NUTRITIONAL ASSESSMENT OF ELDERLY PATIENTS WITH ACUTE MEDICAL ILLNESS PRESENTING TO A TERTIARY CARE HOSPITAL IN SOUTH INDIA - A CASE CONTROL STUDY

A Dissertation submitted in part fulfillment of M.D. Branch-1

(General Medicine) examination of the Tamilnadu

Dr.M.G.R. Medical University, Chennai to be held on

March 2009.

CERTIFICATE

This is to certify that the dissertation entitled ***"Nutritional assessment of elderly patients with acute medical illness presenting to a tertiary care hospital in south India – A case control study"*** is the bonafide original work of Dr. Ramdinpuia towards the M.D. Branch-1 (General Medicine) Degree Examination of the Tamil Nadu Dr. M.G.R University, Chennai to be conducted in 2009.

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ABSTRACT

Title: Nutritional assessment of elderly patients presenting with acute medical illness - a case control study.

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Objectives of the study:

To evaluate the nutritional status of elderly patients afflicted with acute medical illness and to ascertain if there is a correlation between malnutrition and acute medical illness among the elderly.

Methods:

50 elderly patients of age 60 years or more presenting with acute medical illnesses, with onset of illness within 7 days were enrolled into the study and compared with 50 community dwelling elderly controls. The evaluation included clinical and laboratory evaluation of their nutritional status. Nutritional status was assessed using the mini nutritional assessment scoring system and anthropometric data like weight, height and mid arm circumference. Patients were followed up till they were discharged. The associations between malnutrition and acute medical illnesses were analyzed using the SPSS version 16 for windows to identify which factors were risk factors for acute medical illnesses among the elderly patients.

Results:

50 subjects were enrolled during the 8 months from January 2008 to August 2008. 24 % of the elderly patients with acute medical illnesses (cases) were malnourished compared to 2 % among the community dwelling elderly people (controls), as assessed by the mini nutritional assessment. 14% of the cases and

2 % of the controls were found to be at risk for malnutrition. The mean age among the cases was 69 ± 6.8 years, and the mean age among the controls was 65.5 ± 5.4 years. Cases were 4.5 times more likely (95% CI = 1.6-12.5) to have be malnourished (mini nutritional assessment - malnutrition indicator score of less than 17) as compared to the controls. The cases were also 7.5 times more likely (95% CI = 1.5-52.3) to be at risk for malnutrition (Mini Nutritional Assessment - Screening score of less than 12) as compared to the controls. The elderly patients with acute medical illnesses were 5.3 times more likely (95% CI = 1.1-25.8) to have mid arm circumference of less than 12 centimeters, and 65 times more likely (95% CI = 8.3-508.6) to have low serum albumin of less than 3.5 mg% as compared to the controls. The cases also had more co-morbidities ($p < 0.001$) and were on more number of drugs ($p < 0.001$) and also on more number of different types of drugs (mean numbers of drugs taken: 4.7 ± 1.6 by cases, 1 ± 1.7 by controls. $p < 0.001$), as compared to the controls. Infection was the commonest reason for admission among the cases. Cases with a low Mini Nutritional Assessment - Screening score had a poorer outcome in terms of discharge status (p 0.002) than cases with normal score. There was no correlation between individual anthropometric measurements and serum albumin to outcome among the cases.

Conclusion

Malnutrition, as assessed by Mini Nutritional Assessment, mid arm circumference, and serum albumin is strongly associated with acute medical

illness among the elderly. Polypharmacy and having more co morbidities were also associated with acute medical illness among the elderly. Malnutrition, as assessed by Mini Nutritional Assessment is also associated with poorer outcome among elderly patients admitted with acute medical illness.

INTRODUCTION

One of the major features of demographic transition [1] in the world has been the considerable increase in the absolute and relative numbers of elderly people. This has been especially true in the case of developing countries like India, where the decline in fertility rates has combined with an increase in the life expectancy of people achieved through medical intervention. The prevalence of disability increases with ageing, and there will be an urgent need to extend assistance to the elderly, especially the older individuals among the elderly.

Malnutrition is a disorder of nutritional status that results from undernutrition (energy restriction). Prolonged energy restriction results in depleted nutrient stores, leading to the impairment of physiologic or biochemical processes and subsequently to cellular or tissue deterioration, which in turn may lead to acute and chronic disease.

Malnutrition is common among the elderly and the prevalence of malnutrition differs according to health status and living conditions. The prevalence of malnutrition has been estimated with a wide variation in the prevalence of malnutrition of institutionalized elderly people, and is estimated to be 25-60% in the institutionalized patients, and 35% to 65% of hospitalized patients [13, 14]. Estimates for community-dwelling older persons are generally lower, though they have been studied less extensively [15, 16, 17, 18] and are estimated to be 1-15% in the free living elderly. In a study conducted in western India, the overall prevalence of frank malnutrition was 7.1% in community dwelling elderly. Most of the elderly (50.3%) were at risk of malnutrition and less than half of the elderly (42.6%) were fulfilling the criteria of normal nutritional status. [23]

Increased morbidity and mortality in community-dwelling and hospitalized elderly are linked to poor or marginal nutritional status. [116. 117. 118] The detrimental consequences of these persisting nutritional deficits appear to be substantial as selected multiple indices of malnutrition including hypoalbuminemia, and low BMI, have been associated with multiple adverse outcomes that include increased length and duration of hospital stay, complications, readmissions, number of falls, functional limitation, and mortality. [129, 130, 131, 132, 133, 134] There have been several studies which have shown that poor nutrition does lead to complications during hospitalization and increases mortality. [156. 157, 158, 159, 160, 161] They also have a significantly higher risk of dying within a year of hospitalization than those with adequate nutrition. [162]

Relationship between acute illnesses and malnutrition has not been studied extensively, especially in developing country such as India. In a study conducted among 837 elderly patients admitted with subacute illnesses, Almost one-third (29%) of the subjects were malnourished and almost two-thirds (63%) were at risk of malnutrition. Thus, >91% of subjects admitted to subacute care were either malnourished or at risk of malnutrition. [154]

The reasons for the high prevalence of malnutrition in patients hospitalized for an acute illness include poor recognition and monitoring of nutritional status [109, 128, 163, 164] Because the signs of undernutrition may not be adequately addressed during a stay in an acute-care hospital [169], inadequate nutrition is often present at hospital discharge.

Little is known about the older patients' mortality and morbidity risks with acute medical illness associated with malnutrition in India. This study was undertaken to assess the nutrition in acutely ill elderly patients at the time of

admission to a tertiary hospital in South and to establish the relationship, if any, between nutritional status and clinical outcome, and also establish if, there is relationship between malnutrition and acute medical illness in the elderly.

AIM

TO EVALUATE THE NUTRITIONAL STATUS AND OUTCOME AMONG ELDERLY PATIENTS WITH ACUTE MEDICAL ILNESSES IN A TERTIARY CARE HOSPITAL IN SOUTH INDIA.

OBJECTIVES

1. To determine nutritional status of elderly patients admitted with acute medical illness with onset of illness within 7 days as compared to community dwelling elderly people.
2. To determine the clinical and demographic profile of elderly patients with onset of illness within 7 days admitted with acute medical illness.
3. To assess the factors affecting the outcome of these patients with respect to nutritional status.

REVIEW OF LITERATURE

GERIATRIC POPULATION – AN INCREASING POPULATION

As a proportion of the total population, the geriatric population all over the world has been steadily increasing over the decades. This rapid growth of the population of the elderly is a challenge to the medical profession, the administration and society. Elderly people suffer from a variety of problems which are increasingly drawing the attention of the Government and the public.

One of the major features of demographic transition [(1)] in the world has been the considerable increase in the absolute and relative numbers of elderly people. This has been especially true in the case of developing countries like India, where the decline in fertility rates has combined with an increase in the life expectancy of people achieved through medical intervention. Well being of the older person has been mandated in Article 41[(2)] of constitution of India, which directs that the State shall within the limits of its economic capacity and development make effective provision for securing the right to public assistance in case of old age.

Almost 60 % of the elderly people of the world live in the developing world, and this proportion has been rising steadily, with a projected rise to 70% by 2010. Not only this, but it is also known that this elderly population itself is ageing, with the oldest old being more than 10% of the world's elderly [(3)]. According to the 1991 census, India had 60 million elderly of more than 60 years old, which is about 6.7% of the total population, up from the 5.97% in 1971 and 6.32% in 1981 respectively. The %age of elderly is now higher in rural than in urban areas. [(7)] The number of elderly is likely to reach around 120 million by 2031 (EPW Research Foundation; 1994) which is a projected growth of around 140%. The decadal rates of growth of

the elderly population in India indicate that the elderly population has exploded in the 80 plus age range; this group has experienced a growth rate of above 50% in 1981-91 compared to 32% in 1971-81.

Expectation of life at birth for males and females has increased more in recent years. In India, it is projected to be 67 years in 2011-16 for males and 69 years for females. Projections beyond 2016 made by the United Nations have indicated that 21% of the Indian population will be more than 60 years of age by 2050 [(4)] which was 6.8% in 1991. Even smaller nations like Singapore can expect a large increase in this age group (> 65 years), with a 200% increase by 2020. [(5)]

Concerns, discussions and reservations around the vulnerable and minority groups like women, farmers, the schedule castes and tribes, the landless etc have been vociferously voiced; But for the elderly, which comprises one very important vulnerable group which needs attention, it has not been so. There are few statistics to indicate the extent and depth of poverty among the elderly in India, but the few studies that are available indicate that potentially, the elderly may be one of the most vulnerable groups in terms of economy. Economic vulnerability is compounded by physical and to some extent mental vulnerability. Instead of strong family ties in India, the position of a large numbers of old persons has become vulnerable due to which they cannot take for granted that their children will be able to look after them.

The rapidly growing absolute and relative numbers of older people in countries mean that more and more people will be entering the age when the risk of developing certain chronic and debilitating diseases is significantly higher. And with the currently rising global economy slowdown and the associated rising inflation, this problem is likely to be compounded, especially in a developing country such as India which houses a large growing population of the elderly.

There have only been a few studies of the various dimensions of the elderly phenomenon in India, to mention a few would include, Irudaya Rajan *et a.l* (1999) [6] for an excellent review of the elderly situation, Irudayarajan (2001) [7]for a review of the effectiveness of social assistance for poor elderly, Reddy (1996)[8] for a review of the social security for elderly in India and Kumar (1999) [9] for the health situation of elderly women. Gupta *et al.*; 2001 [10] used the Human Development Indicator Survey of 1994-95 to analyse the health-seeking behaviour of the elderly, and concluded that income and education played key roles in determining who sought care.

Prakash *et al* [11] reported that, out of a total of 300 elderly (60+) 29.3% belonged to socio-economic class V, 24.6% and 14.6% were grouped in class II and I respectively. 48% had hypertension. Chronic Bronchitis was seen only in males (6.3%) and bronchial asthma was found in 11.5% and 18.2% males and females respectively. Musculoskeletal problems were present in 11.6% and 20% males and females respectively. Nervous system disorders were found in 8.6%. 34.7% males and 60% females had cataract. Feeling of loneliness was seen in 21.05% males and 27.3% females, followed by feeling of neglect, indicating Indian elderly are vulnerable and morbid.

The prevalence of disability increases with ageing, and there will be an urgent need to extend assistance to the elderly, especially the older individuals among the elderly.

MALNUTRITION AND THE ELDERLY

There is a geriatric continuum with older adults comprising a heterogeneous group, ranging from the very robust to the very frail individuals. With increased age, there is a decreased margin of homeostatic reserve and an increased likelihood of experiencing numerous assaults to the homeostatic balance and these in turn result in an increased risk of frailty.

The early phase of aging (55 to 65 years) is often associated with a positive energy balance and an increase in body fat which is associated with increase in morbidity, mortality, and health care costs. [28, 29, 30] In the subsequent phase of aging (after 65 to 75 years) body fat and lean body mass decrease and continue to decline with a negative energy balance. [31]

Good nutrition is important at every stage of life for maintaining good health and personal productivity, and it is especially important to the elderly because of the physiological changes that occur in the body as people age. Although aging is not a diseased state, it undeniably is a time of multiple illness and general disability. Along with the changes in the biological compositions, life style factors are also important for disorders and diseases in old age. Old age diseases are not always curable, implying a strain on financial as well as physical health infrastructure resources. However, the feeling of well-being can still override actual physical discomforts if the surrounding environment is nurturing. The nutritional status of older adults is influenced by a wide variety of socio-economic, psychological and biological factors.

Malnutrition is a disorder of nutritional status that results from undernutrition (energy restriction). Prolonged energy restriction results in depleted nutrient stores, leading to the impairment of physiologic or biochemical processes and subsequently to cellular or tissue deterioration, which in turn may lead to acute and chronic disease.

The American Society for Parenteral and Enteral Nutrition defined undernutrition as a disorder of nutritional status resulting from reduced nutrient intake or impaired metabolism. Nutritional studies do not discriminate between the two terms, malnutrition and undernutrition, and they are used interchangeably. Moreover, there is some confusion about the terminology used to express deficient nutritional status. In many studies there is no discrimination between "malnutrition" and "the risk of being undernourished" or "being at nutritional risk." While some consider being at risk of malnutrition different from actually being malnourished, as the state of being malnourished certainly is worse than being at risk of it, others believe that these two terms are one and the same [12]

Epidemiology of malnutrition among the elderly

Malnutrition is common among the elderly and the prevalence of malnutrition differs according to health status and living conditions. The link between malnutrition, weight loss, and low energy intake has been recognised as common problems among elderly residents living in institutions. The prevalence of malnutrition has been estimated with a lot of variations among the institutionalized elderly people, and is estimated to be 25-60% in the institutionalized patients, and 35% to 65% of hospitalized patients [13, 14]. Estimates for community-dwelling older persons have been generally lower, though they have not been as studied as extensively [15, 16, 17, 18] and are estimated to be 1-15% in the free living elderly. According to data collected for healthy non-smoking subjects aged 18-100 years, physical and physiologic deterioration in various systems with chronological aging are estimated to be on average about 0.5% per year [19]. In Sweden one in two of aged residents of

old people's homes were at risk of malnutrition and one in three were actually malnourished [20]

Although the prevalence of actual malnutrition is low in healthy elderly persons, the risk of malnutrition is relatively high, which points out the importance of monitoring nutritional status in all groups of elderly people. [21, 22]In a study conducted in Rajasthan, in western India, the overall prevalence of malnutrition was 7.1% in community dwelling elderly. 50.3% of the elderly were at risk of malnutrition and 42.6% of the elderly were fulfilling the criteria of normal nutrition. [23]

Causes of malnutrition among older people

Any circumstance that interferes with consumption of adequate calories, protein and other nutrients from a variety of foods increases the likelihood of malnutrition. Therefore, these specific groups of elders are more vulnerable to the multitude of life circumstances and factors that cause inadequate nutritional intake; they are more likely to become malnourished. Older persons who don't eat enough food to provide the energy and nutrients their mind/body needs to function will become malnourished. The reasons for older people eating too little food can be as simple as too little money or as complex as disease, too many medications and too dependent on others. Unlike younger adults, older persons have reduced muscle and therefore reduced protein stores that can be depleted in as little as three days when they experience trauma and can't eat. [27]

Morley and Thomas [32] attribute the "anorexia of aging" to disturbances in the ability to regulate food intake. Poor nutritional status of the elderly is attributable to multiple factors. With age, the appetite is reduced, physical activity diminishes, and fat-free body mass decreases even in the absence of overt catabolic illness.

Although labeled and categorized in many different ways, these multiple risk factors are the biological, psychological and social stressors which, in any combination, can negatively affect an elder's nutritional intake and eventually his or her nutritional and physical wellbeing. At the same time, certain diseases, conditions and medications can also affect metabolism, and when added to the "risk mix" may further hasten an older person's nutritional and physical decline on the continuum of wellness and illness.

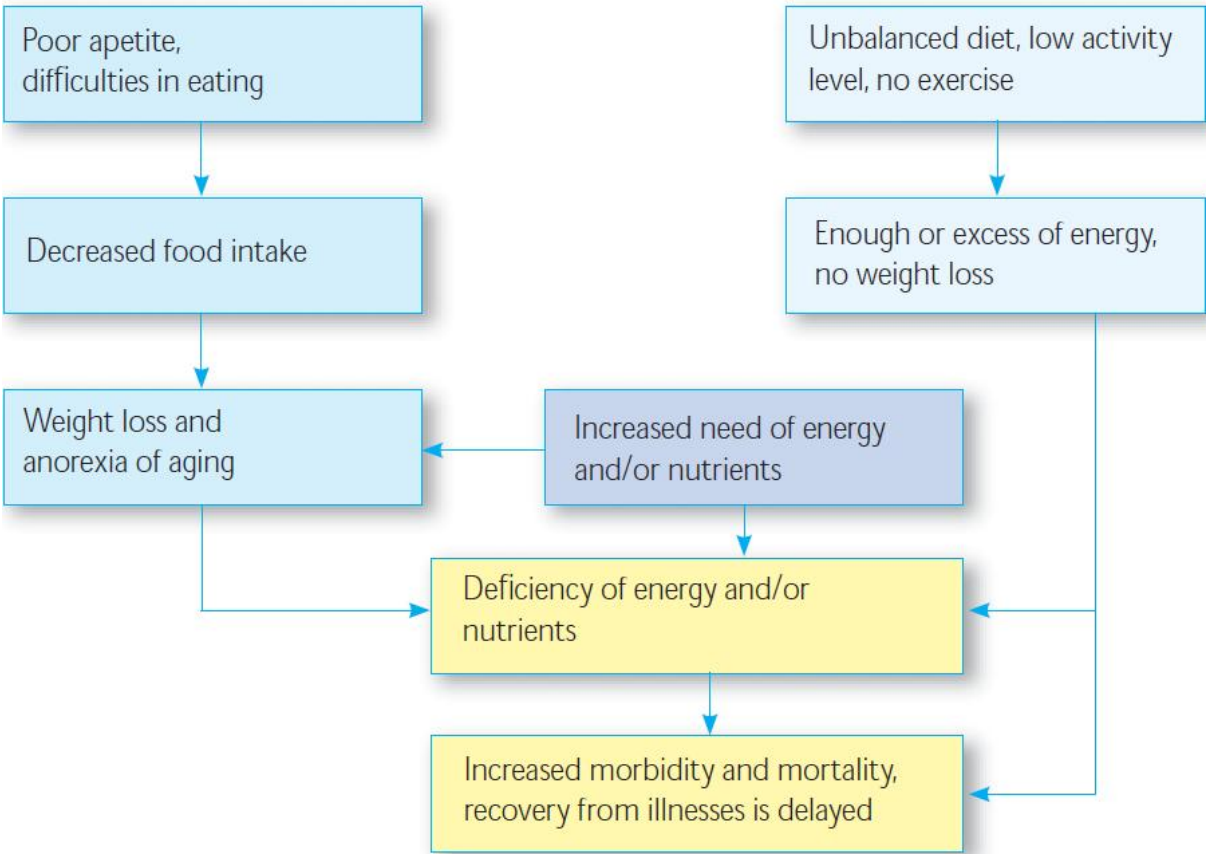

Figure 1: Paths leading to malnutrition among elderly people.

