INTRODUCTION

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Aging is a process of deterioration in the functional capacity of a body that occurs after maturity resulting from structural changes. It is also a marker of the inability of the individual to restore homeostasis when given challenge. (Selvamurthy et al 1999). Aging is a gradual and steady process which takes place over the entire life span of a human.

The transition from adulthood to old age is often perceived as a process of loss, physiologically and psychologically. However, it is not yet clear just how much of this change is biologically determined and how much is a function of psychosocial factors. Age related changes in the body composition, organ function, physical performance and cognition will occur in all. In addition, this is the time when the effects of detrimental environmental exposures and unhealthy lifestyle accumulated throughout the life time, manifests.

During recent years, a massive numerical increase in the elderly population has taken place and this trend is likely to continue undiminished into future. Aging of nations, commonly known as "greying of nations" is undoubtedly the most challenging problem in the next millennium. One of the main features of the world population in the 21st century has been a considerable increase in the absolute and relative numbers of older people in both developed and developing countries.

India, like all the other developing countries, is in the pre-middle era of demographic transition. The members above the age of 60 in 1901 were 12 millions which grew to 20 million in 1951, 45 million in 1981 and 53 million in 1990. The number of aged above 60 years is likely to cross 71 million by the end of this century. By 2020, there would be 142 million Indians aged 60 years and over (WHO Press Release 1998).

Since geriatric population might form a significant proportion of our total population in coming decades, multi-dimensional problems by them in our setup need special consideration. These problems are not exclusively the problems of social, cultural and economic ramifications but include health and medical problems that affect the life of the community as well. Various degenerative processes start occurring with age leading to deficiencies and deformities or other disorders. With advancing age, there is a reduced vitality and increased vulnerability to common diseases both acute as well as chronic. Diseases that are commonly found in this age

are cancer, heart ailments, diabetes mellitus, respiratory tract disorders, bone and joint disorders along with disabilities of vision and hearing.

Nutritional problems are especially prevalent in the elderly. Inadequate nutrition ranks as one of the major problems of old age. The elderly become vulnerable to malnutrition and ill health owing to their economic dependence, social deprivation and change in behaviour towards diet and health care. The physiological and structural changes during aging process may also greatly affect not only functions of mastication, digestion and absorption but also those of nutrient metabolism.

Social and demographic changes that accompany urbanisation has increased the nutritional risk for this group making them vulnerable to deficiencies that further aggravate chronic conditions. Moreover, with advancing age, there is reduced food intake making the vulnerable prone to various diseases.

Gray et al (1991) reported that the percentage of diet by the elderly was below 2/3 rd of the recommended dietary allowances in a survey conducted on 82 healthy free living subjects from US. A similar trend was reported by Gambhir et al (1996) among free living elderly of middle income group, though protein, calcium and vitamin A intakes were comparatively higher. A significant decline in energy, iron, thiamine, β-carotene and total vitamin A intakes with increase in age was also reported.

Studies on diet, nutrition and health profile of free living and hospitalised elderly subjects were also carried out by Mehta et al (1996) in the department of Foods and Nutrition, M.S.University of Baroda. In these studies, aging per se showed distinct differences in food preferences, dietary intake, nutritional status and disease profile from decade to decade thereby leading to gross dietary inadequacy in geriatric men and women.

Studies on hospitalised geriatric patients also showed deteriorated diet profile which would have direct influence on their recovery from grave illnesses. In these studies, very few patients could meet more than 75 % of the RDA for all the nutrients (Shringarpure and Mehta 2000).

Groot et al (1999) examined energy intake of 486 men and 519 women aged 74 - 79 years, participating in SENECA (Survey in Europe on Nutrition and the Elderly, a Concerted Action) study in relation to the adequacy of micronutrient intake. There was an inadequate intake of one

or more nutrients in 24 % of elderly men and 47 % of elderly women. Iron and riboflavin accounted for most of the inadequacies.

In recent years, numerous studies have been conducted to ascertain critically and scientifically the role of various nutrients which in some way or the other delay the process of aging. It has been recognised for many years that calorie restriction was the most effective nutritional regimen for delaying the aging process in laboratory animals. This, in turn, was associated with reduced prevalence of chronic diseases at older ages (McCay et al 1939, 1941). Similar findings were also reported by Yu et al (1982) wherein 50 % increase in the life span was observed in rats because of calorie restriction. It is, therefore, important to probe the linkage from a different angle - not what the aging process imposes on dietary intake and the resulting nutrient status, but "can a particular diet or specific nutrients delay the aging process and in turn avoid the onset of chronic degenerative diseases ?" To get an answer to this question, it is very essential to understand when aging process starts.

