outer cortex and slightly increased trabecular pattern after the supplementation period. Brittleness of the bone was also decreased after supplementation thereby reducing the possibility of occurrence of bone fracture. The foregoing observations indicate that elderly women with the early onset of osteoporosis, if provided with malted food supplements will probably have adequate amounts of calcium (along with their daily dietaries) thus improving their bone X-rays. Moreover, after supplementation a significant reduction in urinary calcium excretion was observed establishing the fact that



PLATE IV
X-RAY PROFILE OF HUMERUS JOINT BEFORE AND
AFTER SUPPLEMENTATION

161a



PLATE V
X-RAY PROFILE OF THE KNEE JOINT BEFORE AND
AFTER SUPPLEMENTATION

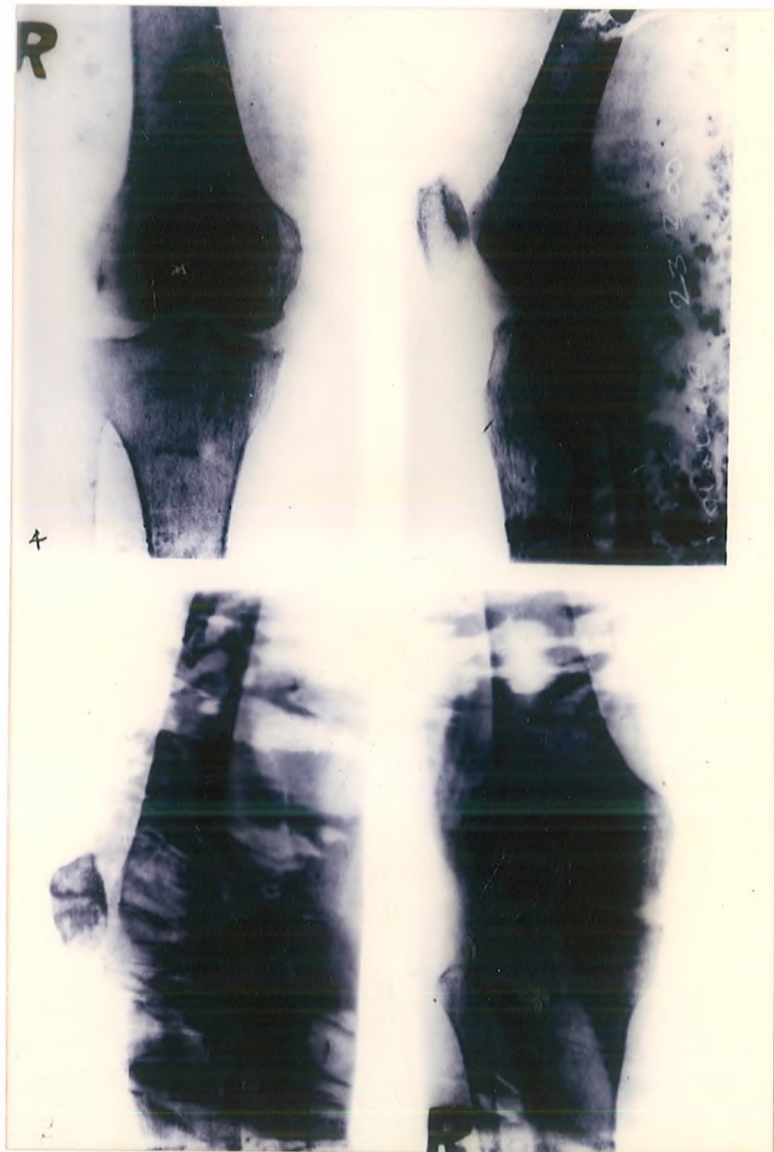


PLATE VI
X-RAY PROFILE OF THE KNEE JOINT BEFORE AND
AFTER SUPPLEMENTATION

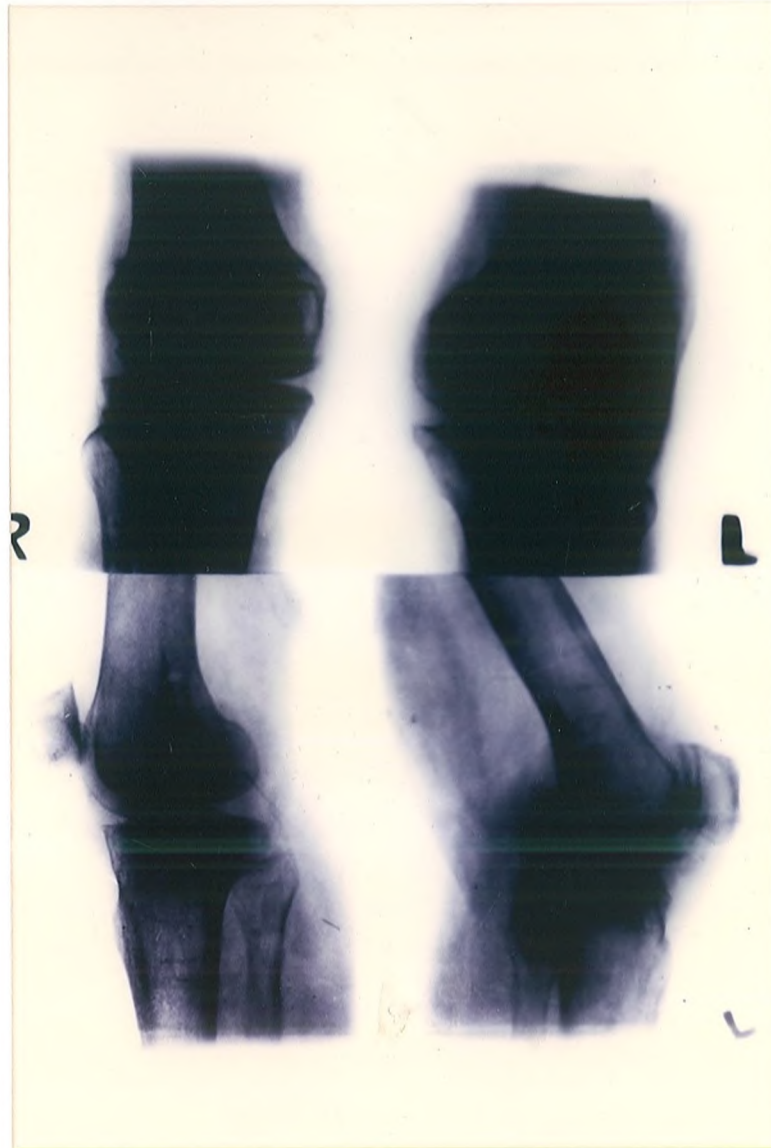


PLATE VII
X-RAY PROFILE OF THE KNEE JOINT BEFORE AND
AFTER SUPPLEMENTATION

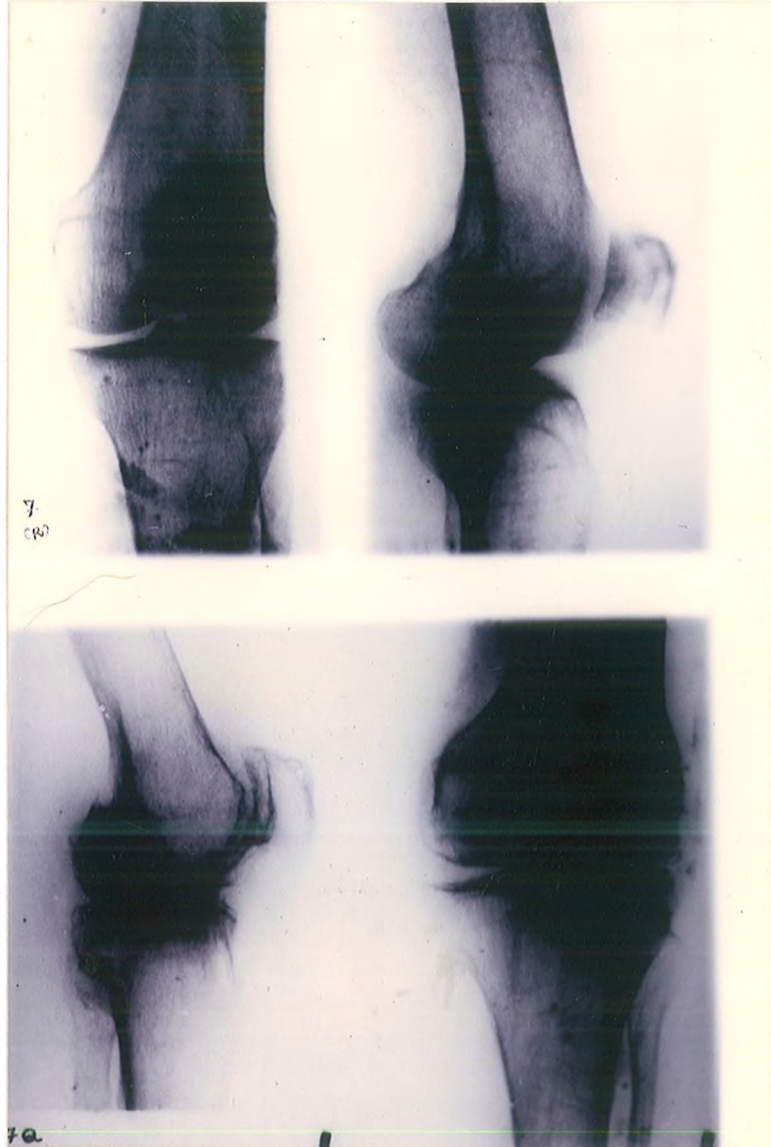


PLATE VIII
X-RAY PROFILE OF KNEE JOINT BEFORE AND
AFTER SUPPLEMENTATION

more calcium is being retained in the bones. Serum calcium also showed an increase after supplementation. Thus the total impact of supplementation on bone Xrays, urinary calcium and serum calcium levels indicates the possibility of helping the elderly women avoid severe fractures which is very common among the elderly women. Malting of the supplement could have helped improve bioavailability and total positive impact over the short period of supplementation in this case study is indicative of the fact that supplementation with such malted cereal: millet food is a feasible solution for better bone health in the elderly thus making it an ideal geriatric supplement.