Risk factors for malnutrition among the elderly

The important risk factors associated with inadequate nutritional intake that can cause or contribute to malnutrition among the elderly are:

1. Diseases and conditions.
2. Mouth and tooth problems.
3. Unintentional weight loss.
4. Disability, functional impairment and dependency.
5. Nursing homes.
6. Chronic use of multiple medications.
7. Poverty and social isolation.

1. ***Diseases and conditions***

Certain diseases and conditions are more prevalent in older than in younger adults and often negatively impact nutritional intake which, in turn, can negatively impact nutritional status. [49, 50, 51] Physiological changes that may influence nutritional status are listed in Table 1; it is not clear whether these changes are due to normal aging or disease process.

Table 1: Changes in Organ Function with Aging that May Influence Nutrient Status

ORGAN	FUNCTION CHANGE
Taste and Smell	Decreased taste buds on tongue
	Decrease in nerve ending response to taste and smell
	Change in taste and smell threshold
Salivary Glands	Saliva flow may be reduced

Oesophagus	Minor changes that may affect swallowing
Stomach	Decreased secretion of some digestive acids and substances
	Decreased size and blood flow
	Decreased ability in breakdown of drugs and alcohol
Skin	Decreased efficiency in vitamin D synthesis

Diseases or conditions suffered by older adults are not often fatal. Four out of five adults over 65 suffer from arthritis, high blood pressure, heart disease or diabetes, with 35% suffering from three or more of these [(53)]. Older women suffering more long-term chronic disabling diseases seem to bear the brunt of impairments, while older men tend to develop relatively short-term fatal diseases [(54)].

Acute conditions (meaning severe but of short duration) that are also associated with malnutrition include infection, injury, surgery, radiation, chemotherapy and other medical therapies [(55)].

Malnutrition due to disease can be further aggravated by any increased energy and nutrient needs (resulting from fever, chronic infection and disease-related changes in metabolism) or by impaired appetite, chewing, swallowing, digestion and absorption of nutrients and it can be both a cause and an effect and its presence can further complicate the progress and outcome of any disease or condition. This is due to the serious health consequences that can result from unattended malnutrition, including decreased immunity, delayed wound healing, weight loss, decreased muscle strength, altered body responses to medications, confusion and disorientation. For some older people with weight loss from chronic

lack of appetite and malnutrition due to multiple and serious diseases, increased calories and nutrients from even the most aggressive nutritional interventions have not been successful in reversing their decline. [56, 57, 58]

Common Chronic Diseases and Conditions in Older People Associated with Malnutrition [59, 60, 61] are as follows:

- Alcoholism
- Arthritis
- Cancer
- Chronic bronchitis and emphysema
- Dental and oral disease
- Depression, dementia, Alzheimer's disease
- Gastrointestinal disorders, including maldigestion/malabsorption syndromes
- Heart disease
- Kidney disease
- Neurological disease
- Osteoporosis
- Sensory losses, e.g. hearing, smell, vision

2. ***Mouth and Tooth Problems.***

An older person's food intake is greatly affected by the condition of their mouth, teeth and oral cavity. Oral health problems commonly found in older adults include dental caries (cavities), periodontal (gum, soft tissue and bone) disease, dry mouth, tooth loss, lack of or poor fitting dentures, medication side effects, disease of the oral tissues, and pain [60]. According to the Institute of Medicine, Division of Health

Promotion and Disease Prevention of United States, around 120 physical or mental diseases produce symptoms in the mouth or affect oral function. [62]

Elders with mouth and tooth problems may eliminate foods they can no longer bite, chew, or easily swallow and those that irritate an already irritated and painful mouth. The more foods older adults eliminate from their diet, the greater their chance of developing nutritional deficiencies. These nutritional deficiencies may, in turn further impact their mouth, teeth and gums, thus setting up a potentially serious cycle of ever worsening nutritional status [63].

Normal saliva flow is necessary for oral health as it protects teeth and tissues from microorganisms, facilitates chewing and swallowing and is essential for taste. Nearly one in five older adults is said to suffer dry mouth (xerostomia), a side effect of some diseases and medications. [64] In general, elders with dry mouth may have difficulty wearing dentures, may have altered taste, and may have difficulty eating. They may also experience pain due to deteriorating mouth tissues.

Swallowing problems are common in older adults and can profoundly affect food choices. In a study of homebound elders in New York, difficulty in swallowing was positively related to not eating for one or more days [65]. Lack of assessment or lack of effective treatment of swallowing problems has been identified as avoidable causes of malnutrition in nursing home residents [66]. Overall poor oral health is associated with protein-energy malnutrition, and was found to be a good predictor of involuntary weight loss, one important indicator of poor nutritional status [67]. It is abundantly clear that oral health problems that interfere with chewing and swallowing, and thus affect food choices, will affect an elder's nutritional status [67, 68].

3. ***Unintentional Weight Loss.***

When measured by its most serious consequence, weight loss can literally become a marker between life and death. Weight loss is one of the most important and sensitive indicators of malnutrition, with both low body weight and unintentional weight loss highly predictive of death and the rate of disease in older people. [69, 70, 71] Although adults as they age experience a decline in metabolism and organ and muscle tissue, the most frequent causes of unintentional weight loss are acute and chronic illness [70,71]. An unintentional weight loss greater than 20% of a person's usual weight is associated with protein-energy malnutrition, and a weight loss of 10 to 20% over less than 6 months places a person at risk for impairment of organ functions. Experts emphasize looking at total weight loss over time, since overweight elders who experience a rapid weight loss may continue to appear overweight and still suffer from protein-energy malnutrition [72].

Recent studies confirm that depression, cancer and other diseases cause involuntary weight loss in older adults; however, in about 25% of those studied, the cause could not be identified [73, 74]. The multiple factors that cause and contribute to unintentional weight loss in older adults are often intertwined and sometimes defy separation, including:

- physical disease including cancer, gastrointestinal disorders, uncontrolled diabetes,cardiovascular disorders, alcohol addiction, pulmonary disease infection and hypothyroidism
- psychiatric disorders including depression and dementia
- inadequate energy intake
- mouth and tooth problems
- alterations in gastrointestinal tract function

- drug - drug/nutrient interactions
- functional disabilities
- socioeconomic conditions

4. Disability, Functional Impairment and Dependency

Any disease or condition that eventually affects physical strength and stamina, or thinking, reasoning and making judgements, creates higher risk for malnutrition through loss of function. The ability to shop, cook and eat are necessary functions if older persons are to care for themselves nutritionally. The incidence of disabilities that may interfere with adequate nutritional intake appears to be high among older persons discharged from hospital to home [(60)]. Therefore, for many disabled elders living at home, the ability to function with their disability becomes as important in their life as treatment for their disease. Recently hospitalized elders who were undernourished just prior to their hospitalization, were more often unable to prepare meals for themselves and needed more help for both shopping and cooking [(75)]. The common Disabling Conditions in Homebound Elders [(76)] are as follows:

- Arthritis
- Dementia
- Heart disease
- Hip fractures (post-hospitalization)
- Lung disease
- Parkinson's disease
- Stroke (post-hospitalization)

In all cases where disease or condition affects function, which in turn affects access to food, and food and nutrient intake, the question becomes does the individual have a support network adequate to compensate where he or she can no longer function? Without adequate support, impaired elders can be in severe jeopardy and at greater risk of becoming poorly nourished, undernourished and even malnourished.

5. Nursing Homes

Being admitted to a nursing home does not safeguard older people from nutritional risk [77]. The complex causes of malnutrition in nursing homes are rooted in disease, conditions and disability. The diseases and conditions commonly associated with older nursing home residents, and with the development of malnutrition, are chronic mental disorders, kidney failure, emphysema, severe heart disease, cancer, chronic severe depression, and impaired manual dexterity [76, 78]. All these diseases and conditions can cause or contribute to weight loss, while at the same time some cause increased nutritional needs, decreased capacity to think, reason and pay attention, and impaired ability to feed oneself. To make matters even worse, residents' loss of appetite with related weight loss has been found to be already present upon admission to the nursing home. [79] And the medications prescribed for these diseases and conditions often affect appetite, chewing, swallowing and other aspects of digestion.

The increased severity of residents' diseases and conditions raises their functional dependence on staff to a critical level. Thus awareness of residents' nutritional needs by nurses, physicians and staff aides, along with allocation of adequate institutional resources, is critical to meeting residents' nutritional needs. Unfortunately, most long-term care institutions struggle with multiple financial,

staffing and treatment and care issues that can negatively impact residents' nutritional care.

A high frequency of infections and fevers can occur in a number of older residents, recurring for some as frequently as every three months. With each recurrence, these residents' nutritional needs increase but are unlikely to be met. [24, 80, 81, 82] These same residents can experience frequent trips to the hospital for various acute episodes, during which time even more weight can be lost and nutritional needs become even greater, and more difficult, if not impossible, to meet.

6. Chronic Use of Multiple Medications

The use of multiple drugs is accepted best practice for common chronic conditions such as hypertension and diabetes. Conscientious clinicians, who adhere to evidence-based guidelines, will often find themselves prescribing six or more drugs for people with several chronic conditions. Unfortunately, using multiple medications may cause problems such as the increased risk of inappropriate use of medications (including drug-drug interactions and duplication of therapy), non adherence, and adverse effects. Drug related problems cause significant preventable morbidity and mortality. Their economic cost is estimated to rank fourth in the developed world, behind cardiovascular disease, cancer and diabetes. Drug related problems include adverse drug events, adverse drug reactions and drug interactions.

Polypharmacy has been defined in different ways. Most simply defined, polypharmacy is the use of multiple medications. Polypharmacy has various definitions and connotations in the literature ranging from the use of 4, 5, 6 or more drugs in combination to the more simplistic addition of just one inappropriate drug to

an existing drug regimen. Others have defined it as the use of more drugs than clinically indicated or too many inappropriate drugs, such as the use of >2 medications to treat the same condition or the use of >2 drugs of the same chemical class. [135]

Elderly patients have decreased total body water, decreased lean body mass, increased body fat, decreased serum albumin levels and altered protein binding, decreased hepatic perfusion and phase I metabolism, reduced renal plasma flow, reduced glomerular filtration rate, decreased tubular secretion function, and various alterations in determinants of tissue sensitivity.[135] These normal consequences of aging may be confounded by others, as well as by disease processes, environment, diet, and medications. The physiology of aging varies among individual patients, leaving some more vulnerable than others to a drug's effects.

Many older adults have multiple medical conditions, such as hypertension, arthritis, heart disease, cancer, and diabetes mellitus, which require multiple medications for proper treatment and availability of new pharmaceutical agents. [83, 84, 85] While use of multiple medications is necessary for some diseases, [86, 87] Polypharmacy may lead to clinically detrimental outcomes and needless financial burden on elderly patients and the health care system. Polypharmacy has been associated with adverse drug events and diminished functional outcomes. [88]

Multiple drug use over long periods of time can affect how the body uses nutrients. For elders who have chronic illnesses, are chronically malnourished, or both, multiple medication use might further weaken what nutritional reserves they have managed to maintain. Medications can affect the ability to eat (by causing loss of appetite, reduced or altered taste and smell, painful swallowing, reduced saliva

flow, nausea and vomiting) and can affect the absorption of nutrients or the body's use of those nutrients once they are absorbed. While certain drugs in combination with other drugs or other factors can cause or contribute to malnutrition in older people, malnutrition itself can affect drug absorption, transport, metabolism and clearance [89, 90].

Polypharmacy has been extensively studied internationally and reported to occur frequently in elderly outpatients. [91, 92, 93] Many studies have found that various numbers of medications are associated with negative health outcomes. [94]

In Finland, the incidence of polypharmacy (ie, >5 medications) increased from 19% of the elderly population (i.e., ≥64 years old) in 1990-1991 to 25% in 1998-1999. [94] A Danish study found that 1-year prevalence of polypharmacy (i.e., ≥5 medications) was 22% for the elderly (i.e., ≥70 years old) in 1994.[96] A study in Sweden determined that 39% of their elderly (i.e., ≥65 years old) received 5 or more medications.[96] In England and Wales, the prevalence of polypharmacy (i.e., >5 medications) among persons 65-74 years was 11%, and 15% for those over 74 years.[97] in the United States, Lassila et al found multiple medication (>5) use in 10% of the elderly (i.e., R65 years old) in 1987-1989. A study conducted in a Medicare managed care organization in Texas found that 15% of its members in 1997 were using 5 or more medications. A nationwide study by Kaufman et al involving a random sample of the population in the United States observed polypharmacy (>5 medications) in 19% of elderly men and 23% of elderly women in 1998-1999. [98, 99, 100] Data from the Third National Health and Nutrition Examination Survey (NHANES III) reveal that 74% of people in this age-group of persons aged 65 and older confirmed recent use of prescription medication and For persons aged 65 to 74 years, more than half used two or more prescription drugs—and 12% used five

or more prescription drugs. For those aged 75 and older, 60% used at least two prescription drugs—and 16% used at least five.

In studying risk for drug-induced malnutrition in 390 older nursing home residents from ten different nursing homes, Varma concluded that given the common drugs that are used with older nursing home residents, nutrient deficiencies may occur in vitamins B6, B12, C, D and K, phosphate, potassium, calcium, magnesium and zinc. But perhaps even more important to the issue of malnutrition due to multiple medications is Varma's finding that of those residents taking one or more drugs causing loss of appetite, nausea, vomiting and aversion to food, 41% lost more than 10% of their body weight over three to 12 months. Only 63% of those who lost weight had blood protein levels measured and recorded in their medical records, but of those, almost one-third were below normal. [101]

Polypharmacy combined with the increased vulnerability to medication in old age make elderly people especially prone to adverse drug reactions and drug-drug interactions. [102, 103] Multiple medication regimens may also lead to difficulties in administering different drugs, noncompliance, and therapeutic duplication in the elderly. [104] Furthermore, polypharmacy is associated with increased hospitalization and mortality in the elderly. [105]Nonetheless, despite the negative aspects, polypharmacy may be needed in persons afflicted with certain disease conditions to improve patients' health and quality of life. The risk of an adverse drug event has been estimated at 13% for two drugs, 58% for five drugs and 82% for seven or more. [106]

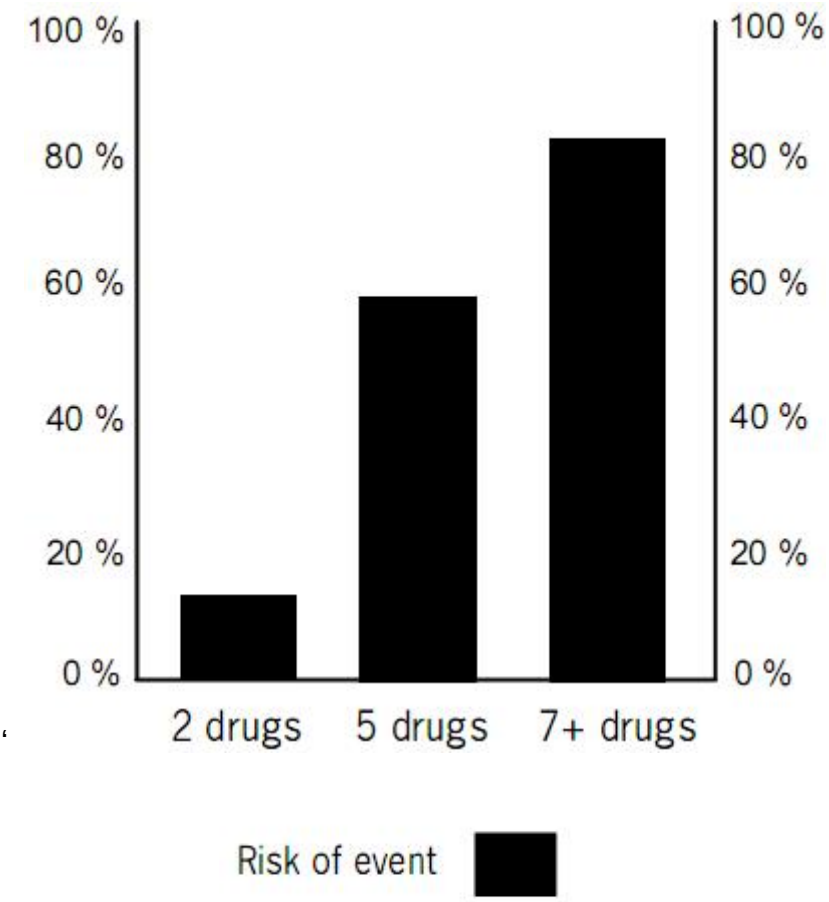

Figure 2: Risk of harm increases with number of drugs taken

Elderly people are at particular risk of drug related problems because of complex drug regimens involving multiple drugs and the physiological changes which accompany aging. Up to 30% of hospital admissions in the elderly may be associated with drug related problems. [107]

Researchers who evaluated a cohort of older ambulatory persons estimated that as many as 27.6% of adverse drug events are preventable and occur most commonly with cardiovascular drugs, diuretics, non opioid analgesics, antidiabetic agents, and anticoagulants.[108] Preventable drug-related morbidity is the fifth most costly health condition. In 2000, the United States spent $133 billion on drugs and an

estimated $177 billion managing drug-related problems. For every $1.00 spent on drug therapy, as much as $1.30 may be spent managing drug-related problems. [109]

Literature revealed limited data on polypharmacy trends and elderly at-risk for polypharmacy at the national level in India. The difficulty is balancing the potential benefits of these drugs, as described in the guidelines, with the risk of harm from the high number of drugs used. Clinicians need to consider carefully numbers needed to treat, numbers needed to harm, long term prognosis and the wishes of individual patients.