Though aging is a phenomenon which is genetically programmed, external factors such as environment, lifestyle factors modify the aging process significantly. As there is a constant dynamic balance between the regenerative and degenerative forces throughout the life span, the exact moment at which the aging process starts is still unknown. Hence, various theories have been proposed to understand aging process. Among them, the well accepted theory refers to the increased levels of free radicals which was proposed by Harman (1956). The basic idea behind this theory was the assumption that aging results from the random deleterious effects of the tissues brought about by free radicals that are produced in the course of cellular metabolism. Free radicals are molecules that contain one or more " unpaired " electron (Mehlhorn 1994).

During various metabolic processes, oxygen acts as a terminal electron acceptor and is eventually converted to a more stable state, water. However, reduction of oxygen is frequently incomplete; even under normal conditions and a series of reactive chemical intermediates also called "reactive oxygen species" (ROS) or "active oxygen" are produced (Sinclair et al 1991). Since oxygen is the compound which is used for all the metabolic processes, it is the most susceptible to the formation of free radicals. These free radicals include :

- Hydroxyl radical, OH^-
- Superoxide radical, O_2^-
- Nitric oxide radical NO^-

- Lipid peroxyl radical LOO^-
- Hydrogen peroxide H_2O_2
- Singlet oxygen O_2

Free radical formation occurs continuously in the cells as a consequence of both enzymatic and non - enzymatic reactions. The sources for these enzymatic and non - enzymatic reactions can be internal as well as external. Some internally generated sources of free radicals include mitochondria, phygocytes, xanthine oxidase, reactives involving iron and other transition metals, arachidonate pathways, peroxisomes, exercise, inflammation, ischaemia / reperfusion (Langseth 1996). Externally generated sources of free radicals are cigarette smoke, environmental pollutants, radiation, ultraviolet light, certain drugs, pesticides, anaesthetics, industrial sovlents and ozone (Langseth 1996). Enzymatic reactions also include deliberate synthesis of reactive oxygen species as phagocytes to neutralise viruses and bacteria.

If free radicals are not inactivated, their chemical activity can pose considerable hazard to biological systems and can damage all cellular macromolecules including protein, carbohydrates, lipids and nucleic acid. Biological organisms have the capacity to minimise such adverse chemical reactions or to repair the damage or to compensate for its effects (eg., by replacing an irreversible damaged cell with a new cell). However, no repair system or compensatory mechanism can be absolutely efficient if the damage to the macromolecules is so random that they are altered in virtually limitless variety.

The damage to cellular macromolecules due to free radicals reactions produce adverse changes. These changes are expected to get accumulated with age throughout the body. Such "normal" changes with age are relatively common to all. However, superimposed on this common patterns are patterns influenced by genetics and environmental differences that modulate the free radical damage. These are manifested as diseases at certain ages. Destructive effects of free radicals on proteins may play a role in the causation of cataracts; free radical damage to DNA is implicated in the causation of cancer while its effects on LDL cholesterol is very likely responsible for heart disease. Oxidative processes have also been implicated in the causation of both cataract and age related disorder of retina - maculopathy along with certain neurological disorders like parkinson's disease. (Puri 1999)

Biological systems have evolved a multiplicity of defences against oxidative attack. The various defences are complementary to one another because the antioxidants act on different oxidants as well as in different compartments. An antioxidant is a stable enough molecule to donate an electron to a rampaging free radical and neutralise it, thus reducing its capacity to damage (Puri 1999). These antioxidants defence is achieved both by enzymatic and by non-enzymatic reactions.

Enzymatic antioxidants mainly include glutathione peroxides, superoxide dismutase and catalase. Superoxide dismutase are a family of antioxidant enzyme which are important in the catalytic decomposition of the superoxide radical to hydrogen peroxide and oxygen. (Langseth 1995). Catalase specifically catalyses the decomposition of hydrogen peroxides. (Langseth 1995). Glutathione peroxidases also act on hydrogen peroxide. The most active form of this enzyme contain selenium. (Langseth 1995).