From the results as portrayed in the foregoing sections of this chapter it is clearly evident that developed malted cereal millet food supplement is an economically feasible, culturally and habitually acceptable supplement to the diets of the elderly. The fact that it helped improve the nutritional profile of the supplemented elderly, the fact that majority of the elderly expressed satisfaction about the supplement as a probable health food and above all the fact that case study points out the probable utilisation benefits of the supplement is a surest assurance to the nutritional quality of the developed supplement. Elderly women selected from charity old age homes, had poor socioeconomic background and certainly were not in any enviable position as far as the food habits, dietary pattern, life style, capacity to earn and position in the old age homes. Though these charity old age homes meant well to support these needy elderly both physically and psychologically within their constraints, the short term study is a pointer towards the possibility of improving within the financial constraints the diet pattern of such old age homes with obvious benefits in terms of the health and nutritional wellbeing of the elderly which in turn can help give them more psychological and sociological security.

SUMMARY AND CONCLUSION

V SUMMARY AND CONCLUSION

The longevity explosion is a triumph and testament to the achievement of man in the fields of preventive and curative medical care and health promotion. With the older persons estimated to constitute a third of the population within the next thirty years, active, healthy and happy ageing is a major concern globally. Translating this concern into a mission, the United Nations had declared 1999 as the International year of the older persons. The dimension of the problems of the elderly and enormous increase in their absolute numbers in India, warrants study of their health and medical needs to improve functional independence and quality of life through reduction/alleviation of morbidity.

Old age homes are mushrooming in India, consequent to modernisation and change in life style. With the increase in old age homes, especially free (charity) homes it becomes imperative that the nutritional and health status of the elderly living in these homes be studied and conclusions drawn so as to do the needful for the productive and active ageing process of the elderly.

In order to provide a better quality of life, awareness about their malnutrition and health related issues, psychological issues, effect of food supplementation on their health is essential. The present investigation entitled 'Nutritional status and impact of a malted food supplement on selected institutionalised elderly' is an attempt towards this. The broad objective of this study was to assess the life pattern and nutritional profile of elderly from selected charitable old age homes of Tamil Nadu and evaluate the potential of a malted food supplement in the diets of the elderly.

Accordingly, fourteen charity old age homes were selected from Madurai, Aruppukottai, Virudhunagar and Tiruchirapalli. A total of 500 elderly in the age group of 60 to 85 years, were available in these homes. The general profile of these elderly were studied using a framed schedule. The particulars collected were, age, marital status, family size, educational level, erstwhile occupation and income, reasons for joining the old age home, period of stay, present leisure time activities and personal habits, details of physiological problems of the aged subjects, dietary practices of the elderly before and after joining the old age home, food beliefs and taboos and present health condition. The psychological well being was assessed using a Geriatric Depression Scale. For all these 500 elderly, anthropometric measurements such as height, weight, BMI, mid upper arm circumference, skinfold thickness were found out. Based on the mid upper arm circumference and skinfold thickness, arm area, arm muscle area and arm muscle circumference were also found out using arm anthropometry nomogram. The functional and clinical assessments were carried out with the help of the physician.

To study the impact of the malted food supplement elderly men and women from five old age homes of Madurai were chosen. Of the 119 elderly, 87 formed the intervention group and 32 formed the control group. These groups were comparable at baseline. Biochemical tests such as cholesterol, creatinine, urea, haemoglobin, glucose, calcium and trace minerals were done before and after the supplementation. A three day weighment survey was also conducted to find out the food and nutrient intake of the 119 elderly. The trace element intake of these elderly was also found by cooked food analysis. The malted supplement (80g) in its most acceptable

form namely “porridge” was given to the 87 elderly who formed the intervention group for 180 days. The impact of the supplement in the intervention group was assessed by anthropometry, biochemical evaluation and subjective evaluation and compared with that of the control. A case study on the effect of the malted supplement on six elderly women suffering from early stages of osteoporosis was also conducted.

In order to improve the dietary intake in terms of calories and other nutrients, a culturally acceptable, economically feasible for adoption in old age homes, easily digestible and locally available food supplement had to be formulated. Accordingly a wheat and ragi supplement, both of which are easily available and low in cost were selected as the main ingredients and malted to improve flavour, digestibility and bioavailability and mixed in equal proportions. The nutrient content and physicochemical characteristics of the malted food supplement were assessed. Ten recipes using the malted supplement were standardised and the acceptability tested by the laboratory panel members and the elderly. Storage stability of the malted supplement packed in 200 gauge low density polyethylene in 500g lots and stored at ambient conditions was found out.

The salient findings of the study are summarised below:

1. Of the 500 elderly selected for the study, 194 were men and 306 were women. Among the elderly men, 30 per cent belonged to the age group of 70 to 74 years followed by 25 per cent in the 75 to 79 age group, 22 per cent in 65 to 69 age group and 17 per cent in the 60 to 64 age group. Among the elderly women 26 per cent belonged to the age group of 70 to 74 years,

followed, by 24 per cent in the age group of 65 to 69 years. The least number of the elderly men and women fell into the age category of 80 to 84 years. In all, 65 to 79 years was the age range of majority of the elderly studied.

2. Of the 194 elderly men, 108 (55%) were literates and 86 (45%) were illiterates. Out of the 306 elderly women, 102 (33%) were literates and 204 (67%) were illiterates. Illiteracy was more common among the elderly women (67%) than men (45%). It was also observed that the percentage of literates increased as the age range decreased, which is in line with the changing National scenario over the last few decades.

3. Among the elderly men 24.23 per cent owned petty shops, followed by 23.20 per cent who were employed as clerks, school teachers and as wholesale grocery merchants. Agriculture was the main occupation for 22.16 per cent and carpentry, masonry, tailoring and weaving were practised by 13.92 per cent of the selected elderly men. Coolies and household male servants were 8.25 per cent and 3.61 per cent respectively. Majority of the elderly women (68.95%) were involved in household work and 17.65 per cent of women were working as agricultural labourers. Almost similar proportion of women were working as skilled labourers (3.92%), petty shop keepers (3.92%) and as school teachers (3.27%). Only few were working as labourers (1.31%) and street vendors (0.98%) selling fruits and vegetables. Most of the elderly (66.40%) were involved in sedentary work like domestic work and light agricultural work like sowing seeds or applying pesticides. The moderate (21.81%) and heavy workers (11.80) formed 33.61 per cent of the elderly surveyed.

4. Of the 194 men, 36 (18.56%) were bachelors and among the 306 women, 48 (15.69%) were spinsters. In the families of 20.89 per cent of the married elderly men and 26.75 per cent married elderly women there were only one child. In each of the families of 20.89 per cent and 19.61 per cent elderly men there were two and three children respectively. Similarly in the families of 21.87 and 16.11 per cent elderly women there were two and three children respectively. There were four children in 17.72 and 13.94 per cent families of elderly men and women respectively.

5. The most common reason stated by 37.5 per cent of the elderly, for joining the old age homes was that they had no one to take care of them. Poverty in the house was the next cause as informed by 29.57 per cent of the elderly. Only 11.54 per cent of the elderly were sent away from their home because they were unable to earn any more. Majority of the respondents (63.00%) were in the old age homes for less than five years followed by those (20.00%) who had been in the old age home for five to ten years. Only 17.00 per cent were in the elderly home for more than 10 years. It was found that more elderly have joined the old home in the recent years. It is an indication of the changing social milieu.

6. The most popular pastime of the elderly was watching television (29.2%) and listening to radio (24.8%). The next common pastime was reading newspapers and magazines. Compared to men, more elderly women helped in the kitchen. While gardening was preferred by 8.80 per cent of the elderly, the premises of the old age homes were kept clean with the assistance of 7.20 per cent of the elderly. In one home the inmates made office covers for which they were paid by the office which supplied them the raw materials for making covers.

7. More men (63 out of 194) were in the habit of smoking cigarette followed by 27 men who were in the habit of taking alcoholic drinks. Twenty three (11.86%) men smoked and drank alcoholic drinks. The habit of chewing betel leaves with or without tobacco was found in 9.28 per cent of elderly men. Majority of the elderly women (80.07%) did not have the habit of chewing betel leaves or using snuff. However, 19.28 per cent of them had the habit of chewing betel leaves and using snuff.

8. The dietary history of the elderly prior to joining old age home revealed that 84.4 per cent of them had rice as the staple food whereas only 15.60 per cent had mixed cereal such as finger millet, sorghum and rice. Only 46 (9.20%) were vegetarians and the rest of them were non vegetarians. The dietary pattern followed in the institution was simple and consisted of breakfast, lunch, plain tea (with snacks occasionally) and dinner.

9. Apart from the foods provided by the institution many elderly men and women had the habit of purchasing foods from nearby shops. It was observed that 17.53 and 16.49 per cent elderly men had the habit of buying coffee and tea respectively from the nearby shops. Snacks like baji and vadai were purchased once a week and occasionally by 15.98 and 23.19 per cent of men respectively. Banana was the fruit purchased most often by the elderly. In the case of elderly women only 3.59 per cent of them purchased food from outside everyday.

10. While 49.80 per cent of the elderly did not have any difficulty in taking food, the others had problems in biting, chewing and swallowing. Though the need to have dentures were found in many, only 12 men and 16 women wore dentures.

11. The elderly had their own food beliefs and taboos. Of the total elderly 75.6 per cent believed that millets were more nutritious than rice. They (91.2%) also knew that green leafy vegetables were good for health. The common belief among 79.2 per cent of elderly was that papaya, pineapple and jack fruit should be avoided by pregnant women, as these three fruits were hot foods and hence abortive.