7. Poverty and Social Isolation

Poverty is a major risk factor for malnutrition for many older people. The risks for undernutrition, emaciation and inadequate intake of vitamins and minerals have been frequently associated with low-income populations over the years, with many researchers reporting the relationship between income and poor nutritional status in older people. [53, 110] Living on fixed incomes and fixed subsistence incomes can make it difficult if not impossible to afford decent housing, utilities, health care, medications, *and* adequate nutritious food.

Cutting back on food, first in quality and variety and eventually in total amount, can be the older person's only choice in meeting expenses. When spending less money on food in order to pay other bills become frequent, serious nutritional problems become more likely. Even the older person once considered "well off" can find an adequate and stable income eroded by ever-increasing health care and medication costs, become destitute in the midst of affluent surroundings, and begin to eat less and less in an attempt to make ends meet. The reasons older people

don’t get adequate food and nutrients are varied and can be explained in part by the concept of food insecurity. Researchers now describe and measure hunger using a concept called "food insecurity," which exists whenever "the availability of nutritiously adequate, safe foods or the ability to acquire personally acceptable foods in socially acceptable ways is limited or uncertain" [111]. In other words, elders experience food insecurity when they do not always have adequate food, when they can’t always afford to buy enough food, when they can’t always get to markets and food programs, and when they can’t always prepare and eat the food that is available in their homes. Inadequate food and nutrient intake, which can cause malnutrition in older people, can begin with food insecurity. But within the concept of food insecurity lays a number of reasons for elders not getting adequate food.

"The problems of older people are both medical and social” and some have said that poverty and social isolation go hand in hand. The lack of social support can play a role in the development of disease and disability, and researchers have shown a relationship between lack of social support and unhealthy outcomes of illness [112]. In older adults, poor physical health and loneliness negatively affect nutrient intake. The loss of a spouse can create social isolation, grief and depression. Even up to two years after the loss of a spouse, widowed elders had significantly lower diet quality. 84% of those widowed suffered unintentional weight loss that might be explained by their lower intake of calories, which as a group was 28% lower than those married [113].

The risk for malnutrition have been found to be high among specific groups of elders, especially those with inadequate income to purchase food, those who are isolated, and those who suffer from illnesses, disease and other conditions affecting independence. [24, 25, 26]

It is difficult to identify which age-related dysfunctions are responsible for causing negative energy balance in elderly people. [33] Both physiological and non-physiological factors cause the decline in food intake among elderly people. Physiological factors include neural, hormonal, and metabolic mechanisms [35, 36] Non-physiological causes of weight loss include social, psychological, medical and pharmacological factors. The possible causes of weight loss in elderly people are shown in figure 3.

Frailty in elderly people is often accompanied by weight loss and/or malnourishment. [36] The absorption rate of macronutrients may be delayed and a number of hormonal and metabolic mediators of energy regulation change with aging. [37] The changes in endocrine function have an influence on nutrient requirements and nutritional status. The nutritional status for its part influences glandular activities. [33]

Total energy expenditure (TEE) and physical activity level (PAL) decline through adult life in men and women. In normal weight individuals daily TEE falls by 150 kcal every decade, and PAL from an average of 1.75 on the second decade of life to 1.28 in the ninth decade [38]

The resting metabolic rate (RMR) is reduced in elderly people by between 10 to 20%, which has been thought to manifest in the reduced lean body mass. RMR among chronically diseased elderly nursing home residents measured by indirect calorimetry was found to be 1 174 kcal/d (29.3 kcal/kg FFM/d). Mean energy intake of these residents was 1474 kcal/d and the energy intake/RMR ratio was 1.27. [39] In females the decline in RMR is smaller than in males. The metabolic causes for age-dependent changes in body composition had not been clearly identified. The

changes in the activities of growth hormone and testosterone may contribute to the shift in balance from lean to adipose tissue. The decreased capacity in muscle fibre regeneration has also been suggested. [40]

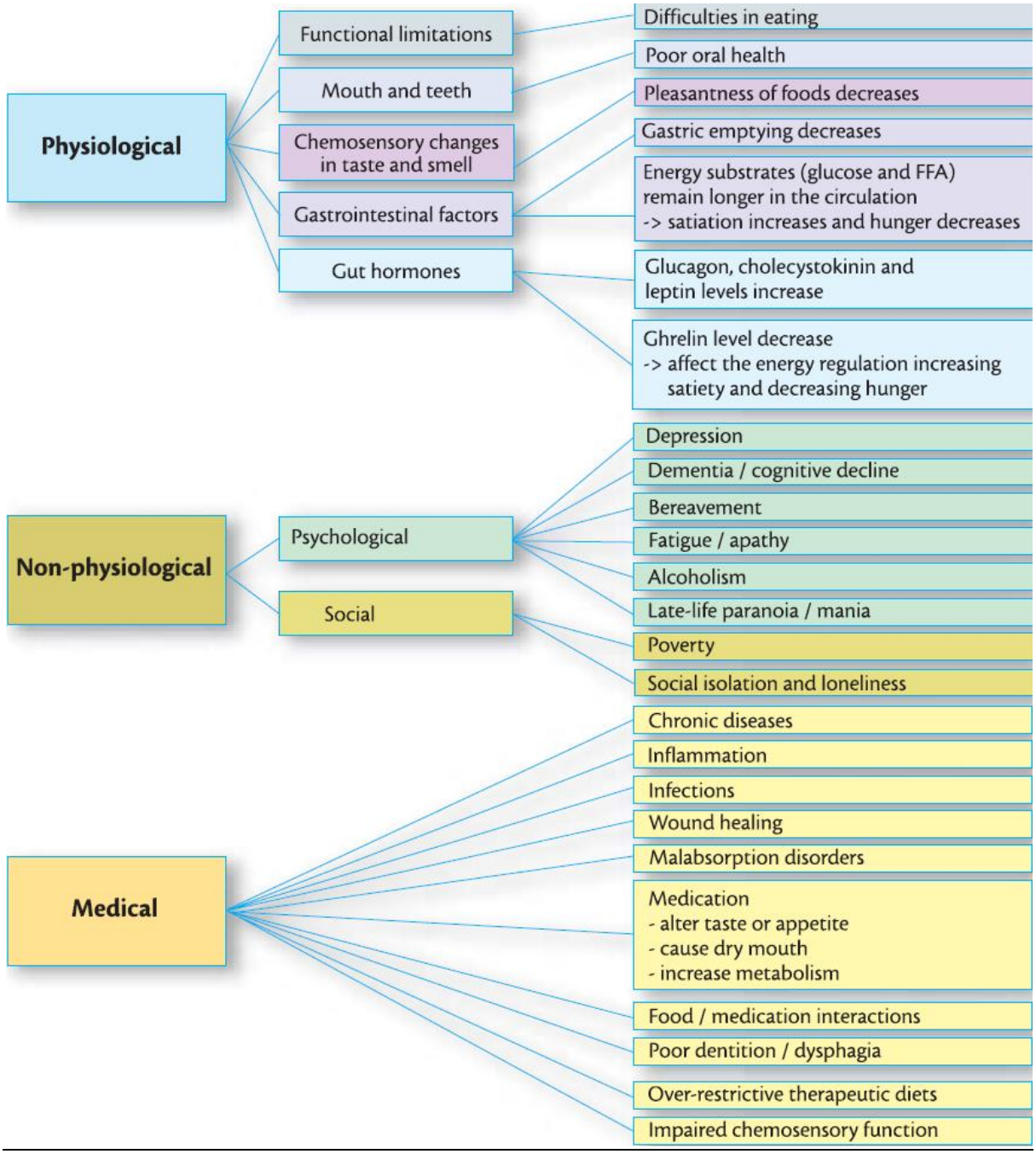

Figure 3: Possible causes of weight loss in elderly people. (Modified from Hays and Morley (35, 33))

The ability of the aged individuals to regulate energy intake is impaired and their ability to increase or decrease energy expenditure in order to attenuate energy imbalance during overeating or undereating decreases. [37] If elderly individuals are underfed for longer periods of time they fail to return to normal body weight again, whereas younger individuals are able to return their baseline body weights. [41]

Early satiation in older compared to younger individuals is a result of the gastrointestinal factors [42] Large meals reduce the rate of gastric emptying in elderly persons compared to younger individuals [43] The result is more rapid satiation because of the reduction in the ability of the fundus of the stomach of the elderly to adaptively relax. [12] A study by Rolls et al suggests that, because of the subjective sensation of satiety, elderly men (aged 60 to 84 years) consume significantly less energy than younger men (aged 18 to 35 years). Moreover, the energy regulation among elderly men is impaired compared to the younger individuals. They also suggested that changes of taste thresholds and decreasing of olfaction lead to decreased food intake in the elderly [44] In addition, the loss of natural teeth, chewing problems, and poor oral health are predictors for the risk of malnutrition [45, 46, 47]

Still, even when provided with adequate food older people may eat too little. Of 21 hospitalized patients, those over 65 years old ate food containing significantly less calories and nutrients over the course of their hospital stay than did the younger patients. Younger patients met 87% of their caloric needs with very little weight loss, while those over 65 met only 56% of their caloric needs with significant weight loss [48], illustrating how changes in nutritional status seen in older people are often secondary to the multiple factors of disease, medication, trauma, living situation, and others.

Any combination of nutritional risk factors can happen to any older person, in any neighborhood, reflecting any social strata.

EFFECT OF MALNUTRITION AMONG THE ELDERLY

Nutritional intakes, dietary habits and aging processes have been shown to be related and interrelated and are of particular importance among the elderly. [114, 115] Increased morbidity and mortality in community-dwelling and hospitalized elderly are linked to poor or marginal nutritional status. [116. 117. 118] Low body mass indices and inadequate energy intakes are associated with functional decline and elder failure to thrive [119, 120]. Deficiencies of energy and individual nutrients are associated with decreased cognition with vitamin B-12 deficiency being particularly problematic in the elderly [121, 122, 123] Inadequate dietary intakes of energy, folate, vitamin D, vitamin B-6, calcium and zinc have been reported in community-dwelling elderly over 60 y old. [124, 125, 126, 127] There is also growing evidence that in the elderly, even micronutrient deficiencies not detectable in a physical examination are associated with declines in cognitive ability. [128] The detrimental consequences of these persisting nutritional deficits appear to be substantial as selected multiple indices of malnutrition including hypoalbuminemia, and low BMI, have been associated with multiple adverse outcomes that include increased length and duration of hospital stay, complications, readmissions, number of falls, functional limitation, and mortality. [129, 130, 131, 132, 133, 134]

Involuntary weight loss among community-dwelling older persons predicts an increased risk of two-year mortality, with one cohort study showing that involuntary weight losers had a greater than 2 fold increased risk of mortality. [135] Wedick and colleagues studied 1801 community dwelling people (mean age 71 at the beginning

of mortality follow-up) and found that men and women losing 4.5 or more kilograms between visits (10 years apart) had higher age-adjusted death rates during the following 12 years than those with stable weight or weight gain.[136] In another study of 4714 community dwelling older people (>65 years), weight loss of 5% or more over a three-year period was associated with an increased risk of mortality that persisted even after a multivariate adjustment.[137] Hospitalised older people (>65 years) with a low body mass index (BMI) [<20 kg/m^2] are also at increased risk of death.[138] After adjustment for multiple confounders, older Australians (> 70 years) with a low corrected arm muscle area (CAMA) [< 21.4 cm^2 for men and < 21.6cm^2 for women] had an increased risk of mortality at an 8-year follow-up.[139]

Obesity has also been associated with functional limitation, co morbid disease, increased health care resource use, and mortality [117, 140, 141]

Malnutrition and hospitalisation in the elderly

Malnutrition is known to impair immune function, respiratory function, and leads to poor prognosis in hospitalized patients. [142, 143, 144, 145, 146] In the elderly population with multiple disabilities and problems, vulnerable to socioeconomic changes and the fact that nutritional status reflects the socio economic problems, to which the elderly are vulnerable for; medical illnesses and hospitalisation are closely related to malnutrition. Poor nutrition had been shown to be associated with increased risk of hospitalization. [150]

There have been several studies, which have shown that protein energy under-nutrition is common among older people in both acute and non-acute hospital setting. [75, 147, 148] and also that poor nutritional status is associated with increased morbidity and mortality [147, 149] and functional decline [117]. In a study published by

Jansen et al [150] it was found that, probability of hospitalisation within 24 months had significant association by multivariate regression with average monthly health care charges: age ≥ 75 y, male sex, albumin < 35.0 g/L, polypharmacy, loss of ≥4.5 kg (10 pounds) over past 6 months, cholesterol < 4.14 mmol/L, and any limitation in activities of daily living or instrumental activities of daily living. Poor nutrition has also been shown to lead to complications during hospitalization and increases mortality, [156. 157, 158, 159, 160, 161] and a significantly higher risk of dying within a year of hospitalization than those with adequate nutrition. [162]Studies have also shown that elderly people, both in their own home and in institutional care, are at risk from nutritional deficiencies. [151]

Because of this, an approach to identifying older persons at risk of hospitalization that includes nutritional risk items may be the best method for facilitating appropriate interventions before the need for hospitalization. Case management interventions for high-risk individuals might diminish the need for hospitalization and prevent deterioration in nutritional status.

So knowledge of nutritional status may be important, particularly as studies have shown that nutritional support, mainly total parenteral nutrition, improves prognosis and mortality in undernourished elderly catabolic patients, such as post-operative patients[84] Therefore the treatment and prevention of malnutrition, which is most common in the older age group, is an important challenge for the health care system.

Malnutrition among the elderly and acute/subacute illnesses

Relationship between acute illnesses and subacute illnesses has not been studied extensively, especially in developing country such as India. In a study

conducted among 837 elderly patients admitted with subacute illnesses, Almost one-third (29%) of the subjects were malnourished and almost two-thirds (63%) were at risk of malnutrition. Thus, >91% of subjects admitted to subacute care were either malnourished or at risk of malnutrition. [154]

The reasons for the high prevalence of malnutrition in patients hospitalized for an acute illness include poor recognition and monitoring of nutritional status [109, 128, 153,155, 163, 164] and inadequate intake of nutrients for days at a time [165, 166, 167]. 16% of community-dwelling persons aged > 60 y consumed < 4184 kJ/d (< 1000 kcal/d) before hospital admission for an acute illness, contributing to making undernutrition a primary factor in morbidity and mortality [168]. Because the signs of undernutrition may not be adequately addressed during a stay in an acute-care hospital [169], inadequate nutrition is often present at hospital discharge.

Assessment tools for nutritional status among elderly patients

Nutritional assessment in the elderly consists of many different tests ± clinical, biochemical and anthropometric. However, objective markers of nutritional assessment often do not reflect physiologic, physical, cognitive and emotional function. Moreover, nutritional assessment using objective markers is more complicated in the older subject because metabolic changes, among others, affect some of the routine biochemical test results, and the reference values of the anthropometric measures are not always age-adjusted. In addition, it is possible that functional impairment may occur at a subclinical level and precede a measurable alteration in body composition, i.e., there may be clearly defined alterations in muscle function at a time when significant changes in body composition could not be detected. Malnutrition or nutritional deficiency is a continuum that starts with an

individual's inadequate intake (that, in fact, does not meet his or her needs) and progresses through a series of functional changes that precede any changes in body composition.

At present there is no gold standard for evaluating nutritional status. The relationship between nutritional status and functional capacities apparently is the simplest, but also the most reliable index of malnutrition [(170)]. There is no gold standard for determining nutritional status and there are no universally accepted criteria to define malnutrition [(171)]. The cut-off values for defining nutritional status vary, and the reference data used in most cases are not derived from the population being studied. Since every study uses a different method of nutritional assessment, a comparison of malnutrition and nutritional risk in the community elderly as well as in hospital patients between different studies is problematic.

The following are the assessment tools used commonly in practise currently for evaluating nutritional status among the elderly which we have used in this study:

- The Mini-Nutritional Assessment (MNA).
- Anthropometric measurements:
    - Weight
    - Height
    - Mid arm circumference
    - Calf circumference
- The body mass index.
- Serum albumin.

The Mini-Nutritional Assessment (MNA)

Screening of nutritional status is considered to be a simple process which aims to identify those malnourished or at significant risk of malnourishment. Nutritional assessment is a more complex process, involving the use of several measures to determine nutritional status.

The Mini Nutritional assessment is a practitioner administered sophisticated screening tool which has been specifically developed to evaluate the risk of malnutrition in frail elderly people and to identify those who could benefit from early intervention. [172] The MNA was designed for easy use by primary care physicians as well as health professionals involved in the care of elderly patients, especially the frail and sick elderly, at home, hospitals, or nursing homes. It is a very simple non-invasive, easy to administer, patient-friendly, non-expensive, very sensitive, highly specific, reliable and validated screening tool.