Nutrition plays a key role in maintaining the body's enzymatic defences against free radicals. Several essential minerals including selenium, copper, manganese and zinc are involved in the structure or catalytic activity of these enzymes. If the supply of these minerals is inadequate, enzymatic defences may be impaired (Langseth 1995).

A second line of defence is small molecular weight non-enzymatic antioxidants; that is, they react with oxidising chemicals reducing their capacity for damaging effects. These antioxidants like vitamins and other micronutrients or even non-nontrient components like phytochemicals especially flavonoids and phenolic compounds (Puri 1999).

Although a wide variety of antioxidant in foods contribute to disease prevention, the bulk of research has focussed on three antioxidants which are essential nutrients or precurssor of nutrients - vitamin E, vitamin C, and β-carotene.

Vitamin E is a generic term used to describe eight compounds - four tocopherols and four tocotrienols. Vitamin E is a principle lipid soluble antioxidant in the body and protects polyunsaturated fatty acids in the cell membrane from peroxidation. It is a potent chain breaking antioxidant, scavenging free radicals and terminating free radical chain reactions (Burton and Traber 1990).

differ widely as compared to the western countries, it becomes necessary to study the inter-relationship between various antioxidants and development of chronic degenerative disease in Indian elderly.

Thus, in light of this background the present study has been planned with the central objective to assess the role of antioxidants in health and disease during aging process.

With increase in age, the elderly become more susceptible to physical disabilities and mental incapacities. Factors such as cultural patterns, level of socio-economic status, environment and social attitudes of the community play a vital role in the physical and mental well being of the aged.

Socio economic factors in terms of age, gender, economic status and education have been shown to exert profound influence on the aging, diet, nutrition and morbidity profile (Bali 1997). The present day lifestyle also exacerbates the situation making the elderly more prone to chronic diseases. Hence, in view of this, the present study aims to assess the socio-demographic attributes of the subjects.

Cardiovascular diseases (CVD) is the leading cause of death in the world today (Padmavati 2000). According to the WHO (2002), it has been estimated that in 2001, 17 million people died of CVD of all types. The most important causes were ischemic heart disease (IHD), hypertension and rheumatic heart disease (RHD). The projections made by Global Burden of Disease study indicates that developing countries would contribute 13 - 8 % of the CVD burden (Reddy 1999). Population based survey in India reported 10 % incidence of IHD (Reddy and Yusuf 1998).

Atherosclerosis, a chronic inflammatory disease of the arterial wall, is the major cause of morbidity and mortality from cardiovascular disease (CVD) in much of the world's population. It is a complex process involving the deposition of plasma lipoproteins and the proliferation of cellular elements in the artery wall. This chronic condition advances through a series of stages beginning with fatty streak lesions composed largely of lipid-engorged macrophage foam cells and ultimately progressing to complex plaques consisting of a core of lipid and necrotic cell debris covered by a fibrous cap (Ross 1993).

Oxidative reactions have been implicated in the progression and possibly the initiation of CVD. Oxidatively modified low density lipoproteins (ox-LDL) have been shown to be more atherogenic than native LDL, resulting in excessive lipid accumulation and formation of foam cells in the intima of the arterial wall (Witztum and Steinberg 1991). LDL is an important target of free radicals, and oxidation of LDL is believed to be an important event in development of atherosclerosis (Sato et al 1990).

Over the past decade, a large body of experimental and epidemiologic data has indicated that dietary antioxidants might reduce the risk of atherosclerosis. Although the antioxidant defense system includes both endogenously and exogenously (diet) derived compounds, dietary antioxidants including vitamin C, vitamin E (α-tocopherol) and β-carotene have received the greatest attention with regard to cardiovascular disease prevention. α-Tocopherol and β-carotene have been of particular interest because both are carried within LDL particles.

Vitamin E, mainly α-tocopherol, is the major fat - soluble antioxidant present in the LDL particle. On average, 5-9 vitamin E molecules are carried by each LDL particle. The reduction of oxidative stress and inhibition of LDL oxidation by vitamin E are thought to be the major actions for which it has received considerable attention as a health benefit in reducing the risk of CVD. Vitamin E in LDL particles acts as a chain breaking antioxidants and prevents lipid peroxidation of polyunsaturated fatty acids and modification of proteins in LDL by reactive oxygen species (ROS) (Carr et al 2000).