12. Mean height of the elderly men was 159.68 ± 6.33 cm and that of the women was 145.05 ± 6.56 cm. The mean weights of men and women were 51.09 ± 8.02 kg and 43.33 ± 7.80 kg respectively. The BMI of elderly women was slightly higher than that of elderly men. The mean arm area and mean arm muscle area of the elderly men were found to be higher than that of the elderly women. But the mean arm fat area of the elderly women was more than that of the elderly men.

13. Functional assessment of the elderly revealed that posture of 93.6 per cent of them was normal. Tremor and stiffness of the hands were observed in 3.20 and 15.20 per cent of the elderly respectively. Almost half of them (48.40%) had poor sight. Varicose veins were seen in 7.80 per cent. The clinical examination indicated that 94.0 per cent of the elderly had normal body temperature. Profuse sweating was observed in 6.80 per cent, localised edema in 9.40 per cent, receded gums in 44 per cent and angular stomatitis in 1.80 per cent.

14. It was found that 37 per cent of the elderly suffered from insomnia, 23.20 per cent from anorexia and 21 per cent from flatulence. Urinary incontinence was reported by 16 per cent. The bowel movement was normal in 76.40 per cent.

15. The incidence of diabetes, CVD, arthritis, hypertension, cataract and asthma among the elderly were 11.0, 6.2, 2.10, 15.2, 44.0 and 6.40 per cent respectively.

16. It was found that the incidence of diabetes and cataract were more in 60 to 70 age group whereas cardiovascular diseases, arthritis, hypertension and asthma were more in the 71+ age group. The incidence of diabetes, CVD, hypertension and cataract was less in low socio economic group and higher in middle income group. The incidence of diabetes CVD, hypertension and cataract was higher in those who had led a sedentary life.

17. The results of the multivariate logistic regression analysis indicated association between various socio demographic factors and the degenerative diseases. Those with no physical exercise were eleven times (Odds Ratio 11.04) more susceptible to diabetes and those involved in sedentary type of occupation and those who belonged to middle income group were seven times (Odds Ratio 7.37) and nearly six times (Odds Ratio 5.87) more susceptible to diabetes respectively. Lack of physical exercise seems to be a strong predictor for cardiovascular diseases and persons with no physical exercise were ten times (Odds Ratio 10.32) more prone to cardiovascular diseases. Middle income group and persons with no physical exercise had more chances of having hypertension (Odds ratios 4.2 and 3.2 respectively).

18. The majority (96.2%) of the elderly felt that they were isolated, 95.4 per cent of the elderly felt that family matters were not discussed with them and 92.4 per cent of the elderly expressed that they were not respected by the family members.

19. While 71.20 per cent of the elderly were friendly, 22.20 per cent were depressed and 14.00 per cent were agitated. When the extent of depression was assessed using the geriatric depression scale it was found that 14.00 per cent were mildly depressed, 10.60 per cent were moderately depressed and 3.40 per cent were severely depressed.

20. The developed malted supplement was light brown in colour, with a pleasant and appealing taste. The gelatinisation temperature ranged between 65 and 68° C. The cold paste viscosity of the malted flour was less than the unmalted flour indicating that more solids (flour) can be added in porridge like preparations giving calorie density and low viscosity. The nutrient content of 100g supplement was : Energy 345 K cal, protein 10g, calcium 190mg, iron 71mg, zinc 3.05mg, copper 0.71mg.

21. Ten common recipes namely sweet and salted porridge, string hoppers, pittu, adai, sweet adai, kozhukkattai, kozhukkattai (sweet), dosai and pakkoda of South Indian cuisine were standardised.

22. The acceptability trials indicated that overall acceptability of the sweet porridge and pakkoda had a maximum score of 24.8 when evaluated by the lab panel. When the same recipes were evaluated by the elderly, salted and sweet porridges were given the highest scores.

23. The storage study indicated that the keeping quality of the malted supplement packed in 200 gauge LDPE pouches and stored at ambient conditions was good for more than two months. This was confirmed by assessing the moisture content, alcoholic acidity, peroxide value and microbial count and by acceptability trials where the 10 recipes were prepared periodically

and evaluated during the storage period. Pakkoda was found to have the same overall acceptability score of 24.8 initially and at the end of the storage period.

24. The amount of malted supplement that could be consumed by elderly in one sitting, in the form of porridge was found to be 80g. The cost of the malted supplement was compared with that of commercially available supplements. It was found that costs of 100g of commercially available supplements I and II were Rs.27/- and Rs.18/- whereas the price of the same quantity of malted supplement was Rs.1.20/-.

25. The two groups namely the intervention group (87 elderly) and control group (32 elderly) were found to be comparable at baseline on demographic characteristics namely age and gender, anthropometric and biochemical variables. All the 119 elderly were found to be normotensive.

26. The food and nutrient intake of the elderly were found to be lower than the RDA. By the inclusion of the malted supplement the energy, protein and thiamine requirements were met. The calcium and iron intake improved but did not meet the RDA. Since the supplement was a malted food the bioavailability of the minerals available would be more than that available from other cereal foods.

27. The weight of the supplemented group was found to have increased while there was a reduction of the same in the control group. The BMI of 77 per cent of the supplemented group improved, 16 per cent maintained and seven per cent reduced at the end of the study period. In the control group 16 per cent improved, 25 per cent maintained and 59 per cent reduced at the end of the study period.

28. The biochemical parameters namely haemoglobin, blood glucose, urea, total protein and globulin increased after supplementation whereas creatinine and cholesterol levels reduced. In the case of control group, reduction in haemoglobin, urea and total protein were observed.

29. The serum calcium increased from 8.52 ± 0.45 to 9.02 ± 0.43 mg/dl, serum iron level from 87.29 ± 17.00 to 95.34 ± 15.88 , zinc levels from 74.24 ± 13.15 to 84.24 ± 14.72 and copper level from 79.66 ± 7.05 to 85.08 ± 9.67 mcg/dl.

30. All the elderly expressed that they felt healthier and did not feel tired as often as they used to feel prior to supplementation, whereas 91.95 per cent expressed ^{that} they felt energetic and 56.32 per cent of the elderly did not want to rest after breakfast, after they started consuming the supplement.

31. Elderly women suffering from early stages of osteoporosis were given 100g of supplement every day for three months. The serum calcium level increased from 8.8 ± 0.43 to 9.3 ± 0.48 mg/dl. The urinary calcium decreased from 209.8 ± 27.7 to 152.3 ± 31.2 mg/dl. These values indicated that considerable amount of calcium has been deposited in the bones. The bone X-ray pattern taken before and after the supplementation also showed certain positive trends, such as slight increase in bone density, thickening of outer cortex and increase in trabecular pattern.

It emerged from the results of this investigation on 500 institutionalised elderly that there were more women in the old age homes than men. Literacy among men was more. It was found that in spite of having children, the elderly had to join old age institution like those who were

either unmarried or without a child. The reasons were destitution, poverty and financial dependence. The number of those joining the institutions were on the increase. Few of the health problems among the elderly were insomnia, anorexia, flatulence, mild constipation. Few of them also suffered from diabetes, CVD, arthritis, hypertension, cataract and asthma. The mean body weight and BMI of the elderly were found to be lesser than that of literature values. It was found that individual lifestyle during adulthood had a clear association with the prevalence of certain disease conditions in old age.

The formulated malted supplement had satisfactory quality attributes, good shelf life, sufficient nutrient content and was cost effective. The malted supplement was found to lend itself in the preparation of common South Indian recipes, with high acceptability.

Supplementation with the malted food supplement was found to have a positive impact on weight, BMI, haemoglobin, blood glucose, total protein and trace mineral profile. Longer period of supplementation along with probable improvements in the dietary intakes of trace elements, if possible to achieve, can probably further help improve the trace mineral profile of elderly in charity homes. These possibilities need consideration even if it means a little more financial input, as good trace mineral nutrition is essential in old age.

The case study points out the feasibility of introducing the malted supplement as a part of the dietaries so as to reduce/delay the onset or progress of osteoporosis in the elderly.

Though limited to a sample population of Tamil Nadu, this investigation gives a positive promising pointer for future multicentric studies in other states. It also serves as a pilot study towards designing better diets at affordable budget in the day to day mushrooming old age homes and paves way for better nutrition and health of the increasing elderly population. Further improvement of such supplements and longitudinal supplementation studies are needed. Hence it is recommended that further research along the following lines be undertaken for improving the health status of the aged, so that they can lead a life with optimum health in old age.

1. Formulation of region specific low cost food supplements.
2. Feasibility of producing low cost food supplements (geriatric supplement) for the elderly which do not need further cooking (Ready to eat form).
3. Fortification of the food supplements with trace minerals and antioxidants.
4. Feasibility of improving the nutrient availability from cereals and legumes through bioprocessing techniques.
5. Long term studies on the benefits of increased physical activity/exercise on the health of the elderly.
6. Longitudinal studies beginning 40+ with food based antioxidants and trace minerals on the nutritional and health status at 60+ and above.
7. Longitudinal studies beginning 40+ with calcium supplements on bone nutrition at 60+ and above.