The MNA test can be performed in less than 15 min, depending on the patient's health status. In those individuals with cognitive impairments the health professional must score the MNA with the caregiver of the patient or based on her own impressions. The original version of the MNA which has been used in this study contained 18 weighted questions, divided into four nutritional areas including anthropometric measurements which includes body mass index (BMI), mid upper arm circumference (MAC), calf circumference (CC) and weight loss, it also includes a global assessment (6 questions related to lifestyle, medication and physical and mental status), a dietary assessment (six questions related to dietary intake and eating problem and a subjective assessment); one question on self perception of whether food intake is sufficient, and one on self experienced health status. The responses can give a maximum of 30 points. The scoring system (ranging from 0 to

30) categorizes subjects as normal (having adequate nutritional status), borderline (at risk of malnutrition), or undernourished (protein-energy malnutrition) [101]

The MNA test was validated by three consecutive studies. The developmental study [172] showed that the MNA test was 92% accurate when compared with a clinical status evaluation done by two physicians expert in nutrition and 98% accurate when compared with a comprehensive nutrition assessment that included anthropometrics, food records, and biochemical indices. The second study (the validation study) [173] was done to determine the discriminatory potential of the MNA test versus the physician-performed clinical status assessment with and without the addition of biochemical indices to the MNA test. There was no added benefit from including biochemical measures into the MNA test because the MNA test accurately assessed patients at an approximately 88% success rate with or without the expensive biochemical indices. The classification potential of the MNA test was evaluated by cross-classification of the patients using the discriminate analysis equations and the clinical status assessment as a reference standard. Using the MNA test, 78% of the patients were classified correctly. These results were confirmed by the inverse analysis. According to the cross-validation results and by using albumin as the independent variable, the following thresholds were selected: a score of ≥24 indicates normal nutrition, <17 indicate malnutrition, and 17–23 indicates a risk for malnutrition.

A score of less than 17 points is regarded as representing malnutrition (MNA 3), 17 – 23.5 as at risk for malnutrition (MNA 2) and more than 24 points that the elderly person is well nourished. [13] Normal MNA and a good condition of nutrition is considered above 24 points, endanger risk of malnutrition appears in the range 17–23.5 points and score under 17 verifies malnutrition. [174]In those with recent weight

loss, or are frail, the MNA is most useful as part of a comprehensive geriatric assessment. When the MNA is ≥ 24, nutritional statuses can be considered good. It is important to provide some information to these patients about how to remain in good health. They should be aware that if they experience weight loss, they should inform their physician. The elderly should also be careful not to be too severe or restrictive in their choice of diets, such as a cholesterol-restrictive diet.

When the MNA is > 17, most of these individuals have protein-calorie undernutrition.[13, 172] They will also have weight loss and low serum albumin. It is important at this time to conduct a comprehensive nutritional assessment with biological, anthropometric, and dietary assessment measure to identify any underlying diseases and to start re feeding under medical surveillance.

The κ statistic for the MNA (Mini nutritional assessment) total score has been shown to be 0.51(95% CI 0.28 – 0.74) [175], demonstrating a significant inter observer agreement. Not surprising, although still significant, the agreement is lower for the intermediate class, i.e., at risk of malnutrition. It closely correlates with biochemical (albumin, prealbumin, transferrin levels, and lymphocyte numbers) and anthropometrical markers (measuring of subcuticular fat, arms circumference) that was verified by a number of clinical studies on wide sets of geriatric patients [174, 176,177, 178] Levels of serum albumin, BMI and weight loss were highly correlated with the MNA score. Figures 4 and 5 show the correlation between the MNA and the usual nutritional indices used in clinical practice.

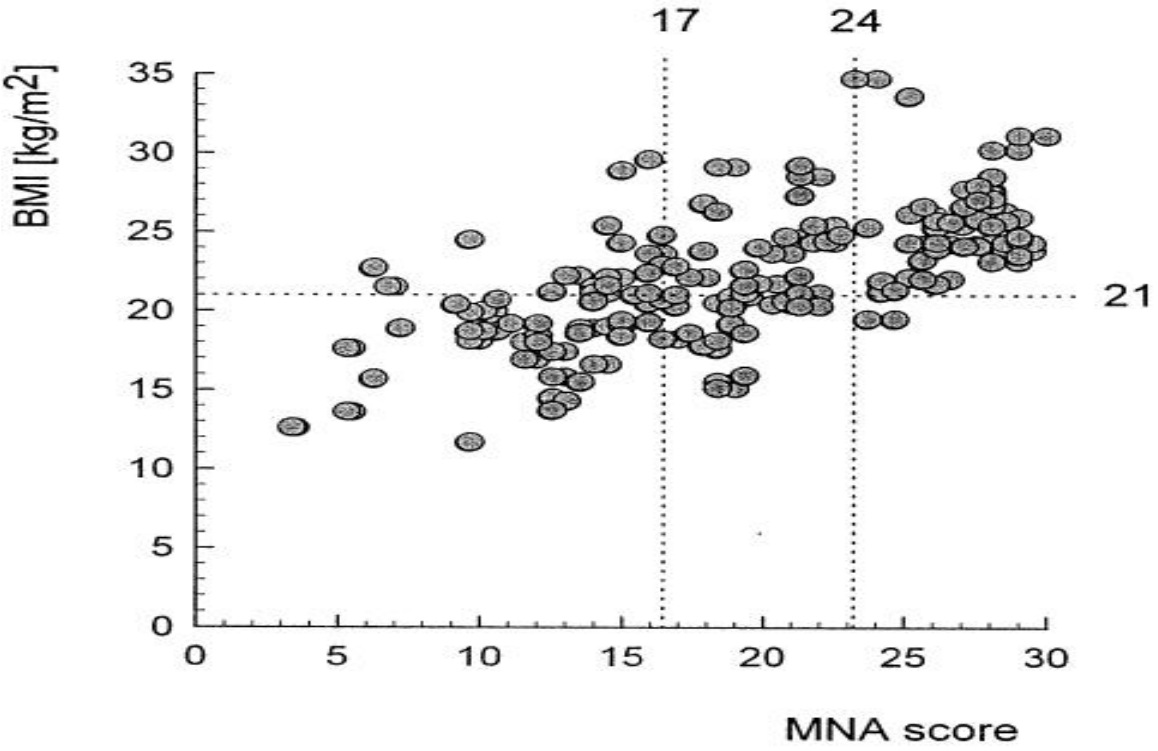

Figure 4: Scatterplot of body mass index (BMI in kg cm2) according to MNA[(172)]. BMI, Pearson correlation coefficient: r 5 0.66 (P = 0.0001; n 5 151).

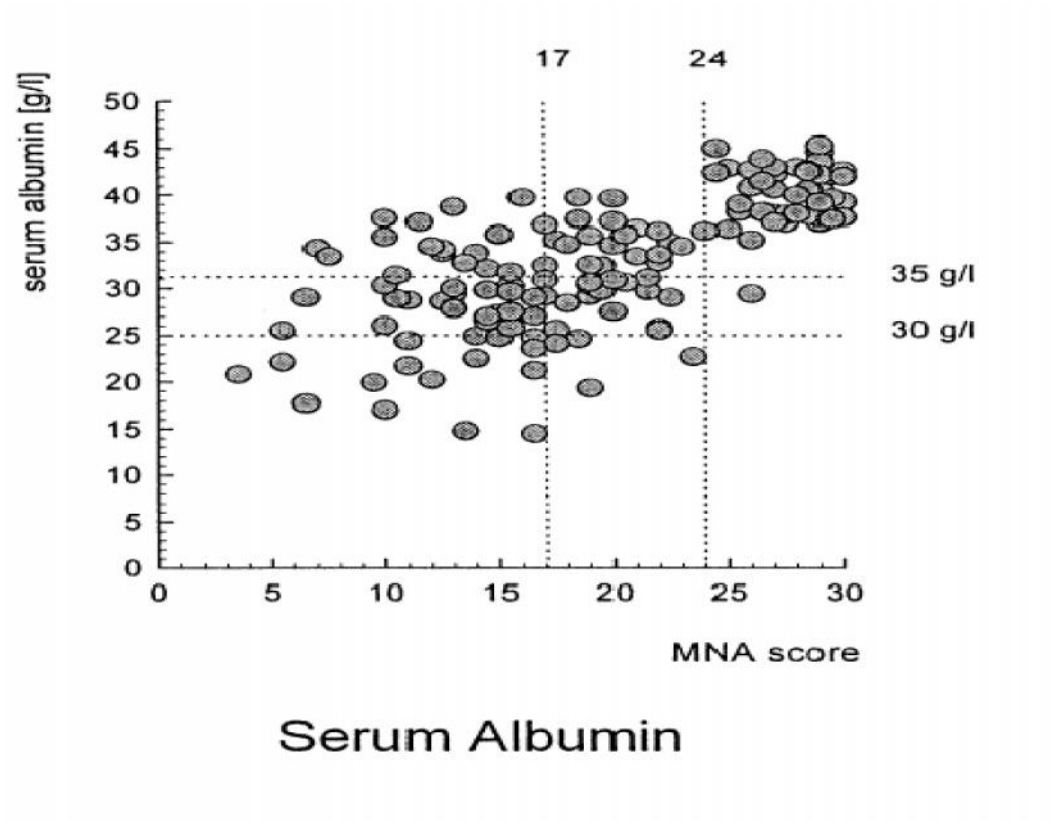

Figure 5: Scatterplots of serum albumin according to Mini Nutritional Assessment (MNA) score (data from the Toulouse 1991) [172]

Most importantly, by using the MNA it is possible to identify people at risk for malnutrition who do not have weight loss or low serum albumin levels: for these individuals MNA is between 17 and 23.5. However these individuals are more likely to have a decrease in caloric intake that can be easily corrected by nutritional intervention.

The New Mexico Aging Process Study [(152)] suggests that the decrease in nutritional intake occurs before weight loss and a fall in serum albumin levels. The severe weight loss and decrease in serum albumin currently used in clinical practice to assess nutritional status often appear too late to be useful nutritional markers. The MNA is able to assess nutritional status in the elderly, before severe changes in weight or albumin levels occur (MNA score between 17 and 23.5).

The MNA (Mini nutritional assessment) has also been found to be predictive of mortality [179] and length of hospital stay and costs [180]. In a study conducted on a study population of 1319 patients, admitted in a tertiary hospital, which comprises of 24% of all the admissions during the study period, the MNA score averaged 19.9 ± 3.8 (SD), where there was a very strong relationship between mortality and MNA scores. There was a threefold increase in death rate in the malnourished group (MNA score <17) compared with the well nourished group (MNA ≥ 24). [181] The median length of hospital stay was also closely related to the MNA, and increased from 30.5 days in those with a score ≥ 24, to 42.0 days in those with a score < 17. Mid arm and calf circumference measurements were associated with an increased risk of in-hospital death, while neuropsychological problems and the ability to live independently were associated with a higher rate of nursing home transfer, and were related to a longer length of stay. [181]

Many other studies have used, or are currently using, the MNA in different outpatient settings such as dialysis [182] and surgery [176] clinics. The MNA (Mini nutritional assessment) tool has been used in elderly people receiving primary health care [183] and those in home nursing care [184]. MNA has been shown to be a very useful tool in detecting residents who need preventive nutritional measures. [185]

Nutritional assessment in the elderly has commanded more attention since the realization that poor nutritional status is common in the elderly and that it is a powerful predictor of poor outcomes in this population. The MNA has been designed to assess nutritional status in frail elderly individuals. By frail, which mean those individuals with some functional impairments, such as mobility, hearing or cognitive disorders, those who live alone, in nursing homes, or who are more than 85 years

old, but living in the community. The MNA also appears to be very useful in hospitalized elderly persons or in those who require surgery. The MNA is mostly useful as part of a comprehensive geriatric assessment that includes cognitive, social, autonomy, and mobility assessment.

Anthropometric measurements

Anthropometric measurements are indirect techniques for assessing body composition. Anthropometric measures are non-invasive techniques that provide information or estimation of body composition, fat, and muscle stores. These measurements include weight, height, circumference, and skinfold thickness. Anthropometric measurements can be used to monitor interventions, detect advanced malnutrition, and predict outcomes. Poor nutritional status, as measured by arm muscle area or BMI, has been associated with decreased survival in hospital population. [186, 187, 188] In a large study from New Zealand, [189] community-dwelling patients were followed for more than 4 y; there was no increased risk of death in subjects above the 90th percentile for age and sex in any of the anthropometric measurements. In another group of patients Milne [190] found that men who survived 5 years had greater initial mean weight and skinfold thickness than those who died. Because aging results in changes in tissue compressibility and elasticity, distribution of body fat, height, and weight, it is important to use reference anthropometric data from individuals of the same age group.

Weight

Body weight declines gradually with age in both sexes. [191, 192] Studies have demonstrated that body weight peaks between ages 55 and 65 years in women and between ages 34 and 54 years in men only to decrease thereafter [193] Men are

estimated to lose up to 6.6 kg between ages 70 and 81 y as opposed to 5.7 kg in women over the same period. Loss of weight happens at the expense of body water and lean body mass, whereas fat loss is usually insignificant. This loss is accompanied by a decrease in the basal metabolic rate. The decline in lean body mass, basal metabolic rate, in addition to decreased physical activity lead to a decrease in energy requirements and thus food intake. [194, 195]

Unintentional weight loss is frequent in the elderly, especially in residents of long-term care facilities. 70% of nursing home residents lose more than 10 lbs. (22 kg) during their stay, as shown by Silver et al. [196] Weight loss in the elderly correlates with morbidity and mortality. Lew and Garfinkel [197] demonstrated increased mortality ratios for those who had less than 80% of average body weight at all ages including the ninth decade. Burr et al. found that surviving subjects older than age 70 y tended to be heavier than those who died, suggesting that an above-average weight is a favourable prognostic factor in old age. [192] In nursing-home patients, weight loss of more than 5 kg in 2 years correlated with increased mortality. In older individuals, more than 10% loss of body weight over the 6 mo before surgery correlated with increased surgical mortality. [198]

Weight loss and decreased body weight also correlated with increased morbidity. [199, 200] In both hospitals and long-term facilities, weight loss contributed to the development of pressure ulcers [199, 200, 201, 202] Malnutrition has been linked to an increased incidence of infection in hospitalized patients older than age 65 y with weight - height ratio less than the 90th percentile. [203] Protein-calorie malnutrition as shown by weight loss .10% and decrease in albumin and total lymphocyte count was linked to impaired immunity and increased septic complications. [204, 205]

Weight loss can be due to loss of body fat and/or loss of lean body mass. Weight loss starts at the expense of body fat before it affects lean body mass. Older individuals in general tend to be underweight and thus do not have body fat to spare. They are less tolerant to weight loss [160] Excessive loss of lean body mass may lead to skeletal and cardiac muscle wasting and loss of visceral proteins. [206] Economically, weight loss has been linked to longer hospital stay and increased medical expenses by about 40%.[207] Campillo et al.reported that malnourished elderly inpatients had higher resting energy expenditures calculated for lean body mass than normal weight patients did. Therefore, calorie combined with protein supplementation is all the more important because nutritional supplementation has been shown to improve outcome and reduce length of hospital stay. [208]

If done accurately, weight (especially paired with height) provides invaluable information about the nutritional status regardless of the method. In a recent study from Michigan, weight records and BMI of nursing-home residents were obtained from the minimum data set. They were shown to closely correlate with more sophisticated anthropometric and bioelectric measurements in estimating nutritional status. [209]

Obtaining an accurate height in the older population can be difficult because of the inability to stand erect. Chronic illnesses such as osteoporosis, spinal deformity, arthritis, and a few other neurologic conditions can affect stature. Thus, alternative measures to estimate height have been used such as recumbent length, segmented height, and other measures.

It has been generally accepted that a person loses approximately 1 cm for each decade after age 20 years mainly due to narrowing of intervertebral disk spaces. Many have argued that rates are estimated from trends or the slopes of

regressions on age by using cross-sectional data and may be confounded by the secular trends toward increased stature. [210, 211, 212] Chumlea et al. [213] showed that a group of healthy white elderly men and women aged 60 to 80 years lost about 0.5 cm every year. If more than the acceptable decrease is noted in the recorded height or when compared with the historic height, interventions preventing additional losses should be instituted.

The body mass index

BMI is a basic tool that has been used to evaluate the nutritional state and it has been the most commonly used mass-height indicators. The BMI is a simple but objective anthropometric indicator of the nutritional status of the adult population founded by the National Research Council's Committee on Diet and Health [214] and seems to be closely related to their food consumption levels. It is relatively inexpensive, easy to collect and to analyze. Collection of data on weight and height from which BMI is easily derived can readily be incorporated into regional and national surveys that are presently being conducted. It could be used for the purpose of nutritional surveillance or for the purposes of monitoring since this allows for interregional or inter-country comparisons as well as longitudinal comparisons within the same region or country. BMI is calculated by dividing body weight (kg) by height (m^2):

BMI = Weight (kg) ÷ Height (m^2)

Normograms are available for an easier determination of BMI. Whereas Garrow and Webster [215] used <20 kg as the cut off for underweight, the NSI has established the normal BMI to be between 22 and 27 kg. [216] Shetty and James [217] further defined degrees of chronic energy deficiency by using BMI <18.4 as mild and BMI <16.0 as severe. The BMI is sensitive to socio-economic status and to seasonal

fluctuations in food consumption relative to the level of physical activity and is a reasonably sensitive index of function and physical performance and may be useful if development projects depend on the physical activity of the community. The deleterious consequences of a low BMI status in adults have been recognized; and there is considerable need to evaluate immune function, proneness to illness, morbidity and mortality in low BMI adults. There is also scope for evaluation of intervention strategies in a community using the BMI as the parameter of choice to identify individuals at risk. Further epidemiological research on anthropometric data and individual food consumption measurements are still necessary, especially in different socioeconomic contexts. The percentage of false positives and false negatives needs to be assessed. However, there is reason to believe the BMI is a simple, responsive and useful index of nutritional status of the adult in a community and may indeed be the method of choice to assess the numbers of people who are undernourished world-wide

Body mass index can serve as an indicator of over-nourishment as well as under-nourishment. [218] Both extremes of BMI confer increased risk of mortality in older persons. [141, 160, 219, 220, 221, 222, 223, 224] Majority of studies observe a U- or J-shaped relation between BMI and the risk of mortality within a defined period of time. [225, 226, 227, 228, 229] In other words, subjects with the highest and lowest relative weights die earlier than subjects with more intermediate levels of relative weight.