An inverse association of dietary vitamin E and risk of coronary disease (RR=0.79) was reported by Rimm et al (1993) in a study carried out on 17916 US Male Health Professionals aged 40 - 79 years. Similar finding was also reported by Kushi et al (1995) in Iowa Women's Health Study carried on 19,687 women aged 55 - 69 years. Vitamin E intake from food was found to be inversely associated with cardiac events (RR = 0.38) in these women.

Studies have also been carried out to find the protective effect of β-carotene against cardio vascular diseases. Rimm et al (1993) observed a significal lower association between β-carotene intake and incident of coronary heart disease in a population of 39,990 men aged 45 - 75 years participating in Male Health Professional Study.

Similarly, Gaziano et al (1995) examined the association between consumption of carotenoid containing fruits and vegetables and cardiovascular mortality among a cohort of 1299 elderly

The other chronic disease that occurs with advancing age is Cancer. Cancer is the end point of multi-step process involving a sequence of events that occur over a period of years or even decades. In this process, a single cell can develop from an otherwise normal tissue into malignancy that can eventually destroy the organism (Guyton and Kensler 1993).

Active oxygen species and other free radicals have long been known to be mutagenic. Mutagenic capacity of oxygen is due to the direct interaction of hydroxyl radicals with DNA (Parshad and Sanford 1971). An unstable radical like the hydroxyl radical will interact indiscriminately with all components of the DNA molecule, producing a broad spectrum of DNA damage.

Cancer of oral cavity is the fifth most commonly occurring cancer in the world. The term oral cancer refers to cancer found in the oral cavity and the orophaynx. The tongue is the most common site of oral cancer.

In 1996, an estimated 57500 new cancer cases were diagnosed worldwide accounting for 5.6 % of all new cancers (American Cancer Society 1997). In parts of India and Asia where chewing tobacco or betel-nut is very common, the incidence of oral cancer is very high. As much as 7 % of all cancer deaths in males and 4 % in females have been reported to be due to oral cancer. It constitutes nearly half (48.51 %) of all cancers in men and 16.01 % of all cancers in women in Gujarat (Gujarat Cancer Registry 1998).

Low intakes of fruits and vegetables have been implicated in the occurrence of oral cancer. Both prospective and retrospective studies suggest that vegetable and fruit intake may reduce the risk of cancers of mouth, phaynx, larynx, and esophagus. (Ziegler 1991). Epidemiologic evidence of a protective effect of vitamin C for non-hormone dependent cancers is strong. Of the 46 such studies in which a dietary vitamin C index was calculated, 33 found statistically significant protection with higher vitamin C intakes. (Block 1991).

Tuyns et al (1987) reported significant lower risk (RR=0.47) with dietary intake of β-carotene in 743 men and women from Calvodos, France.

Significant lower mean carotene levels for all cancers were reported in 2421 men survivors of the Basel study which was started in 1959. (Stahelin et al 1991).

A lower risk of oral and pharygeal cancer was associated with increased intake of fiber, carotene and vitamin C and vitamin E in men and vitamin C and fiber in women in a study carried out by Gridley et al (1990) on 190 subjects from United States.

With this background, it was thus thought worthwhile to assess the dietary intakes of antioxidants rich foods with respect to vitamin C, β-carotene and vitamin E along with their levels in plasma / serum in subjects with and without oral cancer.

Although heredity plays a factor, certain lifestyle habits and health conditions can increase the susceptibility to oral cancer. These include age, tobacco and ghutka chewing, cigarette / bidi smoking, alcohol consumption (Gupta and Nandakumar 1999).

Smoking has been implicated as a major risk factor in carcinogenesis. Free radicals especially nitric oxide in cigarette smoke or the production of reactive oxygen species by recruitment and activation of phagocytes may be contributory factors to cigarette smoke related diseases (Eiserich et al 1995).

High blood concentrations of α-tocopherol and β-carotene have been prospectively shown to be associated with low incidences of several cancers (Gey 1993; Comstock et al 1992; Woodson et al 1999).

Convincing evidence have also been shown that a high alcohol intake is a strong risk factor for malignancies of the mouth, pharynx, larynx, esophagus and liver with lower intakes of dietary antioxidants vitamin. (American Institute for Cancer Research 1997). Epidemiological studies have shown that ascorbic acid has a protective effect against cancer such as oropharyngeal neoplasms (Chan and Reade 1998).