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APPENDICES

APPENDIX I
SCHEDULE FOR COLLECTING THE GENERAL PROFILE OF
THE SELECTED ELDERLY

Date:
Name of the Institution

1. Name of the respondents :
2. Sex : Male Female
3. a) Age : Years
b) Date of birth
4. a) Marital status :
a) Married
b) Widowed
c) Single
d) Divorced
e) Separated
b) No. of children :
5. Reason for joining the Institution
6. Period of stay in the institution
7. Leisure time activities :
a) Reading
b) Listening to radio
c) Watching TV
d) Gardening
e) Any other (Specify)
8. Educational status o the respondents
a) School
b) College
c) Professional
d) Illiterate
9. a) What was the last job held? *What was the income?*
b) Did you have to walk or cycle for long distance?
10. Income source:
a) Pension
b) From children or relatives
c) Any other (Specify)

11. Food habits, before and after coming to the institution

Before

After

- a) Vegetarian
- b) Non-vegetarian

12. Food Availability in the Institution

- i)
 - a. Limited
 - b. Unlimited
- ii)
 - a. Breakfast
 - b. Lunch
 - c. Evening Tea
 - d. Supper

13. Beverage consumption

Frequency per day

- a) Coffee
- b) Tea
- c) Any other (specify)

14. Do you purchase foods from outside

Yes

No

If Yes, a) Type of food

b) Quantity

c) Frequency :Daily, Weekly, Occassionally

15. Do you wear dentures?

Yes

No

16. Do you have problem while biting/chewing/swallowing

If Yes, specify

17. within the past year have you

a) Received medical care?

Yes

No

If Yes, for what kind of disease

b) Been hospitalised?

Yes

No

If Yes, why and for how long

18. Does any particular medical problem affect or interfere with your appetite?

19. Does ~~any~~ ^{you} medical problem ^{you} abstain from or include any food/foods?

Foods

Medical condition

Avoided

Included

27. Maintenance of personal hygiene

	Frequency	Self	Requires help
a. Bathing			
b. Changing clothes			
c. Combing hair			
d. Cutting nails			
e. Washing clothes			

28. Details of urination

a. Polyuria	c. Colour	e. Excessive
b. Nocturia	d. Scanty	f. In continence

29. Details of bowel movement

- Frequency
- Colour
- Hard/Soft stools/Watery
- Do you have the problem of flatulence/constipation

30. Other health problems:

CVD	Food allergy
Hypertension	Piles
Diabetes	Cancer
Renal disorder	Sinusitis
Arthritis	General weakness
Asthma	Obese
Eye ailment	Any other (specify
Gastritis	
Constipation	

31. General information

- Weight (kg) :
- Height (cm) :
- $BMI = \frac{Wt(kg)}{(HtM^2)}$:
- Skinfold thickness :
- Mid arm circumference :

32. Mental state

- Friendly
- Hostile
- Confused
- Agitated
- Tense
- Depressed

APPENDIX II

GERIATRIC DEPRESSION SCALE (GDS-20)

Please write your answers as 'Yes' or 'No'

- | | | |
|---|--------------------------|--------------------------|
| | ☐ | ☐ |
| 1.* Are you basically satisfied with your life? | ☐ | ☐ |
| 2. Have you dropped many of your activities and interests? | ☐ | ☐ |
| 3. Do you feel that your life is empty? | ☐ | ☐ |
| 4. Do you often get bored? | ☐ | ☐ |
| 5. Are you bothered by thoughts that you just cannot
get out of your head? | ☐ | ☐ |
| 6. Are you afraid that something bad is going
to happen to you? | ☐ | ☐ |
| 7.* Do you feel happy most of the time? | ☐ | ☐ |
| 8. Do you often feel helpless? | ☐ | ☐ |
| 9. Do you often get restless and fidgety? | ☐ | ☐ |
| 10. Do you prefer to stay at home at night rather
than go out and do new things? | ☐ | ☐ |
| 11. Do you frequently worry about the future? | ☐ | ☐ |
| 12. Do you feel that you have more problems than most? | ☐ | ☐ |
| 13.* Do you feel that it is wonderful to be alive now? | ☐ | ☐ |
| 14. Do you often feel down hearted and blue? | ☐ | ☐ |
| 15. Do you feel pretty worthless the way you are now? | ☐ | ☐ |
| 16. Do you worry a lot about the past? | ☐ | ☐ |
| 17.* Do you find life very exciting? | ☐ | ☐ |
| 18. Do you think that most people are better
off than you are? | ☐ | ☐ |
| 19. Do you frequently get upset over little things? | ☐ | ☐ |
| 20.* Is your mind as clear as it used to be? | ☐ | ☐ |

Note: Score 1 for each 'Yes' except starred item where each 'Yes' have to be scored negatively.

APPENDIX III

CLINICAL EXAMINATION SCHEDULE

Name :

Date :

Age :

Sex :

Name of the institution

Clinical Symptoms

- | | | |
|-------------------------|---|--|
| a. Temperature | : | Normal
Elevated
Hypothermia |
| b. Sweating | : | Normal
Profuse |
| c. Nails | : | Normal
Brittle
Spoon shaped
Discoloured |
| d. Edema | : | No edema
Localised |
| e. Skin | : | Normal
Dry skin
Depigmentation |
| f. Teeth | : | Pearl white
Caries/discoloured
Plaque deposition
Broken |
| g. Gums | : | Normal
Receded
Inflamed |
| h. Lips | : | Normal
Cracked/dry
Angular Stomatitis |
| i. Digestive function | : | Normal
Distended |
| j. Respiratory Symptoms | : | Normal
Asthmatic
Dyspnic
Persistant cough |

APPENDIX IV

PROCEDURE FOR ANALYSIS OF TRACE MINERALS USING ATOMIC ABSORPTION SPECTROPHOTOMETER

Principle:

When the sample of solution is heated to a high temperature by burning it in a flame, the flame breaks up the chemical bonds between the molecules and enables the atoms to float freely in the sample area. In this state, the atoms absorb ultra violet visible radiation. The wavelength of absorption for each element is narrow. Hence at a particular wavelength, the absorption is measured. The amount of light absorbed gives an indication of the amount of metal that is present in the sample.

Procedure for Routine Analysis

1. Selected lamps to be used and inserted them in to the lamp quadrants.
2. Depressed the relevant lamp-select button for the lamp being used and set the meter -select to the same lamp.
3. Switched on instrument set the lamps at the desired current and allowed to stabilise for 10-15 minutes.
- 4 Set the indicator unit in the transmission mode with the select switch in normal.
5. Set the monochromator to the wavelength required with the relevant slit opening and using again setting to give 80 per cent reading.

The wavelength and slit opening used for the trace minerals analysed are given below:

TRACE MINERALS	WAVELENGTH (NANOMETER)	SLIT OPENING	CONCENTRATION
IRON	248.3	0,2	2-6
ZINC	213.9	1.0	0.2-1
COPPER	324.8	0.5	2-4

6. Selected the desired mode of operation on the indicator with unit i.e. absorbance and transmission.
7. Selected the "auto 100" and tuned the "set 100" to read 0.0 absorbance or ten per cent transmission
8. Lighted the flame
9. Fed the samples and corresponding readings
10. Internal blanks were also analysed along with samples and appropriate corrections were made in the sample readings.

APPENDIX V

RECIPES USING MALTED SUPPLEMENT

Porridge : Ingredients

Malted supplement	:	100g
Water	:	200 - 250 ml
Salt	:	To taste

Method: Dissolved the malted supplement in water and boiled stirring continuously till cooked. Removed from fire, added salt and served hot. To prepare sweet porridge, sugar or jaggery can be added instead of salt.

Stringhoppers: Ingredients

Malted supplement	:	100g
Salt	:	To taste
Coconut scrapings	:	10 - 20g

Method: Mixed salt and the malted supplement. About 200ml of water was boiled and poured into the malted supplement. Mixed well to a soft dough using a ladle. Small portions were filled into the extruder and extruded on the perforated plates on which coconut scrapings were spread. Steamed for seven to eight minutes. Removed from the steam cooker and served while hot. It can be eaten along with sugar or any gravy.

Pittu : Ingredients

Malted supplement	:	100g
Salt	:	To taste
Water	:	100 -150 ml
Coconut scrapings	:	10 - 20g
Sugar (optional)	:	10g

Method: Mixed malted supplement and salt. Boiled water was sprinkled little by little on the flour and mixed till the flour resembled bread crumbs. Steamed for seven to eight minutes. Removed from steam cooker and served with coconut scrapings and sugar.

Adai : Ingredients

Malted supplement	:	100g
Salt	:	1g
Oil	:	For smearing on the pan

Method: Mixed malted supplement and salt and prepared a soft dough with cold water. Shallow fat fried on an iron pan or a non stick pan turning frequently to prevent charring and ensure even frying.

Sweet adai was prepared similarly by mixing 20g powdered jaggery to the flour instead of salt.

Kozhukkattai (Salted): Ingredients

Malted supplement	:	100g
Water	:	100ml
Salt	:	To taste
Mustard	:	5g
Chopped onions	:	20g
Green chillies	:	10g

Method : Prepared a dough with malted supplement and salt. Mixed chopped onions and green chillies Portioned into balls and pressed into oval shapes. Steamed for ten minutes. Served while hot.

Kozhukkattai (Sweet): Ingredients

Malted supplement	:	100g
Coconuts scraping	:	50g
Cooked and mashed bengalgram dhal	:	50g
Water	:	100ml
Jaggery	:	50g

Method: Prepared a dough with malted supplement into balls, placed on a greased plantain leaf or plate flattened into a circular shape of about 15 cm diameter. Mixed cooked and mashed bengalgram dhal and jaggery (filling). Placed the filling in the centre and folded the dough to cover the filling and pressed into oval shapes. Steam for ten minutes. Served while hot.

Dosai: Ingredients

Malted supplement	:	100g
Salt	:	2g
Water	:	as required

Method : Mixed malted supplement and salt. Prepared a thin batter. Heated an iron pan or a non stick pan, smeared oil and poured a ladle full of batter on the pan and spread the batter to a thin sheet using the ladle. Turned dosai once to cook both sides. Removed from the pan and served while hot.

Pakkoda : Ingredients

Malted supplement	:	100g
Salt	:	2g
Chopped onion	:	20g
Chopped green chilies	:	10g
Chopped curry leaves	:	5g
Oil	:	for frying

Method : Prepared a thick batter. Added salt. Mixed with chopped onions, green chilies and curry leaves. Heated oil. Dropped small portions of the batter into the oil and fried till done. Removed from oil and served.