Andres et al. showed that as age increased from 60 to 69 years, the lowest mortality occurred at progressively increasing body weight. Similar data were obtained for persons in their 70s and 80s, suggesting that higher mortality occurs with low body weights [221, 222] These conclusions were challenged by Harris et al. who Interestingly, via the Framingham heart study showed that loss of 10% of BMI

between ages 55 and 65 years was correlated with increased risk of mortality in non smokers and suggested that the increased mortality in thin older persons may reflect a subtle illness or effect from smoking. [141] Porter et al. showed increased mortality for those with low BMI of all ages, but a very low BMI was more lethal in older people. [160]

The aging process causes a decrease in lean body mass and an increase in body fat (which occurs in middle age) along with shortened stature. The loss of height due to compression of the intravertebral disks, osteoporosis, and other pathologies may lead to a pseudoincrease in BMI. Ideally, a “true” BMI should be calculated by using the original premorbid height reflecting the true length of the body frame. This is almost impossible to apply in the elderly population for obvious reasons.

Since the early 1920s, several researchers have attempted to find equations to calculate body fat with simple measurements. After several unsuccessful formulas, scientists in the United States, Czechoslovakia, and the United Kingdom produced predictive equations based on measurements of body circumferences and skinfold thickness. [230, 231, 232]

At present, the measurement of mid-arm circumference (MAC; measured by a flexible tape) and triceps skinfold (TSF; measured by a caliper) is thought to provide a crude assessment of fat stores and muscle mass. [233] MAC and TSF have been reported to correlate highly with total and percentage of body fat in older adults [234, 235] Standard techniques for anthropometric measurements have been established. There is general agreement that no statistical difference exists between measurements taken from ei ther side of the body. It is recommended, however, that measurements be made while the patient is in the erect position. If the patient is

unable to assume an upright position, values obtained in the supine position are acceptable. [236, 237] MAC and TSF are used to calculate the mid-arm muscle circumference (MAMC) and the mid-arm muscle area (MAMA), which serve as more sensitive indicators of somatic protein reserve. MAMA has the advantage of being a two-dimensional measurement, as opposed to MAMC, which is a one-dimensional measurement. This makes MAMA more sensitive to changes in the size of MAM secondary to weight changes.

Mid arm and calf circumference measurements were associated with an increased risk of in-hospital death, higher rate of nursing home transfer, and were related to a longer length of stay. [181]

Triceps skinfold measurement is a measure of subcutaneous fat. However, in the older population, it may be less accurate because of the physical changes with age. These changes include apparent redistribution of fat from subcutaneous to deep adipose tissues, decreased elasticity of skin, alterations in skin thickness, and atrophy of subcutaneous adipocytes contributing to increased tissue compression. These changes limit reliability and accuracy of the TSF. Also, major difficulty has been noticed in accurately locating anatomic landmarks for measurements, even when attempted by experienced clinicians. [238]

Serum albumin

Serum protein levels are important markers of the body protein pool. Measurable proteins include albumin, transferrin, transhyterin (prealbumin), retinol-binding protein (RBP), fibronectin, C-reactive protein, interleukines, and others. Proteins with a long half-life are most useful in evaluating chronic nutritional changes in the outpatient setting. Proteins with a short half-life are most useful in the acute or subacute settings.

Albumin is a negative acute phase protein that decreases with ongoing inflammation [239], and many of the reported associations with albumin may reflect this. Albumin concentration and clinical assessments of nutritional status may reflect different clinical processes. [240] Albumin has relatively long half-life 20–21 days. It functions both to maintain plasma osmotic pressure and to transport substances in plasma. Serum levels of albumin reflect the net result of hepatic synthesis (12–15 g/d), plasma distribution, and protein loss. Over 60% of albumin is present in the extravascular pool and can be mobilized to the intravascular space in periods of stress due to surgery or infection. The functional catabolic rate of albumin is proportional to the size of the extravascular pool, which allows the concentration in the serum to remain relatively constant. The values giving evidence for significant malnutrition and predicting increased mortality in seniors are under 3.5 g/l [132, 241]. The state of hydration, transit among intravascular and extravascular space, liver and kidney disease could influence albumin concentration. It is also a negative protein of acute phase and it is suitable to relate its values to CRP levels. [242]

Serum albumin levels have long been considered a major measure of malnutrition and the defining value for determining the diagnosis of kwashiorkor. Low albumin concentrations are commonly observed in older persons and are associated with worse health outcomes and mortality. [243, 244, 245] Determining the level of albumin had been considered to be a golden standard in the evaluation of nutritional condition. It remains to be a suitable marker for screening and monitoring of malnutrition [246], its indicative value is increased in combination with prealbumin, transferrin or cholinesterase.

Decrease of albumin serum level correlates with total prognosis of patients, it is an independent indicator of severity of clinical state. [247]Several studies in patient

groups or population samples have shown a relation between low albumin concentration and poor functional status in older persons [248, 249] Even among nondisabled older persons, lower albumin concentrations have been shown to be independently associated with poorer performance as assessed by objective physical performance tests [250] Low albumin concentration is also predictive of a greater decline in functional status [251] and associated with increased mortality and morbidity rates in both hospitalized patient and samples of community dwelling elderly persons.[252, 253] For every 2.5 g/L decrease in serum albumin concentration, there is a 24% to 56% increase in the likelihood of dying.[254, 255]

With aging there is possibly a small decline in serum albumin levels (0.8 g/L per decade in persons older than 60 years), but factors other than age per se have never been completely excluded in these studies. Centenarians appear to have significantly lower serum albumin levels than do younger persons. [256, 257]

Serum albumin levels often decline rapidly after hospital admission. [258] The rate of fall is too rapid to allow for a nutritional explanation. Two reasons appear to explain this fall: postural changes and cytokines. Altering posture from the upright to the recumbent position produces a decline in serum albumin of 5 g/L. [258, 259, 260] Cytokines such as tumor necrosis factor-a, interleukin-2 (IL-2), and IL-6 inhibit albumin production by inhibiting albumin gene expression and cause a vascular endothelial leak,31 resulting in an increase plasma clearance rate of albumin. [261, 262, 263]

Chronic alteration in serum albumin can occur with diseases affecting hepatic production of albumin (liver disease and congestive heart failure) or the rate of albumin loss (nephrotic syndrome and protein-losing enteropathies). Thus, although serum albumin levels remained the gold standard for the diagnosis of protein energy

malnutrition, they are a somewhat tarnished standard. Serum albumin in older individuals continues to be useful because of its excellent prognostic ability as a marker of mortality and other poor outcomes such as hip fracture.

Malnutrition is an important predictor of morbidity and mortality in the elderly but is often overlooked. Malnutrition can worsen existing medical problems and cause a decline in functional status. Under-nourished older people are not only at risk of increased mortality. They are also at risk of multiple complications, which can significantly impact on their overall quality of life.

Little is known about the older patients' mortality and morbidity risks with acute medical illness associated with malnutrition in India. Frequently, sick and possibly malnourished patients are transferred directly for hospitalization with acute medical illness. When undernourished patients are transferred with acute medical illness, complications may result. This study was undertaken to assess the nutrition in acutely ill elderly patients at the time of admission to a tertiary hospital in South and to establish the relationship, if any, between nutritional status and clinical outcome, and also establish if, there is relationship between malnutrition and acute medical illness in the elderly.

INDEX FOR THE MATERIALS AND METHODOLOGY: PAGE

METHODOLOGY

Setting

The study was conducted among the elderly inpatients in the medical wards of Department of Medicine of the Christian Medical College (CMC), Vellore, South India, which is a 2200 bedded tertiary care teaching hospital.

Duration of Study

January 2008 to August 2008.

Inclusion Criteria

1. Inclusion criteria for a case was, elderly patients of age of 60 years or more admitted with acute medical illness of duration less than 7 days.
2. Inclusion criteria for a control were, ambulant healthy men or women, age 60 years or above with no acute medical illnesses, usually relatives of in-patients and out-patients.

Exclusion Criteria

1. Exclusion criteria for cases were:
    - **a.** Moribund patients.
    - **b.** Those who were unwilling to be interviewed or could not be interviewed.
    - **c.** Confused or unresponsive patients, from whom the required information could not be obtained from family members or the caregivers.
    - **d.** Those patients in whom weight could not be obtained.

2. For controls those who have been admitted or treated for acute medical illness over the last 6 week were excluded.

Study Design

The study was a case control prospective study where elderly patients of age of 60 years or above admitted with acute medical illness of duration less than 7 days, were compared with controls.

Sample size

From a previous Indian publication it was known that the prevalence of malnutrition among the community dwelling elderly is 7.1% [23]. Assuming a prevalence of 35% of malnutrition among acutely ill elderly patients with a significance level of 5% and 80% power to detect this difference, the sample size was determined to be 39 elderly subjects in each group.

Study Protocol

The following specific data was collected through a proforma (Annexure A) at the time of enrollment into the study

1. Demography- Age, Sex, Name, Hospital number.
2. Anthropometry- Weight, height, Body mass index, mid arm circumference.
3. Details of admission: Duration of illness, Date of admission and discharge, Diagnosis, co-morbidities, Medications, Discharge status.
4. Mini Nutritional Assessment.
5. Serum albumin level.

At admission the medical records of the patients was scrutinized to obtain diagnosis at admission, drug history, and to corroborate information provided by patients during the interview. Different type of medications and number of medications administered were recorded. Patients' knowledge of their medication regimen was determined by asking them to recite their regimen and comparing this response with information in their medical records. Whenever possible, family members were consulted for further corroboration. For confused or unresponsive patients, the required information was obtained from family members or the caregivers.

Anthropometric parameters obtained and assessed at admission or within 24 hours of admission included:

a. Weight of the patient, measured using a common weighing scale used in the hospital in kilograms.
b. Heights measured as heel shin height in centimeters.
c. Mid-arm circumference was measured in centimeters at the mid-point between acromion and olecranon on the non dominant arm over the triceps with with arms hanging down and away from trunk and the forearm supinated.
d. For calf circumference with patient sitting on the end of the examining table, allow the legs to hang freely and then tape was applied horizontally around the maximum girth of calf.
e. BMI was also assessed at admission using the formula ;

$$\text{BMI } (kg/m^2) = [\text{Weight } (kg)] \div [\text{height } (m^2)]$$

Mini Nutritional Assessment (MNA®) scoring system was used to assess nutrition during the time of the interview at admission. The screening score was performed for

all patients, and when the score for a particular individual was 12 points or more, of a possible score of 14 points, the particular individual was considered as normal as per the validated questionnaire, the MNA®. Whereas, those individuals who scored less than 12 points were considered as possibly malnourished, and were assessed for malnutrition by completing the second part of the MNA® questionnaire, the MNA® Assessment. After the MNA® Assessment was completed, the individuals were classified as at risk of malnutrition if the score (Malnutrition Indicator Score) was in the range 17 to 23.5 points out of a possible 30 points. And those who scored less than 17 points on possible 30 points were classified as malnourished.

Serum albumin was obtained for all the cases and among the controls; it was not done for those were unwilling to provide a blood sample. Patients were followed up daily till they were discharged or died and medical and discharge records were also reviewed. Discharge status was recorded as per the discharge status as assessed by the treating physicians.

Definitions:

1. Body mass Index- defined as [264] a) Malnourished if BMI was less than 20 kg/m2.

b) Normal if BMI was between 20 and 25 kg/m2.

c) Overweight if BMI was between 25 and 30 kg/m2.

d) Obese if BMI was more than 30 kg/m2.

2. Mini Nutritional Assessment (MNA®) score [173]:

a. The screening score

≥ 12 points: Not malnourished.

< 12 points: Possibility of malnourishment exists.

b. Malnutrition Indicator Score

<17 points: Malnourished

17 to 23.5 points: At risk for malnutrition.

> 23.5 points: Normal nutritional status.

3. Serum albumin: [131, 240, 269]

a. < 3.5 mg%: Malnutrition.

b. ≥ 3.5 mg%: normal nutritional status.

4. Mid arm circumference: [181]

a. < 12 cm: malnutrition.

b. ≥ 12 cm: normal nutritional status.

Statistical analysis

Continuous variables are presented using mean ± standard deviation and categorical variables are presented using frequencies and %ages. Continuous variables were compared using Student's t test. Association between categorical variables was assessed using Chi-square test with Yates continuity correction. All statistical analyses were performed using SPSS 16.0 for windows. A p-value < 0.05 was considered to be statistically significant.

Results

The results of this study are based on, as mentioned in the methodology, evaluation and assessments of 50 elderly in patients, with age more than 60 years or above and 50 controls recruited prospectively over a period of eight months.

Part 1: Nutritional and non-nutritional risk factors for acute medical illness among elderly patients - Case-control analysis.

Age:

There were more controls in the age group range 60 to 69 years compared to cases (80% and 60% respectively (p 0.05). Among the cases, 34% were in the age group range 70 to 79 years. There were only 6% in the age group range of more than 80 years. (Refer to table 2 and Figure 6)

Among the controls, 15.7% of the controls were in the age group range 60 to 69 years. There was only one patient in the age group range of more than 80 years.

The mean age among the cases was 69.04 years (Standard deviation 6.8), and the mean age among the controls was 65.5 years (Standard deviation 5.4).

Age	Group				Total
	Case		Control		
	Male	Female	Male	Female	
60-69 years	16 (53.3%)	14 (70%)	16 (76.2%)	25 (86.3%)	71
70-79 years	11 (36.7%)	6 (30%)	5 (23.8%)	3 (10.3%)	25
≥80 years	3 (10.0%)	0	0	1 (3.4%)	4
Total	40 (80%)	20 (40%)	21 (42%)	29 (68%)	100

Table 2: Comparison of cases and controls by age.

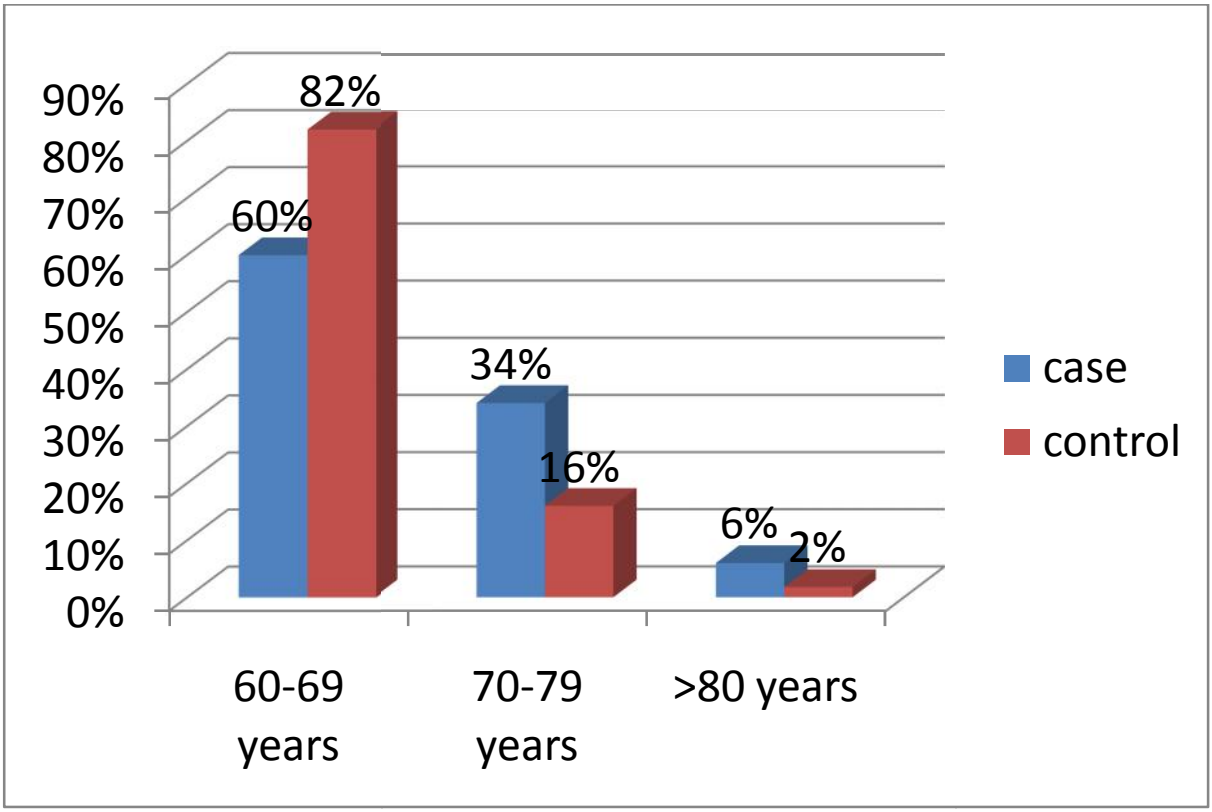

Figure 6: Comparison of cases and controls by age.

Weight and height:

Among the cases, the mean weight was 59.79 kilograms (standard deviation 11.610) as compared to the controls group, who had a mean weight of 60.5 kilograms (standard deviation 12.4).

Among the cases, the mean height was 159.7 centimetres (standard deviation 5.4), which was statistically significantly higher (p value = 0.0001) as compared to the controls group, who had a mean height of 154.7 centimetres (standard deviation 6.8).

Body mass index (BMI):

Among the cases, 20% compared to 10% among controls in the BMI group range of less than 20 kg\m^2. 46% of the cases and 50% of the controls were in the BMI group range of 20 to 25 kg\m^2. 6 % among cases and 12% of the controls were obese.

The mean BMI among the cases was 23.5 kg\m^2 with standard deviation of 4.7. The mean BMI among the controls was 25.1 kg\m^2 with standard deviation of 6.1. (Refer to table 3 and Figure 7)

BMI (kg\m^2)	Group		
	Case	Control	Total
<20	10 (20%)	5 (10%)	15 (15%)
20-25	23 (46%)	25 (50%)	48 (48%)
25-30	14 (28%)	14 (28%)	28 (28%)
>30	3 (6%)	6 (12%)	9 (9%)

Table 3: Comparison of cases and controls by BMI.