No evidence or harmful effects of β-carotene on cancer in the physician health study was observed (Hennekens et al 1996) inspite of earlier controversy regarding the role of β-carotene in increasing the risk of lung cancer (Heinonen and Albanes 1994). Hence, with this in mind, it was thought worthwhile to study the antioxidants profile in subjects with and without oral cancer.

The non - nutrient antioxidants are consumed daily often at concentrations far exceeding nutritional antioxidants. These compounds are mainly polyphenolics especially flavanoids,

phenolic acids, anthocyanidins etc (Deckar 1995). Flavonoids and other polyphenols belong to the group of phytochemicals. Research of flavonoids received added impulse with the discovery of the "French Paradox". Epidemiologic studies suggest a protective role of dietary flavonoids against coronary heart disease (de Groot and Rauen 1998). An important effect of flavonoids is the scavenging of free radicals. In vitro experimental systems also showed that flavonoids possess anti-inflammatory, antiallergic, antiviral, and anticarcinogenic properties (Middleton 1998). Thus, an attempt was also made to study the frequent consumption of vegetables in non-nutrient component in the present study.

Life style factors in terms of physical activity is also an important component in the polyfactorial mix of elements that effect the morbidity and mortality of older population. Aging is commonly characterised by a progressive decline in both occupational and leisure time activity (Montogue 1985).

Decline in action may lead to an increase in total body weight and may be partially responsible for the increased prevalence of chronic diseases that accompany aging (La Porte et al 1984).

There is some data to show that physical activities have a beneficial effect. Sedentary living habits have been reported to increase the risk of several chronic diseases (Peffenbarger 1984; Albanese 1989; Lean 1987). Thus, the present study also aimed to assess the activity pattern of all the subjects with and without diseased conditions.

Existing knowledge about nutrition and aging suggests that nutrition has the power to make a substantial impact on the health and functional status of older individuals. The size and rapidity of the ongoing demographic and nutrition transition demand that nutrition for aging adults receive equal priority in a family. Social changes are also placing the elderly at even greater risk of food insecurity and malnutrition. This burden of undernutrition and chronic diseases poses a tremendous challenges for the care givers of the elderly. Various types of nutritional deficiences and co-morbidities occur in elderly even if they are staying in a joint families. This is basically because there is no change in the dietary habits of the elderly with advancing age. They continue to take the same diet as they were used to during their adulthood years. Moreover, in a joint family system, food preferences common to all are considered. Elderly tend to eat what is cooked for the whole family. It thus becomes important to educate the care giver with respect to the physiological changes taking place in old age and importance of micronutrients especially dietary antioxidants in preventing deficiences and chronic diseases. However, before targetting

the care givers for any intervention programs, it is necessary to assess their existing knowledge about importance of diet in old age and to know if they are able to put that knowledge into practice. This will help to plan the intervention program in more detail as the investigator can concentrate to emphasis only on those areas. Hence, keeping this in mind, an attempt was made to assess the knowledge and practices of the care givers of the elderly with respect to importance of diet and nutrition during old age.

Thus, in light of this background, the broad objective of the study was to assess the role of antioxidants in health and disease during aging process. The specific objectives were as given below:

1. **To collect information on local adult and elderly population with respect to**
   A. Socio-demography
   B. Nutritional status
   C. Dietary pattern
   D. Lifestyle related factors.
   E. Disease profile
   F. Antioxidants profile in diet as well as from blood.

2. **To collect information on adult and elderly population suffering from cardiovascular diseases (CVD) with respect to**
   A. Socio-demography,
   B. Nutritional status
   C. Dietary pattern
   D. Lifestyle related factors.
   E. Disease profile
   F. Clinical profile.
   G. Antioxidants profile in diet as well as from blood

3. **To collect information on adult and elderly population suffering from oral cancer with respect to**
   A. Socio-demography,
   B. Nutritional status
   C. Dietary pattern
   D. Lifestyle related factors.

E. Disease profile

F. Oral hygienic practices

G. Clinical profile.

H. Antioxidants profile in diet as well as from blood.

4. **To study the inter-relationship of various factors in health and disease.**

5. **To study the knowledge and practices (KAP) of the caregivers with respect to the antioxidant rich foods and overall health care of the elderly.**

The literature related to the present study has been reviewed in the next chapter.