APPENDIX VI

SCORE CARD FOR EVALUATING RECIPES WITH

MALTED FOOD SUPPLEMENT

Criteria	Scores	Malted Food Supplement Recipes				
		1	2	3	4	5
<u>Colour</u>						
Very good	5					
Good	4					
Moderate	3					
Poor	2					
Very Poor	1					
<u>Appearance</u>						
Very good	5					
Good	4					
Moderate	3					
Poor	2					
Very poor	1					
<u>Flavour</u>						
Highly acceptable	5					
Acceptable	4					
Partially acceptable	3					
Slightly acceptable	2					
Unacceptable	1					
<u>Texture</u>						
Highly acceptable	5					
Acceptable	4					
Partially acceptable	3					
Slightly acceptable	2					
Unacceptable	1					
<u>Taste</u>						
Very good	5					
Good	4					
Fair	3					
Poor	2					
Very Poor	1					

APPENDIX VII

ANTHROPOMETRIC MEASUREMENTS OF SELECTED ELDERLY

SNO	HT	WTB	WTA	MAC	AA	AMC	SFT	AMA
1	172.5	63.0	64.0	25.5	49	21.5	11.2	38
2	163.0	53.0	57.0	25.4	51	20.5	16.0	34
3	150.0	57.0	60.0	25.3	51	22.5	9.8	42
4	166.5	39.0	41.0	20.0	32	17.0	8.6	24
5	140.0	25.0	50.0	27.0	58	24.5	9.2	48
6	165.0	59.0	62.0	26.6	56	23.5	9.2	46
7	145.0	51.0	52.0	29.0	66	25.5	11.0	53
8	166.0	51.0	53.0	23.8	45	19.5	14.0	31
9	145.0	50.0	52.0	27.5	60	25.0	8.0	51
10	135.0	37.0	39.0	18.6	27	16.5	6.8	21
11	140.0	32.0	32.0	17.6	25	15.5	6.0	19
12	152.0	51.0	51.0	25.6	52	23.0	8.8	43
13	155.0	46.0	50.0	24.0	46	22.0	7.0	40
14	154.5	46.5	47.5	24.3	47	22.0	7.2	40
15	141.5	44.0	44.0	24.5	48	22.5	7.6	41
16	141.0	39.0	38.0	23.7	45	21.5	7.4	39
17	136.0	36.0	36.0	24.0	46	21.5	7.2	38
18	146.0	32.0	33.5	18.5	27	16.0	6.8	21
19	147.0	27.5	27.5	16.5	21	14.5	6.6	17
20	145.0	31.0	36.0	17.4	24	15.5	6.4	19
21	136.0	35.0	38.0	21.5	36	19.0	7.2	28
22	145.0	52.0	51.0	19.5	30	16.5	10.0	21
23	159.0	40.0	40.0	20.6	34	18.5	7.0	27
24	141.0	44.0	44.0	25.5	52	23.0	8.8	43
25	148.0	44.0	46.0	18.7	27	16.0	8.0	21
26	163.0	49.0	50.0	21.0	35	18.5	7.2	28
27	150.0	40.0	40.0	25.5	52	23.0	9.2	43
28	144.0	34.0	36.0	19.3	29	17.5	7.0	24
29	165.5	45.0	46.0	20.3	23	18.0	6.8	26
30	162.0	43.0	45.0	21.7	38	20.5	3.8	34
31	160.0	46.5	47.0	22.5	40	20.0	7.6	32
32	155.0	47.0	49.0	25.3	51	24.5	3.8	49
33	150.0	52.0	53.0	24.6	48	22.5	7.2	42
34	171.0	49.0	52.0	21.6	37	18.5	9.0	28
35	158.0	48.5	50.0	20.8	34	18.0	7.4	26
36	150.0	52.0	54.0	24.6	48	21.5	10.0	39
37	162.5	58.0	61.0	27.7	61	21.5	13.0	45
38	164.5	47.0	52.0	23.3	43	21.5	4.4	38
39	148.0	50.0	53.0	26.0	54	23.0	8.8	42
40	161.0	52.0	55.0	22.0	38	19.0	8.6	29
41	158.0	39.0	43.0	25.3	51	23.0	7.6	43
42	164.0	54.0	56.0	20.8	35	18.0	9.0	24
43	164.0	54.0	57.0	24.3	47	21.0	10.4	36
44	170.0	48.0	52.0	22.5	40	19.5	8.0	31
45	164.0	54.5	56.0	23.4	44	21.5	7.1	38
46	149.5	45.0	46.0	23.8	45	20.5	11.0	34

47	158.0	40.5	45.0	20.4	33	17.5	9.0	24
48	160.0	41.0	44.0	23.1	42	20.5	8.0	33
49	158.5	39.0	41.0	21.2	36	19.5	4.0	31
50	147.5	54.5	56.0	24.8	49	20.5	14.0	34
51	164.0	56.5	57.0	25.0	50	22.5	7.8	42
52	132.0	32.0	34.0	22.0	38	18.5	7.4	31
53	136.0	40.0	41.0	23.0	42	19.5	11.0	31
54	141.0	40.0	42.0	22.0	38	20.0	5.0	32
55	142.0	51.0	50.0	26.6	59	23.5	9.0	46
56	143.5	55.0	55.0	27.0	58	21.0	19.0	36
57	147.5	36.0	39.0	18.6	27	14.0	11.2	15
58	137.0	35.0	36.0	23.2	43	19.5	11.0	32
59	146.0	36.5	37.0	21.0	35	18.0	10.0	26
60	161.0	46.5	49.0	23.4	44	21.5	7.0	38
61	153.0	58.5	60.0	22.0	38	19.0	10.0	29
62	140.0	30.0	31.0	20.0	32	17.5	6.8	24
63	162.0	41.0	41.0	20.8	35	19.5	4.0	30
64	143.5	47.5	50.0	23.2	43	20.0	10.4	33
65	145.0	44.5	48.0	22.3	39	18.5	12.0	27
66	146.0	51.0	51.0	20.6	34	19.5	3.6	30
67	145.0	38.0	40.0	22.0	38	19.0	8.0	29
68	138.0	35.0	36.0	19.8	31	17.4	7.0	24
69	155.0	55.0	57.0	24.3	43	21.0	7.0	36
70	154.0	42.0	42.0	21.3	36	19.0	7.0	29
71	136.5	34.0	36.0	22.0	38	19.0	8.0	29
72	151.5	40.0	44.0	24.0	46	21.5	8.0	38
73	139.5	35.0	35.0	18.0	26	16.0	6.8	20
74	150.0	41.0	43.0	22.3	39	18.5	12.6	27
75	126.0	25.0	27.0	18.5	27	17.0	4.8	23
76	151.0	55.0	56.0	26.0	54	23.5	8.0	45
77	151.0	52.0	51.0	21.3	36	19.0	6.8	29
78	139.0	39.0	43.0	21.3	36	18.5	8.0	27
79	141.0	45.5	47.0	22.8	41	19.5	10.0	31
80	147.5	39.0	42.0	23.8	45	21.5	8.0	38
81	167.0	43.0	45.0	19.5	30	16.0	9.0	21
82	151.0	38.0	40.0	22.0	38	19.5	8.0	30
83	140.0	32.0	33.0	21.0	35	18.5	8.0	27
84	131.0	45.0	45.0	25.6	52	22.5	8.6	42
85	141.5	43.0	44.0	22.2	39	21.0	8.2	36
86	150.5	47.0	48.0	31.5	79	28.0	10.0	63
87	141.5	44.0	44.0	27.5	60	24.5	10.4	49
88	155.0	45.0	44.0	24.7	49	20.5	13.8	24
89	150.0	35.0	33.5	20.4	33	17.0	11.2	23
90	144.5	31.0	29.0	20.5	33	17.0	10.0	23
91	162.5	41.5	38.5	20.7	34	17.5	9.2	24
92	139.0	33.5	33.0	22.8	41	20.0	8.6	32
93	135.0	38.0	37.0	21.0	35	18.5	6.6	27

94	163.0	44.0	42.5	23.5	43	20.5	10.0	34
95	147.5	52.0	50.0	26.5	56	23.0	10.0	43
96	151.0	39.0	40.0	21.3	36	17.5	11.0	25
97	146.0	36.0	36.0	16.0	20	14.0	6.0	15
98	140.0	33.0	33.0	22.6	40	19.0	9.8	29
99	141.0	43.5	44.0	25.3	51	21.5	11.0	38
100	142.0	34.5	36.0	22.3	39	19.0	9.6	29
101	136.0	33.0	33.0	19.0	28	17.0	6.0	23
102	122.0	30.0	31.0	24.5	48	21.5	8.4	38
103	145.0	34.0	35.0	18.4	26	15.5	8.2	19
104	163.3	46.0	45.0	20.3	33	17.5	8.8	24
105	165.5	45.0	46.0	20.6	33	19.0	5.8	29
106	156.0	72.0	72.0	25.1	51	23.0	8.0	43
107	158.0	49.0	48.0	23.5	44	21.0	8.2	36
108	139.5	35.0	35.0	20.3	33	17.0	9.8	23
109	159.0	56.0	55.0	25.5	52	21.0	15.0	36
110	158.5	63.0	63.0	26.8	57	20.0	21.4	31
111	139.0	44.0	42.0	23.5	44	19.5	12.0	31
112	147.0	47.5	47.5	23.8	45	20.5	10.0	33
113	151.5	41.0	41.0	22.7	40	19.5	8.2	31
114	153.0	49.0	48.0	24.2	47	20.5	12.0	35
115	167.0	56.0	55.0	25.0	50	21.5	11.0	38
116	164.0	55.0	51.0	25.4	52	23.5	5.8	46
117	142.0	46.0	45.0	25.5	52	20.5	16.0	34
118	161.0	60.0	58.0	27.0	58	23.5	11.0	45
119	163.0	57.0	55.0	26.6	56	23.0	10.8	44