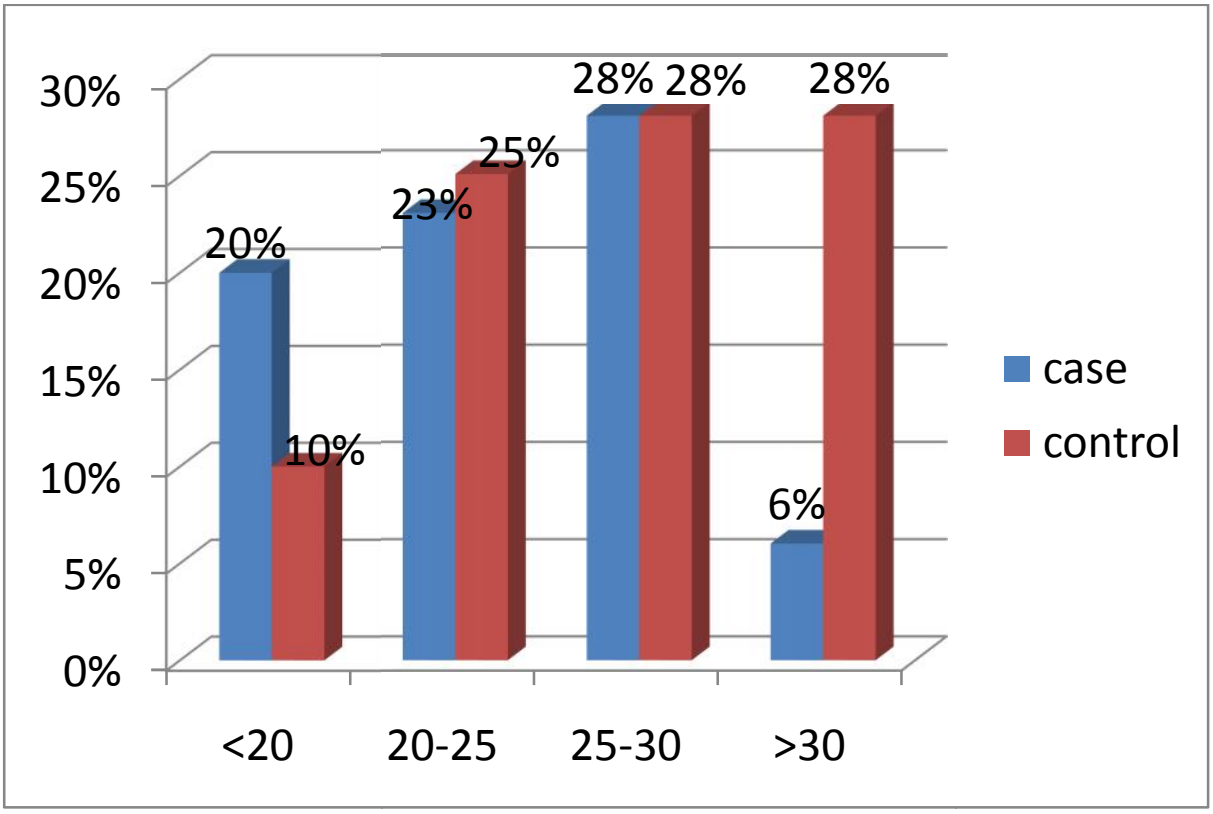

Figure 7: Comparison of cases and controls by BMI.

Co morbidities:

Among the cases, there were only 16% without any co morbidities. 58% of the cases were patients with hypertension. 68% of the cases were diabetics. 12 % were diagnosed cases of obstructive airway disease and 8% had ischaemic heart disease.

Among the controls, there were 66% without any co morbidities. 12% of the controls were patients with hypertension. 14% were diabetic. 10% were diagnosed cases of obstructive airway disease and 4% had ischaemic heart disease. The average number of co-morbidities among the cases was 2.02, while it was only 0.6 among the controls. There was a significant difference in the proportion of co morbidities between the cases and controls ($p < 0.001$). (Refer to table 4)

Co morbidities	Group		TOTAL
	Case	Control	
No co-morbidities	8 (16%)	33 (66%)	41
Hypertension	29 (58%)	6 (12%)	35
Diabetes	34 (68%)	7 (14%)	41
Obstructive airway disease	22 (22%)	5 (10%)	27
IHD	6 (12%)	3 (6%)	9
Old CVA	4 (8%)	2 (4%)	6
Arthritis	6 (12%)	5 (10%)	11
TOTAL	109	61	170

Table 4: Comparison of cases and controls by co morbidities (% totals more than 100% as a patient may have several co-morbidities)

Mini Nutritional Assessment - Screening score:

Evaluation of the screening score which indicates if the particular individual being screened is possibly malnourished or not, revealed that there was a significantly lower score among the cases as compared to the controls ($p < 0.001$). The mean score among the cases was 11 (standard deviation 3.024), while the mean score among the controls was 13.2 (standard deviation 1.1). The mean score among the cases was 11 (standard deviation 2.5). The cases were also 7.5 times more likely (95% CI = 1.5-52.3) to be at risk for malnutrition (Mini Nutritional Assessment - Screening score of less than 12) as compared to the controls.

Among the cases, 38% had scores of less than 12, while 12% among the controls had scores of less than 12 points. 62% among the cases had scores of l2 points or more, as compared to 88% among the controls. (Refer to table 5, Figure 8)

Table 5: Comparison of cases and controls by Mini Nutritional Assessment - Screening score.

Mini Nutritional Assessment - Screening score	Group			P-value
	Case	Control	Total	
<12	19 (38%)	6 (12%)	25 (25%)	< 0.001
≥12	31 62%	44 (88%)	75(75%)	

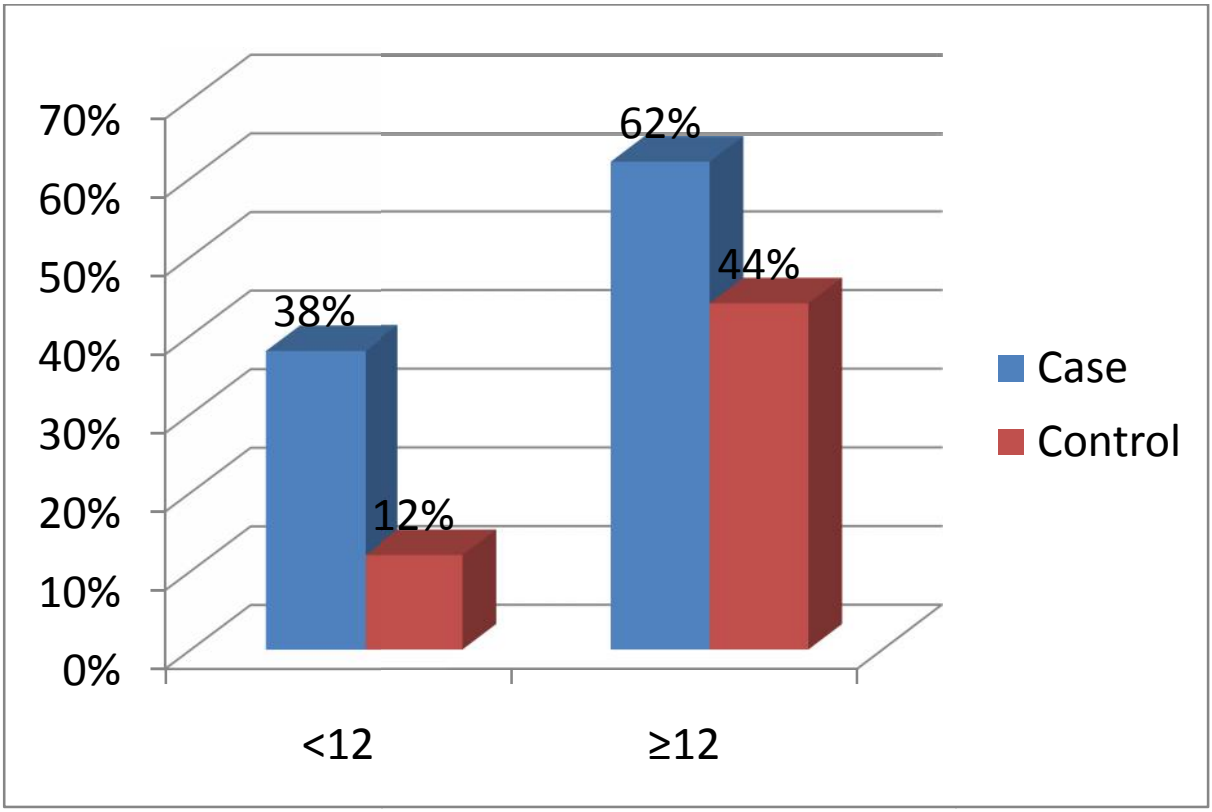

Figure 8: Comparison of cases and controls by Mini Nutritional Assessment - Screening score.

Mini Nutritional Assessment - Malnutrition Indicator Score:

Evaluation of the Malnutrition Indicator Score, performed among those with possible malnutrition as per Mini Nutritional Assessment (MNA®), revealed that the elderly patients with acute medical illnesses were significantly malnourished as compared to the controls (p 0.005). The mean score among the cases was 15.7 (standard deviation 3.03), while the mean score among the controls was 20.6 (standard deviation 4.6). The mean score across both the cases and controls was 116.8 (standard deviation 3.9). Cases were 4.5 times more likely (95% CI = 1.6-12.5) to have be malnourished (mini nutritional assessment - malnutrition indicator score of less than 17) as compared to the controls.

Among the elderly with acute medical illness, 24% were malnourished while only 2% were malnourished in the control group. Among the cases, 14% were at risk for malnutrition, while there were 8% of controls were at risk for malnutrition.

Among the cases, all patients (i.e. 19 patients) who had Mini Nutritional Assessment - Screening score less than 12 points, there were no patient with normal nutritional status. (Refer to table 6 and Figure 9)

Table 6: Comparison of of cases and controls by by Malnutrition Indicator Score.

Malnutrition Indicator Score	Group		P-value
	Case	Control	
<17 Points (Malnourished)	12 (24%)	2 (4%)	0.005
17-23.5 points (At risk for malnutrition)	7 (14%)	2 (4%)	
≥23.5 points (Normal nutritional status)	0	2 (4%)	

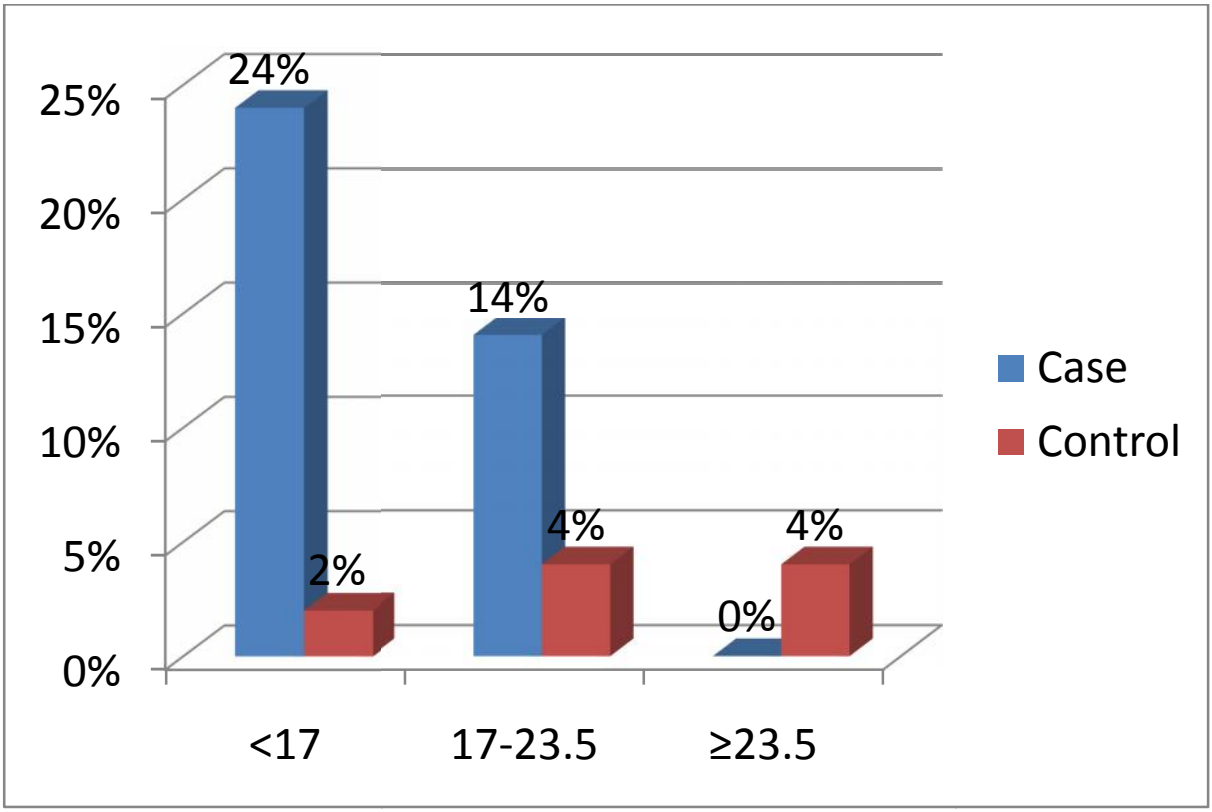

Figure 9: Comparison of of cases and controls by Malnutrition Indicator Score.

Mid arm circumference (MAC):

There were 82% among cases with acute medical illnesses and 96% among controls with mid arm circumference of more than 21 centimetres. This difference was statistically significant (p 0.025). The cases were also 5.3 times more likely (95% CI = 1.1-25.8) to have mid arm circumference of less than 12 as compared to the controls. The mean MAC across both the cases and controls was 24.5 cm (Standard deviation 3.5). The cases had a mean mid arm circumference of 23.1 centimetres (Standard deviation 2.6), and the controls had a mean mid arm circumference of 25.8 centimetres (Standard deviation 3.8). (Refer to table 7 and Figure 10)

Table 7: Comparison of cases and controls by mid arm circumference.

Mid arm circumference	Group			P-value
	Case	Control	Total	
<21 cm	9	2	11	0.025
	18%	4%	11%	
≥21 cm	41	48	89	
	82%	96%	89%	

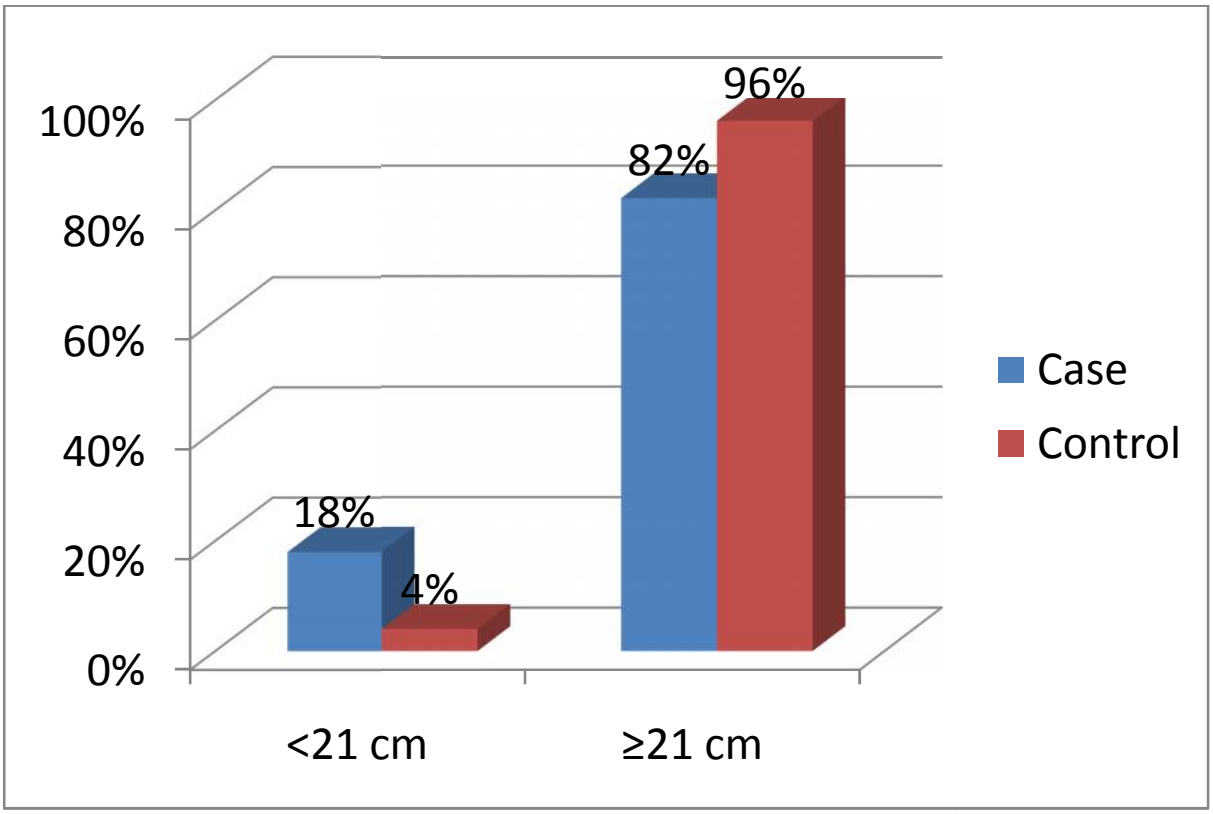

Figure 10: Comparison of cases and controls by mid arm circumference.

Serum Albumin:

Among the cases there were 58% with serum albumin level of less than 3.5 mg% as compared to only 2.1% of the controls. Two of the controls were unwilling to

give blood for testing serum albumin level. The mean serum albumin level across both the cases and controls was 3.8 mg%. The cases had a mean serum albumin level of 3.3 mg% (standard deviation 0.7), and the controls had a mean serum albumin level of 4.2 mg% (standard deviation 0.3). The cases had significantly lower serum albumin level as compared to the controls ($p < 0.001$). The cases were also 65 times more likely (95% CI = 8.3-508.6) to have low serum albumin of less than 3.5 mg% as compared to the controls. (Refer to table 8 and Figure 11)

Table 8: Comparison of cases and controls by serum albumin.