Note :

HT - Height (cm)

WT - Weight (kg) **WTB - Before WTA - After**

MAC -Mid Arm Circumference (cm)

AA - Arm Area (cm²)

AMC - Arm Muscle Circumference (cm)

SFT - Skin Fold Thickness (mm)

AMA - Arm Muscle Area (cm²)

APPENDIX VIII

NUTRIENT INTAKE OF THE SELECTED ELDERLY

SNO	ENERGY	PROT	FAT	CAL	IRON	VITA	THI	RIB	NIA	VITC
1	2230	60.0	15.00	327	29.00	690	1.19	0.46	22.90	10.90
2	2007	54.0	13.00	290	26.00	621	1.07	0.29	14.00	106.00
3	1765	42.0	12.00	308	22.00	750	1.09	0.32	15.20	108.00
4	2007	56.0	14.00	311	28.00	602	1.11	0.42	20.20	95.00
5	1547	40.0	12.00	252	20.00	571	0.76	0.29	12.10	96.00
6	2106	52.0	14.00	350	24.00	745	1.20	0.51	16.00	101.00
7	1509	39.0	11.00	240	18.00	540	0.78	0.28	12.00	85.00
8	2453	61.0	16.00	320	30.00	648	1.20	0.49	22.10	105.00
9	1578	40.0	11.00	246	19.00	583	0.79	0.30	12.20	91.00
10	1848	47.0	14.00	400	23.00	629	1.07	0.32	10.70	104.00
11	1598	37.0	16.00	280	16.00	584	0.71	0.23	12.30	111.00
12	1332	31.0	13.00	202	14.00	556	0.66	0.20	10.30	100.00
13	1680	42.0	12.00	250	20.00	580	0.73	0.27	12.40	84.00
14	1791	44.0	14.00	335	23.00	728	1.11	0.33	16.25	105.00
15	2123	53.0	15.00	330	26.00	650	1.21	0.51	16.00	99.00
16	1496	38.0	10.00	232	18.00	547	0.68	0.25	9.40	88.00
17	1663	42.0	12.00	258	20.00	608	0.76	0.28	10.50	98.00
18	1180	32.0	14.00	110	13.00	108	0.87	0.28	10.75	23.00
19	1098	25.0	13.00	121	12.00	97	0.72	0.24	10.80	37.00
20	1610	44.1	14.00	115	14.30	102	1.02	0.32	13.30	27.00
21	1075	30.0	13.70	138	12.20	173	0.82	0.31	9.60	26.00
22	1339	30.0	14.00	138	12.00	94	0.82	0.30	9.60	26.00
23	1440	39.6	14.30	130	14.20	118	1.06	0.38	12.40	27.00
24	1482	41.3	14.80	138	14.70	125	1.07	0.39	12.70	28.00
25	1140	31.8	12.40	111	12.10	98	0.87	0.33	9.90	25.00
26	1076	30.0	13.00	114	12.00	1100	0.82	0.29	9.64	25.00
27	1607	44.0	15.40	110	15.80	107	1.11	0.35	14.80	33.00
28	1156	31.4	12.70	108	12.40	102	0.85	0.32	10.10	24.00
29	1472	33.0	15.00	102	14.00	95	0.91	0.32	9.90	35.00
30	1510	41.0	14.10	168	19.60	88	0.89	0.39	13.40	13.00
31	1592	42.0	13.60	195	20.60	73	0.91	0.37	14.40	11.00
32	1680	45.0	15.00	186	22.00	96	0.91	0.41	14.90	15.00
33	1848	49.0	14.90	190	24.00	99	1.11	0.40	15.80	13.00
34	1714	46.0	15.00	190	24.30	101	1.08	0.40	15.30	13.00
35	1791	47.0	16.30	219	23.20	83	1.03	0.41	16.20	13.00
36	1834	48.0	14.80	178	23.00	88	0.98	0.37	15.40	14.00
37	1815	47.0	14.60	176	22.00	94	0.97	0.36	15.10	13.00
38	1906	49.0	15.10	181	23.00	105	1.16	0.43	16.10	14.00
39	1820	48.0	14.60	184	24.00	93	1.13	0.40	17.48	13.00
40	2189	57.0	17.70	268	28.60	101	1.33	0.51	19.80	15.00
41	2002	53.0	15.40	202	26.40	99	1.31	0.44	19.00	14.00
42	1512	40.0	13.90	164	19.10	80	0.81	0.36	13.10	10.00
43	2138	57.0	15.60	266	28.00	126	1.34	0.55	19.00	18.00
44	1990	52.0	17.00	244	25.80	92	1.33	0.46	17.95	14.00
45	1680	35.0	17.00	220	20.00	190	0.89	0.55	13.90	12.00
46	2052	46.0	24.00	297	25.30	265	1.17	0.77	18.20	14.00
47	1767	39.0	19.00	233	22.70	210	0.99	0.61	15.40	13.00
47	1640	34.0	18.00	225	19.00	202	0.88	0.51	13.10	11.00

48	1724	38.0	20.00	254	19.00	226	0.97	0.49	14.10	13.00
49	1786	43.0	20.60	268	23.00	236	1.07	0.64	15.72	12.00
50	1631	34.0	19.00	256	19.20	256	0.88	0.44	13.60	12.00
51	1964	47.0	22.00	270	25.30	241	1.10	0.70	17.27	15.00
52	1790	39.0	21.00	259	20.00	220	0.98	0.51	14.20	14.00
53	1830	40.0	22.00	275	21.00	240	1.01	0.50	14.30	14.00
54	1945	44.0	23.00	280	22.00	262	1.09	0.53	14.40	15.00
55	1594	35.0	18.00	190	16.20	221	0.96	0.32	11.80	12.00
56	1440	32.0	19.00	217	16.80	216	0.95	0.33	11.90	13.00
57	2039	46.0	24.00	323	24.76	322	1.11	0.55	17.10	15.00
58	1782	38.0	21.00	256	20.00	230	0.97	0.51	14.20	14.00
59	1457	33.0	21.38	231	17.67	230	0.94	0.39	12.20	11.00
60	1864	40.0	18.00	248	21.00	236	1.07	0.62	14.40	14.00
61	1910	55.0	21.97	221	18.20	123	1.02	0.44	13.96	8.10
62	1814	52.0	20.90	209	17.10	117	0.89	0.42	13.26	7.70
63	1816	46.0	17.40	177	18.40	97	0.89	0.43	14.30	5.60
64	1586	41.0	14.80	165	13.00	95	0.81	0.34	10.10	5.90
65	1584	41.0	14.80	160	13.00	94	0.80	0.33	10.00	5.80
66	1778	51.0	20.40	206	16.90	114	0.87	0.41	12.98	7.50
67	1610	43.0	15.00	170	15.00	100	0.87	0.36	10.40	7.90
68	1697	43.0	15.20	181	16.00	111	0.99	0.38	10.90	8.20
69	1742	45.0	17.00	193	16.20	114	0.96	0.40	12.70	8.00
70	1795	48.0	19.10	180	17.00	116	0.95	0.41	13.00	9.00
71	1512	41.0	14.60	165	12.00	98	0.86	0.33	9.60	5.80
72	1658	42.0	15.10	172	15.10	99	0.87	0.35	10.20	6.00
73	1469	42.0	16.91	170	14.00	95	0.83	0.34	10.75	6.20
74	1632	47.0	18.80	180	15.40	105	0.86	0.39	11.93	6.90
75	1616	46.0	18.59	187	15.40	104	0.88	0.37	11.83	6.80
76	1771	51.0	20.50	203	16.30	110	0.88	0.39	12.30	7.00
77	1806	51.0	20.60	218	16.90	119	0.91	0.40	12.80	7.00
78	1691	42.0	15.10	175	16.20	110	0.89	0.38	10.80	8.40
79	1681	42.0	12.00	210	16.20	310	0.81	0.33	10.70	86.00
80	1650	41.0	12.00	180	16.00	102	0.83	0.33	10.80	8.40
81	1661	42.0	12.00	250	20.00	610	0.76	0.28	10.50	95.00
82	1390	33.0	13.00	208	14.00	560	0.69	0.22	10.40	80.00
83	1479	34.0	14.00	220	15.00	508	0.71	0.22	10.50	98.00
84	1530	40.0	14.00	158	16.00	102	0.78	0.31	10.20	6.10
85	1648	40.0	13.00	240	18.00	410	0.80	0.31	12.30	86.00
86	1527	41.0	14.00	169	20.00	90	0.87	0.39	13.60	13.00
87	1672	41.0	12.00	258	18.00	460	0.83	0.30	11.80	89.00
88	1840	46.0	13.00	380	22.00	610	1.06	0.31	18.00	96.00
89	1407	32.0	14.00	246	15.00	600	0.71	0.21	10.30	96.00
90	1490	38.0	11.00	242	18.00	538	0.78	0.29	12.10	88.00
91	1755	43.0	13.00	320	22.00	760	1.09	0.31	15.20	101.00
92	1581	39.0	12.00	250	19.00	575	0.79	0.30	12.10	90.00
93	1279	30.0	13.00	224	13.00	510	0.63	0.19	9.90	103.00
94	1668	41.0	12.00	285	20.00	600	0.80	0.30	14.10	97.00
95	1679	42.0	12.00	261	20.00	614	0.80	0.31	10.70	86.00
96	1930	48.0	14.00	352	24.00	700	1.19	0.49	16.00	102.00

97	1497	38.0	10.00	230	18.00	540	0.70	0.26	9.30	90.00
98	1588	39.0	11.00	240	19.00	590	0.88	0.28	10.10	96.00
99	1670	41.0	12.00	280	19.00	610	0.86	0.29	10.90	102.00
100	1380	37.8	15.00	135	15.30	125	0.97	0.34	13.10	26.00
101	1207	27.0	14.00	133	13.00	107	0.79	0.26	11.10	41.00
102	1400	39.0	12.00	96	14.00	90	0.89	0.29	13.00	29.00
103	1534	42.0	16.00	143	17.00	140	1.03	0.36	13.60	30.00
104	1607	39.6	13.80	110	14.20	109	1.01	0.34	13.80	30.00
105	1520	40.0	13.90	160	19.40	85	0.82	0.37	13.10	10.00
106	1980	51.0	16.00	236	24.10	90	1.21	0.41	16.90	14.00
107	1461	40.0	14.00	100	15.00	98	1.01	0.32	13.50	30.00
108	1812	49.0	16.80	201	23.50	105	1.30	0.47	16.10	16.00
109	1950	43.0	22.00	260	23.00	250	1.12	0.78	16.30	15.00
110	2102	45.0	25.00	289	24.00	270	1.19	0.81	17.60	15.00
111	1835	41.0	2.30	288	21.60	260	1.01	0.49	15.40	14.00
112	1602	36.0	22.00	242	18.70	253	0.98	0.25	13.20	12.00
113	1760	39.0	21.00	260	19.80	260	0.99	0.38	14.50	14.00
114	1893	41.0	19.00	240	22.00	240	1.09	0.80	16.10	14.00
115	1866	42.0	18.00	243	22.50	216	1.09	0.63	15.30	12.00
116	1957	50.0	18.70	191	19.70	105	1.02	0.46	15.40	6.10
117	1580	39.0	11.00	230	18.00	413	0.85	0.29	11.10	95.00
118	2179	55.0	20.40	212	21.60	116	1.10	0.52	16.80	6.70
119	1997	51.0	19.10	195	20.20	107	1.03	0.47	15.70	6.20

Note : Energy (Kcal), Protein (g), ^{Fat(g)}Calcium (mg), Iron (mg), Vitamin A (mcg)
Thiamine (mg), Riboflavin (mg), Niacin (mg), Vitamin C (mg).

APPENDIX IX

BIOCHEMICAL PARAMETERS OF THE SELECTED ELDERLY

BEFORE AND AFTER SUPPLEMENTATION

	HBB	HBA	BGB	BGA	CB	CA	CHB	CHA	UB	UA	TPB	TPA	ALB	ALA	GLB	GLA
1	10.3	11.1	92	93	1.0	1.1	210	190	32	28	6.8	7.3	4.3	4.0	2.5	3.3
2	11.5	15.8	106	99	1.0	1.1	189	198	31	32	6.8	6.9	4.4	3.7	2.4	3.2
3	10.3	11.9	65	79	0.9	0.9	219	194	28	23	7.0	6.9	4.5	3.7	2.5	3.2
4	9.9	10.7	93	112	0.9	1.0	183	169	35	37	7.1	7.3	4.6	3.9	2.5	3.4
5	11.7	12.7	116	119	0.9	1.0	224	231	24	27	7.0	6.9	4.6	3.7	2.4	3.2
6	9.1	11.5	93	109	1.2	1.0	224	214	33	36	7.2	7.3	4.5	4.1	2.7	3.2
7	9.1	11.5	96	101	1.0	1.1	182	176	25	25	6.3	7.3	4.0	3.9	2.3	3.4
8	11.7	12.3	98	102	0.9	0.9	151	152	36	38	6.2	7.8	3.9	3.6	2.3	4.2
9	9.5	11.9	114	105	0.9	0.8	259	240	18	15	6.9	7.5	4.2	4.1	2.7	3.4
10	9.1	9.9	104	99	0.7	0.8	168	160	25	21	6.0	7.2	4.0	3.9	2.0	3.3
11	9.0	8.7	136	126	1.1	1.0	156	160	25	28	6.8	7.0	4.0	3.9	2.8	3.1
12	11.5	13.9	82	100	1.0	0.9	184	172	28	30	6.9	7.4	4.0	3.9	2.9	3.5
13	6.7	7.9	116	127	1.2	1.2	133	130	29	22	6.0	7.2	3.8	4.0	2.2	3.2
14	8.0	8.7	137	132	1.1	1.0	156	151	32	33	6.0	6.5	3.9	4.0	2.1	2.5
15	10.7	10.7	117	120	0.8	0.7	158	150	30	30	6.9	6.5	4.4	4.0	2.5	2.5
16	9.9	12.7	112	115	0.8	0.8	191	185	29	30	6.4	6.5	4.5	4.4	1.9	2.1
17	6.3	7.5	114	119	0.8	0.8	148	144	18	25	6.1	6.7	3.7	4.0	2.4	4.7
18	7.1	7.9	139	128	0.8	0.9	195	200	18	21	6.0	7.0	3.0	3.4	3.0	3.6
19	10.3	11.1	106	108	0.9	0.8	140	142	23	20	6.5	7.0	4.0	4.2	1.5	2.8
20	9.9	9.9	108	97	0.9	0.9	139	150	22	19	6.9	7.0	3.0	3.6	3.9	3.4
21	10.1	11.1	108	102	1.0	0.9	163	160	24	25	6.5	7.1	4.0	4.2	2.5	2.9
22	7.1	7.9	124	127	0.9	1.0	198	190	25	26	6.0	6.6	3.7	3.9	2.3	2.7
23	8.1	8.3	92	98	1.0	1.0	217	222	18	21	6.2	7.3	3.9	4.7	2.3	2.4
24	9.9	11.1	97	105	1.3	1.2	208	202	29	29	6.5	7.0	4.0	4.4	2.5	2.6
25	7.1	8.7	114	105	1.0	0.8	146	151	19	24	6.1	6.3	3.9	3.8	2.2	2.5
26	10.7	10.7	119	123	1.0	0.9	153	150	27	30	6.2	6.5	3.8	3.8	2.4	2.7
27	8.7	9.9	78	87	1.1	0.9	174	178	22	21	6.8	7.5	3.4	4.9	3.4	2.6
28	8.3	8.9	104	91	1.2	1.1	154	150	27	23	6.9	7.4	4.6	4.6	2.3	2.8
29	7.9	8.3	104	108	1.2	1.0	158	161	28	30	6.1	6.8	3.8	3.9	2.3	2.9
30	12.1	12.6	94	91	0.9	0.9	224	220	16	20	6.6	7.2	4.0	3.9	2.6	3.3
31	9.5	9.5	76	90	1.2	1.0	162	175	21	17	6.3	7.1	3.9	3.9	2.4	3.2
32	13.5	13.5	91	82	1.3	1.0	165	174	26	22	6.7	6.9	4.1	3.9	2.6	3.0
33	13.1	14.7	90	95	1.2	1.0	156	150	23	23	6.9	7.3	4.3	3.8	2.6	3.5
34	10.3	11.9	114	106	1.0	1.0	194	185	21	19	6.2	7.3	3.7	4.1	2.5	3.2
35	9.1	9.7	100	104	1.3	1.1	173	181	34	33	6.0	6.8	3.7	3.9	2.3	2.9
36	9.1	9.9	82	74	1.0	1.0	161	167	20	23	6.2	7.1	3.6	3.4	2.6	3.7
37	10.5	11.9	73	85	0.9	1.0	156	154	29	28	6.5	6.9	3.9	3.7	2.6	3.2
38	9.8	12.1	97	84	0.9	1.0	187	175	28	30	6.6	7.3	4.0	4.3	2.6	3.0
39	11.9	11.9	131	128	1.2	1.0	237	226	23	28	6.3	6.6	4.0	4.0	2.3	2.6
40	9.9	11.9	116	109	1.1	1.1	139	133	28	28	6.6	7.2	4.0	4.0	2.6	3.2
41	9.9	11.1	74	84	1.2	1.0	168	158	25	25	6.9	6.9	3.5	3.3	3.4	3.6
42	9.8	10.9	104	105	0.8	0.8	157	150	21	25	6.9	7.0	3.5	3.5	3.4	3.5
43	6.4	6.8	93	96	1.0	0.9	141	150	25	24	6.0	7.2	3.4	3.8	2.6	3.4
44	10.7	10.9	93	102	0.9	1.0	155	157	28	29	6.9	7.1	3.6	3.7	3.3	3.4
45	11.5	12.0	111	106	1.3	1.2	167	168	27	26	7.0	7.8	3.9	4.1	3.1	4.7
46	11.9	12.0	97	100	0.8	0.9	137	140	22	26	7.0	7.4	3.5	3.9	3.5	3.5