Serum albumin	Group		Total
	Case	Control	
<3.5 mg%	29 (58%)	1 (2.1%)	30 (30.6%)
>3.5 mg%	21 (42%)	47 (97.9%)	68 (69.4%)

	Group		p-value
	Case	Control	
Mean serum albumin	3.3 ± 0.7 mg%	4.2 ± 0.3 mg%	< 0.001

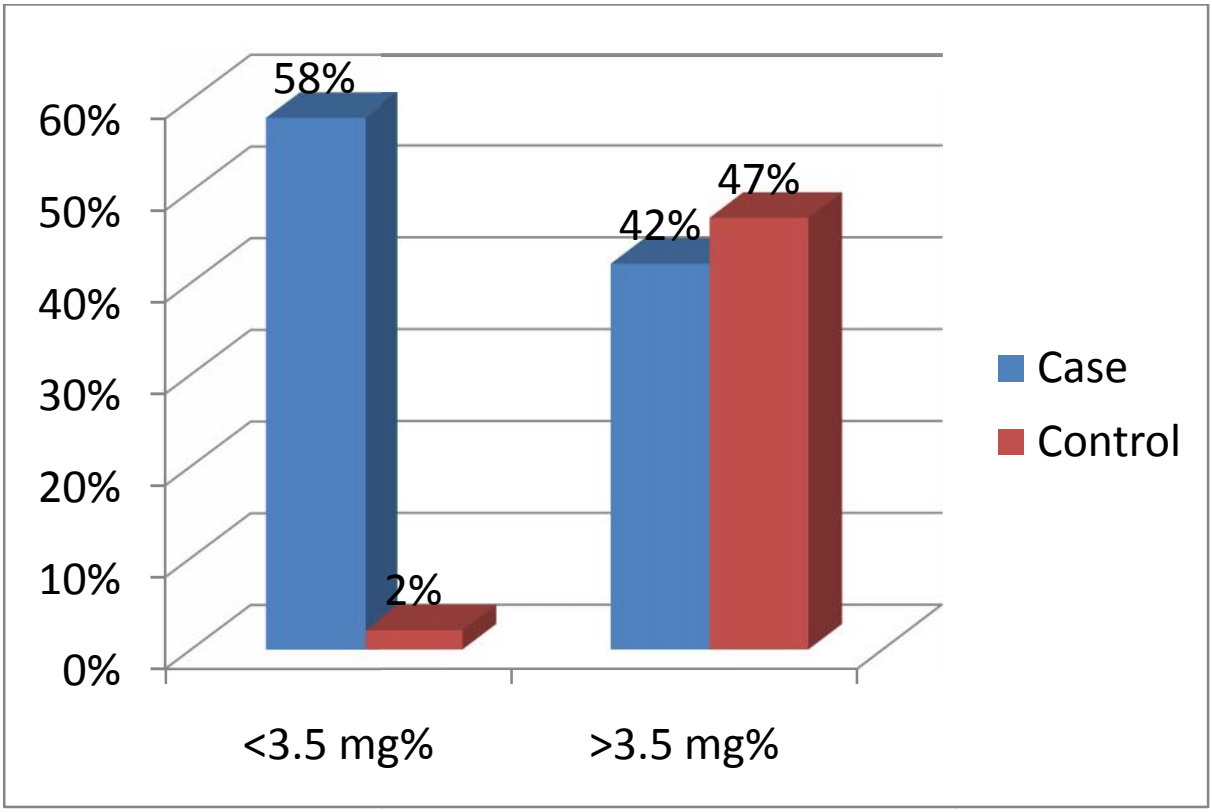

Figure 11: Comparison of elderly patients with and without medical illness by serum albumin.

Type of medication and number of drugs taken:

The elderly patients with acute medical illness were on significantly more number of medications in terms of different type of medication and total number of drugs taken as compared to the healthy controls.

60% of the controls were not on medications, while all cases were on medications. Antidiabetics and antimicrobials were the commonest drugs taken by the cases. Both the drugs were taken alone or in combination with other drugs by 34 patients each (68%). Antihypertensive drugs were taken by 58% (29 patients) of the elderly patients with acute medical illnesses. (Refer to table 9)

The mean numbers of drugs taken were: 4.7 (standard deviation 1.6) by cases and 1.02 (standard deviation 1.7) by controls. The difference was statistically significant ($p < 0.001$).

Table 9: Comparison of cases and controls by medication. (% totals more than 100% as a patient was on several different medications)

Medications	Group		Total	P- value
	Case	Control		
Not on medication	0	30 (60%)	30	< 0.001
Antimicrobials	34 (68%)	0	34	
Antidiabetic	34 (64%)	7 (14%)	41	
Antihypertensive	29 (58%)	6 (12%)	35	
Anti-platelets	20 (40%)	8 (16%)	28	
Bronchodilators	12 (24%)	5 (10%)	17	
Antipyretics/painkiller	34 (68%)	7 (14%)	41	
Nutritional supplements	8 (16%)	5 (10%)	13	
Total	171	68	239	

Part 2: DESCRIPTIVE ANALYSIS OF GERIATRIC PATIENTS WITH ACUTE MEDICAL ILLNESS.

Diagnosis at admission

Infection was the commonest diagnosis at admission among the cases. 34% of the cases were admitted with a primary diagnosis of infection. Cardiovascular illnesses were the next commonest diagnosis on admission. (Refer to figure 12)

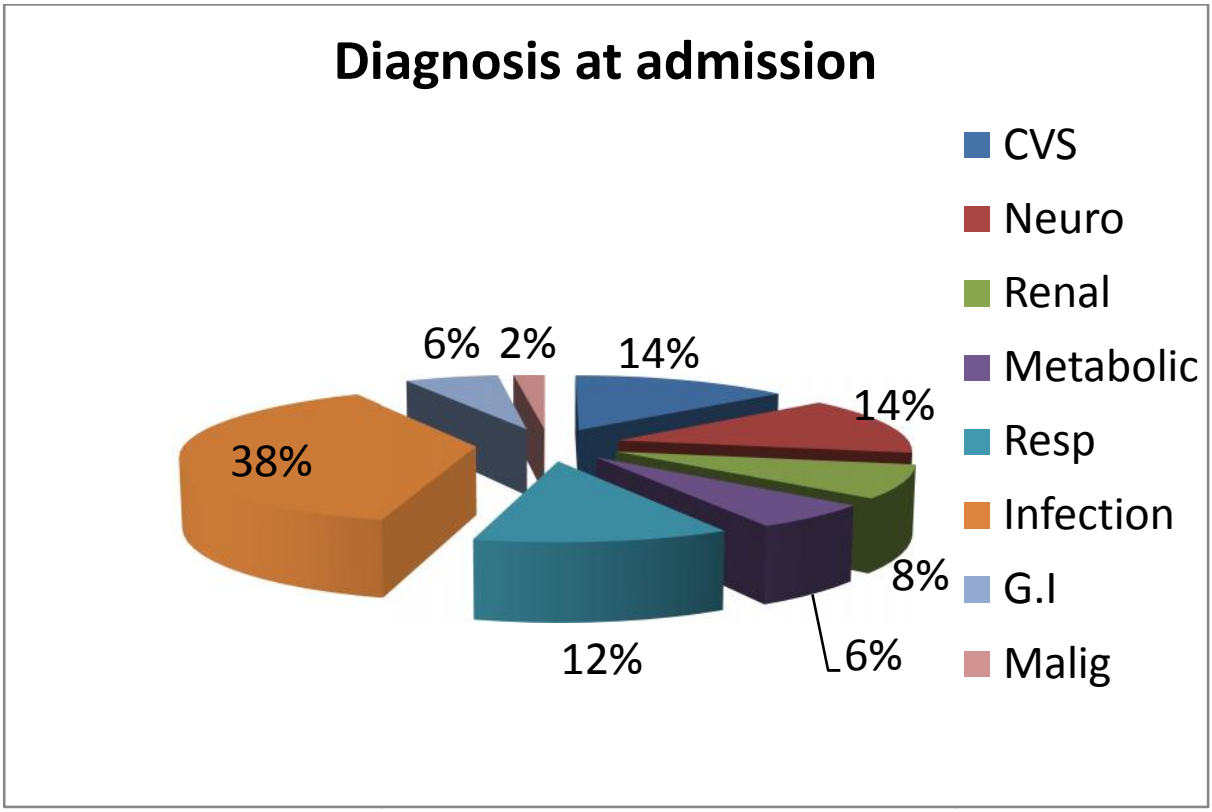

Figure 12: Distribution of disease among cases.

Duration of illness

20% of the cases were admitted with duration of illness of 7 days, 18% with1 day, and another 18% were admitted with duration of illness of 5 day. The mean duration of illness was 4.08 days (standard deviation 2.1).

Discharge status

Out of the 50 patients, 60% were cured, 15 patients improved, 2 were discharged in the same condition (discharged against medical advice), and 3 patients died. (Refer to figure 13)

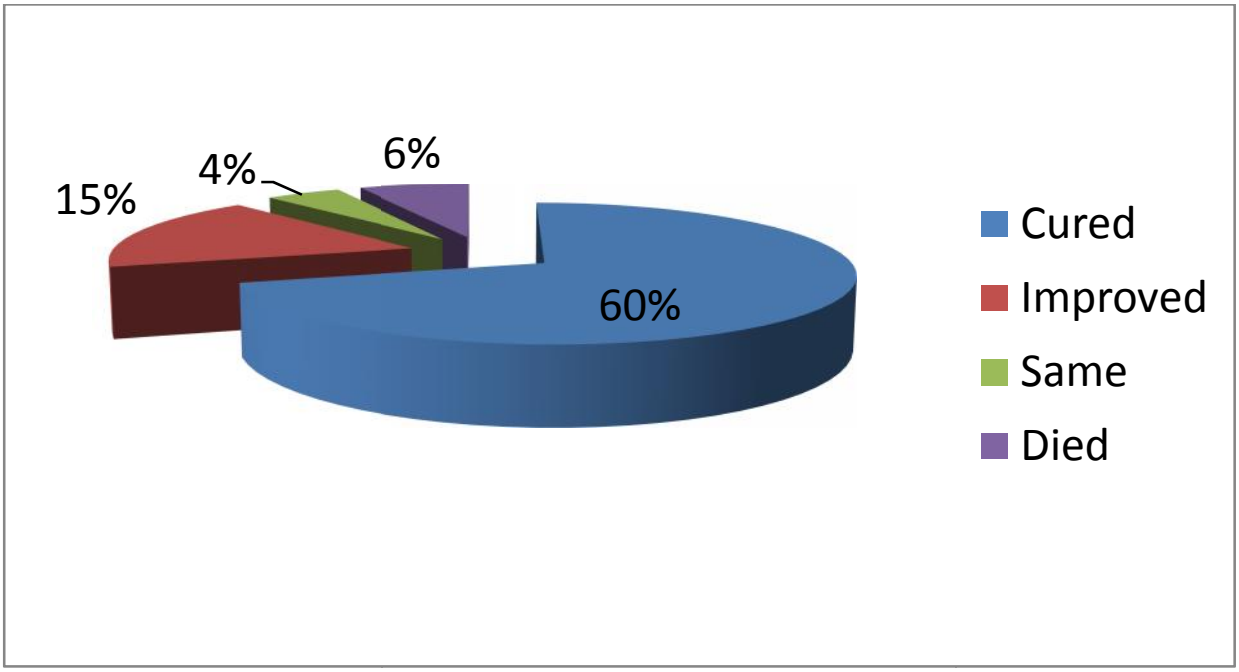

Figure 13: Distribution of medications taken among cases.

Outcome in terms of discharge status of admitted cases by age, gender, height and weight.

Age, gender, height and weight were found to have no relation to outcome as measured by discharge status among the acutely ill elderly patients. (Refer to table 10)

Table 10: Outcome in terms of discharge status of cases by age, gender, height and weight.

	Cured	Improved	Same	Died	P-value
Age (years)	69.4 ± 6.9	67.5 ± 6.9	68.5 ± 9. 2	73.3 ± 4	0.565
Males (n=30)	53.3%	33.3%	6.7%	6.7%	
Females	70%	25%	0	5%	

(n=20)					
Height (cm)	158.7 ± 5.3	160.7 ± 5.6	165.5 ± 2.1	161±4.4	0.273
Weight (cm)	60.6 ± 13	58.5 ± 10.1	53.5 ± 2.1	61.7 ± 8.1	0.812

Outcome in terms of discharge status among geriatric patients with acute medical illness by number of medications taken.

Number of medications taken by the patients did not influence the outcome as measured as discharge status. All the 3 patients who died were on anti hypertensives and antimicrobials, while 2 of the patients who died were on anti diabetic medication. All patients who died and had no improvement at discharge, were on 6 or more drugs. (Refer to table 11)

Table 11: Outcome in terms of discharge status among cases by number of drugs taken.

No. Of medications taken	Discharge status				
	Cured	Improved	Same	Died	Total
Two drugs	3	1	0	0	4
	10%	6.7%			8%
Three drugs	5	3	0	0	8
	16.7%	20%			16%
Four drugs	8	3	0	0	11
	26.7%	20%			22%
> Five drugs	6	5	2	3	16
	20%	33.3%	100%	100%	32%

Outcome in terms of discharge status among geriatric patients with acute medical illness by Mini Nutritional Assessment - Screening score:

Evaluation of the screening score, which indicates if the particular individual being screened is possibly malnourished or not, revealed that there was a significantly better outcome in terms of discharge status among those who scored more points as compared to those who scored less. There were 80% with scores of 12 points or above who were cured, while only 20% with scores of less than 12 points were cured. (Refer to Table 12 and figure 14).

The mean screening score across for those who were cured was 12.1 points (Standard deviation 2.2), 9.9 points (Standard deviation 2.6) for those who improved, 9.9 points (Standard deviation 2.6) for those who remains same, and 9 points (Standard deviation 5.6) for those who died. This difference was statistically significant (p 0.002).

Table 12: Outcome in terms of discharge status among the cases by Mini Nutritional Assessment - Screening score.

	Cured	Improved	Same	Died	P-value
MNA - Screening score	12.1 ± 2.2	9.9 ± 2.7	9.9 ± 2.6	9 ± 5.6	0.002

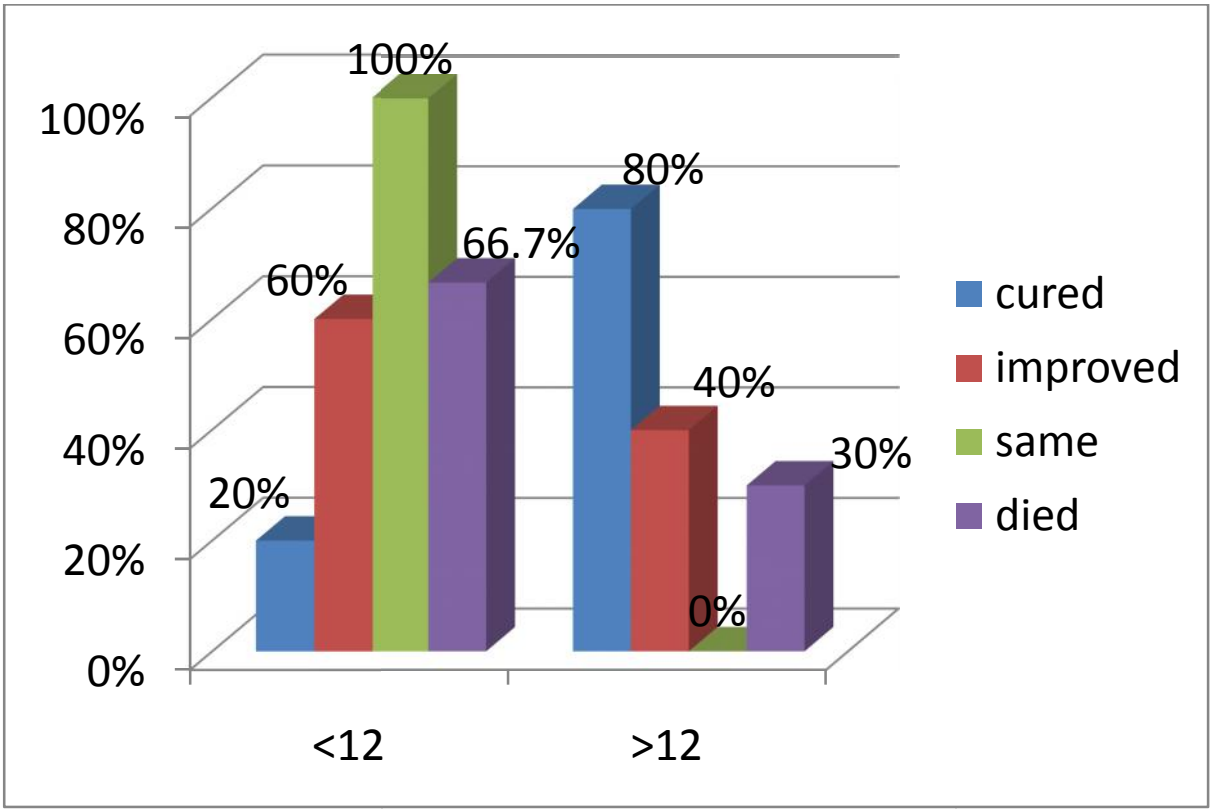

Figure 14: Distribution of outcome in terms of discharge status among cases by Mini nutritional assessment – scoring status.

Outcome in terms of discharge status among geriatric patients with acute medical illness by Mini Nutritional Assessment - Malnutrition Indicator Score:

Among those who scored less than 12 points in the MNA screening, none scored >23.5 points. Comparison of the < 17 points group and 17-23.5 points group as a factor for outcome in terms of discharge status among geriatrics patients with acute medical illness, revealed there it did not contribute to change in the outcome, measured as status at discharge. (Refer to table 13)

Table 13: Distribution of outcome in terms of discharge status among geriatric patients with acutely medical illness by Malnutrition indicator score.