S.No HBB HBA BGB BGA CB CA CHB CHA UB UA TPB TPA ALB ALA GLB GLA

47	6.3	7.0	98	110	1	1.2	1.1	152	155	26	28	7.2	7.4	3.8	3.5	3.4	3.9
48	10.7	11.0	89	95	1	1.0	1.1	157	150	22	26	7.0	7.2	3.6	3.9	3.4	3.3
49	9.1	9.8	113	110	1	1.1	1.2	134	137	30	32	7.2	7.2	4.0	3.8	3.2	3.4
50	8.3	9.6	128	125	2	1.0	0.9	154	150	23	24	7.0	7.5	3.6	3.9	3.4	3.6
51	11.1	11.1	109	101	1	0.9	1.0	180	174	21	26	6.9	7.2	3.6	3.8	3.3	3.4
52	10.5	11.5	99	110	2	0.7	0.8	142	143	22	26	6.9	6.9	3.7	3.5	3.2	3.4
53	9.9	10.5	105	102	2	1.2	1.0	204	208	27	33	6.8	7.2	3.5	3.5	3.3	3.7
54	10.3	10.9	96	92	2	0.8	0.8	183	180	20	22	6.3	7.0	3.0	3.6	3.3	3.4
55	9.9	10.9	91	96	2	1.1	1.0	148	150	25	28	6.6	7.0	3.2	3.4	3.4	3.6
56	9.9	10.2	113	101	2	1.0	0.8	197	190	24	23	7.0	6.9	4.2	3.4	2.8	3.5
57	9.5	10.0	90	89	2	0.9	0.8	170	170	21	23	7.0	7.5	3.3	3.5	3.7	1.0
58	7.9	8.5	106	97	2	0.8	1.0	222	205	20	22	6.6	7.2	3.3	3.8	3.3	3.4
59	9.5	10.0	116	121	2	1.0	0.9	148	145	21	22	6.9	6.9	4.0	4.0	2.9	2.9
60	9.5	9.9	119	117	1	0.8	0.9	145	147	26	29	6.8	6.9	3.5	3.5	3.3	3.4
61	8.6	8.8	72	79	2	1.1	0.8	206	197	29	30	6.7	7.8	3.8	4.9	2.9	2.9
62	10.1	11.5	85	84	2	1.2	0.8	160	166	26	28	6.5	6.3	3.4	3.4	3.1	2.9
63	9.1	11.3	96	94	1	1.2	1.1	156	160	23	28	6.7	7.0	4.1	4.2	2.6	2.8
64	10.3	11.8	83	88	2	1.0	0.9	210	206	25	29	6.8	7.1	4.0	3.8	2.8	3.3
65	12.3	12.3	84	89	2	1.0	0.7	165	159	27	23	6.6	7.0	4.2	4.3	2.4	2.7
66	9.0	9.8	92	95	2	1.2	1.1	182	187	24	24	6.7	7.2	4.0	4.1	2.7	3.1
67	9.7	11.0	83	96	2	0.8	0.9	189	178	27	26	6.8	6.9	4.2	4.9	2.6	2.0
68	7.1	9.3	92	97	2	1.0	0.8	202	197	26	29	6.8	7.0	4.1	4.1	2.7	2.9
69	10.3	14.5	96	98	2	1.0	0.7	189	187	25	26	6.7	7.1	3.7	3.8	3.0	3.3
70	11.0	11.5	93	90	2	1.0	1.0	213	200	26	26	6.8	7.0	4.0	4.0	2.8	3.0
71	6.9	7.8	121	107	2	1.1	0.8	210	202	19	20	6.7	7.1	4.3	4.4	2.4	2.7
72	9.5	12.0	84	94	2	0.9	0.9	182	175	21	24	6.8	6.7	4.4	4.2	2.4	2.5
73	6.9	7.7	93	97	2	0.7	0.7	180	182	22	28	6.7	6.8	4.5	4.2	2.2	2.6
74	8.9	9.8	96	94	2	0.8	0.7	238	219	24	27	6.2	6.2	4.0	3.9	2.2	2.3
75	8.9	10.3	98	99	2	1.0	1.0	191	197	27	27	6.9	7.5	4.4	4.6	2.5	2.9
76	8.3	12.0	99	90	2	1.0	0.9	226	214	28	27	6.6	7.4	3.8	4.4	2.8	3.0
77	8.7	9.8	93	112	2	1.1	0.8	228	220	28	24	6.5	7.3	3.9	4.1	2.6	3.2
78	8.4	9.0	102	110	2	0.9	0.9	200	192	20	22	7.0	7.6	4.2	4.4	2.8	3.2
79	9.8	10.3	98	102	2	0.8	0.8	183	180	22	24	6.3	6.8	3.5	3.6	2.8	3.2
80	9.0	10.1	104	109	2	0.7	0.8	198	191	25	23	6.7	7.2	3.8	3.7	2.9	3.5
81	10.8	11.9	123	120	1	1.0	1.0	156	148	27	27	6.5	7.1	6.5	4.0	3.0	3.1
82	8.8	9.2	108	115	2	0.9	0.9	211	209	31	33	6.8	7.4	3.4	4.0	3.4	3.4
83	9.1	9.8	100	111	2	0.9	0.8	206	210	20	23	6.6	7.0	3.6	4.0	3.0	3.0
84	8.9	8.8	99	106	2	0.9	0.9	177	170	28	31	6.4	7.2	3.4	3.6	3.0	3.6
85	10.0	10.8	113	119	2	1.0	1.0	199	185	31	30	6.8	7.3	3.8	4.0	3.0	4.3
86	11.6	12.0	101	107	1	1.1	1.2	186	180	30	32	6.4	7.5	3.9	4.1	2.5	3.4
87	9.0	10.0	128	123	2	0.9	0.9	190	180	22	26	7.0	7.5	4.0	4.9	3.0	2.6
C. 88	11.5	10.7	93	88	1	1.2	1.3	142	138	35	38	6.9	7.0	4.3	3.9	2.6	3.1
89	10.3	10.7	112	116	2	1.2	0.9	210	214	39	40	6.9	7.3	4.0	3.9	2.9	3.4
90	10.0	10.0	107	110	2	0.8	0.7	199	201	29	28	6.2	6.2	3.9	3.8	2.3	2.4
91	9.5	9.5	105	120	1	1.1	1.1	231	226	34	31	7.0	6.9	4.0	3.6	3.0	3.3
92	9.0	9.5	98	96	2	1.2	1.2	185	180	37	33	6.6	6.2	4.0	3.8	2.6	2.4
93	8.7	8.8	108	102	2	0.7	0.7	192	198	36	35	6.5	6.5	4.1	4.0	2.4	2.5

S.No	HBB	HBA	BGB	BGA	CB	CA	CHB	CHA	UB	UA	TPB	TPA	ALB	ALA	GLB	GLA	
94	11.5	12.3	99	99	1	1.0	1.0	237	230	27	30	6.6	7.0	4.0	3.9	2.6	3.1
95	9.3	9.5	101	100	2	1.0	1.0	190	195	32	30	6.7	6.3	4.3	4.1	2.4	2.2
96	11.5	11.5	137	138	1	1.0	1.1	194	194	27	25	6.6	6.5	4.2	4.1	2.4	2.4
97	9.5	9.4	86	88	2	0.7	0.7	156	160	30	31	6.5	6.5	4.0	4.1	2.5	2.4
98	9.2	9.0	98	95	2	0.6	0.8	175	178	36	32	7.0	6.8	4.4	4.1	2.6	2.7
99	14.1	14.0	91	100	2	0.9	0.7	215	215	28	27	6.8	7.0	3.7	4.2	3.1	2.8
100	9.9	9.0	110	107	2	1.2	1.2	163	165	27	20	6.4	6.3	3.9	3.8	2.5	2.5
101	11.5	11.0	100	97	2	1.0	1.0	178	181	23	23	6.7	6.9	3.7	4.1	3.0	2.8
102	10.4	10.4	99	101	2	1.0	1.0	184	184	22	22	6.6	6.9	4.0	4.0	2.6	2.9
103	10.9	11.1	124	114	2	1.2	1.2	183	195	24	20	6.6	6.0	3.8	3.6	2.8	2.4
104	9.9	10.0	107	110	1	1.0	1.0	162	160	25	28	6.7	6.8	3.8	3.9	2.9	2.9
105	7.9	8.3	100	98	1	1.0	1.1	158	166	28	28	6.8	6.8	3.9	3.8	2.9	3.0
106	9.8	9.5	111	108	1	0.9	1.0	156	152	28	30	6.6	6.1	4.1	4.0	2.5	2.1
107	10.4	10.1	92	95	1	1.1	1.2	152	150	22	20	6.4	6.1	3.9	3.8	2.5	2.3
108	11.1	10.7	83	89	1	1.2	1.2	174	180	30	25	6.1	6.1	3.7	3.8	2.4	2.3
109	10.1	10.1	92	95	1	1.0	1.1	167	171	29	25	6.6	6.5	3.5	3.5	3.1	3.0
110	9.9	10.1	129	129	1	1.2	1.3	231	225	32	29	7.0	7.0	4.0	7.0	3.0	3.0
111	10.1	9.9	117	110	2	1.0	1.0	181	191	27	25	6.9	7.0	3.6	3.7	3.3	3.3
112	9.9	9.9	111	116	2	1.0	1.2	174	179	39	35	7.0	7.2	3.7	3.8	3.3	3.4
113	10.1	10.2	134	128	2	0.9	1.0	277	275	29	26	7.0	6.8	4.0	3.9	3.0	2.9
114	10.4	10.2	101	93	2	1.1	1.1	180	186	24	26	6.8	6.8	3.9	4.0	2.9	2.8
115	11.9	11.9	108	116	1	1.1	1.1	224	230	38	40	7.0	7.2	3.9	4.2	3.1	3.0
116	11.2	11.0	76	78	1	1.0	1.1	138	147	24	24	6.9	6.9	4.0	4.2	2.9	2.7
117	12.1	12.1	77	75	2	1.1	1.2	183	183	23	23	6.7	6.9	4.2	4.3	2.5	2.6
118	11.9	11.5	93	96	1	1.2	1.2	172	180	32	29	6.5	6.8	4.3	4.2	2.2	2.6
119	12.4	12.0	97	100	1	1.0	1.0	139	140	26	24	6.8	6.6	4.0	3.8	2.8	2.8

Note :

Before supplementation

HBB - Heamoglobin (g/dl)

BGB - Blood Glucose (mg/dl)

CB - Creatinine (mg/dl)

CHB - Cholesterol (mg/dl)

UB - Urea (mg/dl)

TPB - Total Protein (g/dl)

ALB - Albumin (g/dl)

GLB - Globulin (g/dl)

After supplementation

HBA - Heamoglobin

BGA - Blood Glucose

CA - Creatinine

CHA - Cholesterol

UA - Urea

TPA - Total Protein

ALA - Albumin

GLA - Globulin

S. - Supplemented
C. - Control