Malnutrition Indicator Score	Discharge status				
	Cured	Improved	Same	Died	Total
< 17 points (Malnourished)	3	7	1	1	12
	50%	77.8%	50%	50%	63.2%
17 – 23.5 points (At risk for malnutrition)	3	2	1	1	7
	16.7%	20%	50%	50%	16%
>23.5 points Normal nutritional status	0	0	0	0	0

Outcome in terms of discharge status among geriatric patients with acute medical illness by serum albumin, weight and mid arm circumference:

Serum albumin, weight and mid arm circumference did not contribute to change in the outcome measured as discharge status among geriatric patients admitted with acute medical illness. (Refer to table 14)

	Cured	Improved	Same	Died	P-value
Serum albumin (mg%)	3.2 ± 0.7	3.5 ± 0.7	3.5 ± 0.3	3.3 ± 0.7	0. 382
Mid arm circumference (cm)	23.4 ± 1.6	22.7 ± 0.7	21.3 ± 0.2	23 ± 2.6	0.748
Weight (cm)	60.6 ± 13	58.5 ± 10.1	53.5 ± 2.1	61.6 ± 8.1	0.812

Table 14: Outcome in terms of discharge status among cases by serum albumin

Duration of admission:

The minimum number of days of admission in this study was 3 days, and the maximum duration of admission was 35 days. Mean duration of admission was 9.1 day (Standard deviation 6.4).

Outcome in terms of length of hospital stay among geriatric patients with acute medical illness by age, gender, body mass index (BMI), mid arm circumference, serum albumin levels, Mini Nutritional Assessment – screening score and Malnutrition Indicator Score:

Age, gender, body mass index (BMI), mid arm circumference, serum albumin, Mini Nutritional Assessment - Screening score levels and Malnutrition Indicator Score did not contribute to change in the outcome measured as duration admitted among geriatric patients admitted with acute medical illness.

Variable		Duration of admission (days)	p-value
Age (years)	60-69 years	9.5 ± 6.8	0.76
	70 to 79 years	8.9 ± 6.2	
	80 years and above	6.7 ± 3.2	
Males		8.7 ± 5.2	0.546
Females		9.8 ± 7.9	
BMI(kg\m^2)	less than 20	8.3 ± 3.9	0.872
	20 to 30	9.2 ± 7	
	more than 30	10.3 ± 6.3	
Mid arm circumference	<21 cm	9.1 ± 3.8	0.996
	>21 cm	9.1 ± 6.9	
Serum albumin	<3.5 mg%	9.14±4.749	0.982
	>3.5 mg%	9.1±8.306	
Mini Nutritional Assessment			
Screening score	<12 points	10.68±7.725	0.179
	≥12 points	8.16±5.361	
Malnutrition Indicator Score	<17 points	10.83±8.277	0.916
	17 to 23.5 points	10.43±7.3	
	>23.5 points	Nil	

Table 15: Predictors of length of hospital stay.

DISCUSSION:

During the last 15 years a considerable number of studies have examined the nutritional situation of institutionalized elderly and reported prevalence figures for malnutrition and nutritional problems. There is little information about the nutritional state of residents of elderly patients with acute medical illness in India. Malnutrition, particularly protein-energy malnutrition, is likely to be a common problem.

Since most institutionalized elderly in the acute care setting are more or less disabled and generally living in an institution because of their need of help or care, high prevalence rates of malnutrition could be expected as well in this group of elderly. In our study, nutritional status of hospitalized elderly Indians was compared with community dwelling elderly people. The prevalence of malnutrition among the elderly patients admitted with acute medical illnesses in this study was 24%, which is comparable to previous studies, done mostly in the west. Poor nutrition had been shown to be associated with increased risk of hospitalization. [150]The prevalence of this problem had not been well documented before in India, with the few studies there are suggesting a prevalence of only 5 – 65% [13, 14]. Silver et al, [196] in a study among 130 elderly patients in an academic nursing home, two thirds of whom were over the age of 65 years, estimated that as many 35% to 65% of older patients hospitalized for acute illness were malnourished. Matthias et al [266], in a recent German multicenter study, reported 56% of 306 geriatric patients in acute care settings were moderately or severely malnourished according to nutrition assessed by the subjective global assessment (SGA). The setting of this study being a tertiary care center, it is possible that those who approach this kind of care could be less malnourished as they are more likely to be more affluent than the general population

if elderly. Patients in whom adequate information for performing the MNA was not possible were excluded, and these patients may often be the more moribund and sicker patients, and possibly missing out on a proportion of malnourished patient due to this selection bias.

The prevalence of malnutrition among the community dwelling elderly in our study was 2%, comparable to some western studies, [15, 16, 17, 18] but much lower than previous Indian studies [23] where a study conducted in western India using the MNA found the overall prevalence of frank malnutrition to be 7.1% in community dwelling elderly. Most of the elderly (50.3%) were at risk of malnutrition and less than half of the elderly (42.6%) were fulfilling the criteria of normal nutritional status. Whereas, our study found 94% of the community dwelling to be having a normal nutrition, and 4% in the category of, at risk for malnutrition. The reason why the prevalence is so low in this study could reflect the fact that, the study being performed in a tertiary care setting, it is possible that the sample reflected the more affluent proportion of the population who can afford tertiary care, and thus better place in terms of resources, and therefore less likely to be malnourished. As at present there is no gold standard for evaluating nutritional status, [170] the variability of prevalence rates in different studies at different times could possibly reflect the fact that different criteria and methods can be used to define nutritional status.

Studies from a variety of clinical settings previously demonstrated a high degree of correlation between the measured value of various markers of protein calorie nutrition status and the risk of subsequent morbidity and mortality as malnutrition in the elderly is often associated with functional impairment, disability and impaired health.

The Mini Nutritional Assessment system was found to be associated with acute medical illness among the elderly. The elderly patients with acute medical illnesses were 4.5 times more likely (95% CI = 1.6-12.5) to have be malnourished (mini nutritional assessment - malnutrition indicator score of less than 17) as compared to the controls. This finding correlates with other studies looking at MNA and morbidities. [178, 180, 181] In a study conducted by Marie-Claire et al on a elderly population of 1319 patients, admitted in a tertiary hospital, where there was increase in hospital admission and a threefold death rate in the malnourished group (MNA score <17) compared with the well nourished group (MNA ≥ 24). The median length of hospital stay was also closely related to the MNA, and increased from 30.5 days in those with a score ≥ 24, to 42.0 days in those with a score < 17. [181]

The elderly patients with acute medical illnesses were 65 times more likely (95% CI = 8.3-508.6) to have low serum albumin of less than 3.5 mg% as compared to the controls. This finding correlates with previous studies, which showed that hypoalbuminemia correlates with total prognosis of patients; it is an independent indicator of severity of clinical state [247], poor functional status in older persons [248, 249], independently associated with poorer performance as assessed by objective physical performance tests [250], greater decline in functional status [251] and associated with increased mortality and morbidity rates in both hospitalized patient and samples of community dwelling elderly persons.[252, 253]

The elderly patients with acute medical illnesses were 5.3 times more likely (95% CI = 1.1-25.8) to have mid arm circumference of less than 12 centimeters as compared to the controls. This finding correlates with previous studies. In an elderly population of 1319 patients, admitted in a tertiary hospital, mid arm circumference less than 21 centimeters was associated with an increased risk of in-hospital death,

higher rate of nursing home transfer, and were related to a longer length of stay. [181]

Low Mini Nutritional Assessment - Screening score of less than 12 points was associated with poor outcome in terms of worse discharge status (p 0.002). In previous studies, Mini nutritional assessment has been found to predict outcome among elderly institutionalised patients in terms of mortality, length of hospital stay, and cost [179, 180] in other studies as well. The Malnutrition Indicator Score was not found to influence outcome probably because the sample size was very small (19 cases, 8 controls).

Polypharmacy has been known to be associated with increased hospitalization and mortality in the elderly [105] and it may lead to clinically detrimental outcomes and needless financial burden on elderly patients and the health care system. In our study, we also found polypharmacy in terms of usage of more total number of drugs and different drug were risk factor for acute medical illnesses among the elderly patients.

In our study, even though the mean Body mass index was lower in the cases (Cases - 23.45 ± 4.75 kg\m^2. Controls - 25.1 ± 6.1 kg\m^2) the difference was not found to be a statistically significant. Both extremes of BMI confer increased risk of mortality in older persons. [141, 160, 222, 223, 224] In the Epidemiologic Follow-up Study of the first National Health and Nutrition Examination Survey (NHEFS) (n = 14,407), a cohort study based on an representative sample of the U.S. population, it was found that increased risk of mortality was associated with lowest 15% of the elderly population and also the highest 15% of the elderly population. Mid arm circumference and serum albumin were also not found to influence outcome. The reason behind this most likely is because our patients are better nourished as they can afford tertiary care and may not reflect the true BMI in the community.

Limitations

1. The sample size was too small to detect significant outcome in terms of mortality and morbidity.

Conclusion

The important conclusions of this study are as follows:

1. 24% of the elderly patients with acute medical illnesses (cases) were malnourished compared to 2% among the community dwelling elderly people (controls), as assessed by the mini nutritional assessment.
2. 14% of the cases and 2% of the controls were found to be at risk for malnutrition as assessed by the mini nutritional assessment.
3. The mean age among the cases was 69 ± 6.8 years, and the mean age among the controls was 65.5 ± 5.4 years.
4. Cases were 4.5 times more likely (95% CI = 1.6-12.5) to be malnourished (mini nutritional assessment - malnutrition indicator score of less than 17) as compared to the controls.
5. The cases were also 7.5 times more likely (95% CI = 1.5-52.3) to be at risk for malnutrition (Mini Nutritional Assessment - Screening score of less than 12) as compared to the controls.
6. The elderly patients with acute medical illnesses were 5.3 times more likely (95% CI = 1.1-25.8) to have mid arm circumference of less than 12 centimeters as compared to the controls.

7. The elderly patients with acute medical illnesses were 65 times more likely (95% CI = 8.3-508.6) to have low serum albumin of less than 3.5 mg% as compared to the controls
8. The cases had significantly more co morbidities (Average number of co morbidities: 2.02) as compared to the controls (Average number of co morbidities: 2.02) ($p < 0.001$)
9. The cases were also on more number of drugs and more number of different type of drugs as compared to the controls (mean numbers of drugs taken: 4.7 ± 1.6 by cases, 1 ± 1.7 by controls. $p < 0.001$).
10. Among those elderly patients with acute medical illnesses, infectious illness was the commonest cause for seeking medical advice.
11. Cases with a low Mini Nutritional Assessment - Screening score of less than 12 points had of poorer outcome in terms of discharge status compared to the community dwelling elderly people.
12. There was no correlation between individual anthropometric measurements and outcome among the cases.

Malnutrition in older people is a serious and growing global problem. It is clear that there are multiple physiological and non-physiological causes for the development of PEM in elderly people. Under-nutrition in older people is undesirable and brings with it many adverse health outcomes. There is strong evidence that nutritional supplementation when provided to under-nourished older people in hospitals and long term care facilities, can decrease complications, decrease hospitalisation and even mortality. Research into better management strategies should strongly be encouraged and community awareness should be heightened. This study shows that malnutrition is a risk factor for acute medical illness among the

elderly people. It is imperative that interdisciplinary teams pay close attention to the nutritional status of elderly patients

Poor nutrition contributes significantly to the increased morbidity in terms of acute medical illness with onset of illness less than seven days among the elderly patients of age sixty years or more.

BIBLIOGRAPHY

1. Census of India (1991). Registrar General and Census Commissioner, India, Personal Communication Aug. 1992.
2. National Policy on older persons. 1996; 4-6.
3. BOLD, 2001 “Health Status of Elderly in India” International Institute of Ageing, United Nations, Malta.
4. United Nations (UN). The sex and age distribution of population, 1990.
5. Hobbs F, Damon B. 65+ in the United States, In Current Population Reports. Washington DC: US Bureau of Census; 1996. pp. 23-190.
6. Irudayarajan, S., S. Sharma and U. S Mishra,. 2000, India’s Elderly: Burden or Challenge? Sage Publishers, New Delhi.
7. Indrani Gupta, Deepa Sankar. Health of the Elderly in India: A Multivariate Analysis. Journal of Health & Population in Developing Countries, 24 June, 2003
8. Reddy, K.N. 1996 “Social Security for the Elderly in India: Need for Reform” Research and Development Journal Help Age India, 3 (1).
9. Kumar, P.V 1999 “Elderly Women in Rural India: Need for Policy Intervention” Help Age India, 5 (3), pp. 27-30.

10. Gupta, I., P. Dasgupta and M. Sawhney, 2001. “ Health of the Elderly in India: Some Aspects of Vulnerability” Discussion paper series No 26, Institute of Economic Growth, University Enclave, Delhi-7.

11. Rahul Prakash, S.K. Choudhary, Uday Shankar Singh, Morbidities among elderly in urban Rajasthan, Indian Journal of Community Medicine Vol. XXIX, No.1, Jan.-Mar., 2004.

12. Morley JE, Thomas DR. Anorexia and aging: pathophysiology. Nutrition 1999;15:499–503.

13. Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: the mini nutritional assessment as part of the geriatric assessment. Nutr Rev 1996;54:59-65.

14. M. L. Omran, J. E. Morley : Assessment of Protein Energy Malnutrition in Older Persons, Part I: History, Examination, Body Composition, and Screening Tools. *Nutrition* 2000;16:50–63.

15. Manson A, Shea S. Malnutrition in elderly ambulatory medical patients. Am J Public Health 1991;8l:l 195-7.

16. Dwyer JT. Screening older American’s nutritional health: current practices and future possibilities. Washington, DC: The Nutrition Screening Initiative, 1991.

17. Reuben DB, Greendale GA, Harrison GG. Nutrition screening in older persons. J Am Geriatr Soc l995;43:415-25.

18. Jensen GL. The rural elderly: living the good life? Nutr Rev 1996;54(suppl):S 17-21.

19. Sehl ME, Yates FE. Kinetics of human aging. I: Rates of senescence between ages 30 and 70 years in healthy people. J Gerontol 2001;56A:B198-20.

20. Saletti A, Lindgren EY, Johansson L, Cederholm T. Nutritional status according to mini nutritional assessment in an institutionalized elderly population in Sweden. Gerontology 2000;46:139–45.

21. Guigoz Y. The Mini Nutritional assessment (MNA®) review of the literature – what does it tell us? J Nutr Health Aging. 2006;10:466–485.

22. de Groot CP, van Staveren WA; Survey in Europe on Nutrition and the Elderly, a Concerted Action. Undernutrition in the European SENECA studies. Clin Geriatr Med. 2002;18:699-708.

23. Baweja S, Agarwal H, Mathur A, Haldiya K R, Mathur A. Assessment of Nutritional Status and Related Risk Factors in Community Dwelling Elderly in Western Rajasthan Journal of The Indian Academy of Geriatrics, 2008; 1:5-13

24. Vellas B. Effects of the aging process on the nutritional status of elderly persons. In Munro H, Schlierf G, ed.: Nestle Nutrition Workshop Series: Volume 29. Nutrition of the Elderly. NY: Raven Press, Ltd.; 1992.

25. Ahmed FE. Effect of nutrition on the health of the elderly. J. Am. Diet. Assoc. 1992; 92: 1102-1108.

26. Young ME. Malnutrition and wound healing. Heart and Lung. 1988; 17: 60-67.

27. Nutrition Strategic Study: A Report to the Director of the Ohio Department of Aging. Columbus, OH: Ohio Department of Aging; 1989.

28. Cornory-Huntley JC, Harris TB. An overview of body weight of older persons, including the impact on mortality. The National Health and Nutrition Examination Survey I – Epidemiologic Follow-up Study. J Clin Epidemiol. 1991; 44:743-53.

29. Andreyeva T, Sturm R, Ringel JS. Moderate and severe obesity have large differences in health care costs. Obes Res. 2004; 12:1936–43.

30. Calle EE, Teras LR, Thun MJ. Obesity and mortality. N Engl J Med. 2005;353:2197–9.

31. Wilson MMG, Morley JE. Aging and energy balance. J Appl Physiol. 2003;95:1728–1736.

32. Bales CW. What does it mean to be ‘‘at nutritional risk”? Seeking clarity on behalf of the elderly. Am J Clin Nutr 2001; 74:155-6.

33. Morley JE, Thomas DR, Wilson MM. Cachexia: pathophysiology and clinical relevance. Am J Clin Nutr. 2006; 83:735–43.

34. Moreiras O, van Staveren WA, Amorim Cruz JA, Carbajal A, de Henauw S, Grunenberger F, Roszkowski W. Longitudinal changes in the intake of energy and macronutrients of elderly Europeans. SENECA Investigators. Eur J Clin Nutr. 1996; 50:S67–S76.

35. Hays NP, Roberts SB. The anorexia of aging in humans. Physiol Behav. 2006; 88:257–66.

36. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 001;56:146–56.

37. Roberts SB, Rosenberg I. Nutrition and aging: changes in the regulation of energy metabolism with a Physiol Rev. 2006; 86:651–67.

38. Roberts SB, Dallal GE. Energy requirements and aging. Public Health Nutr. 2005; 8:1028–36.

39. Lammes E, Akner G. Resting Metabolic Rate in Elderly Nursing Home Patients with Multiple Diagnoses. J Nutr Health Aging. 2006;10:263–270.

40. Evans WJ. Exercise and muscle metabolism in the elderly. In: Hutchinson ML, Munro HN, eds. Nutrition and aging. New York, NY: Academic Press; 1986.

41. Roberts SB, Fuss P, Heyman MB, Evans WJ, Tsay R, Rasmussen H, Fiatarone M, Cortiella J, Dallal GE, Young VR.. Control of food intake in older men. JAMA. 1994; 272:1601–1606.

42. Morley JE Anorexia, body composition, and aging. Curr Op Clin Nutr Met Care. 2001;4;9–13c.

43. Clarkston WK, Pantano MM, Morley JE, Horowitz M, Littlefi eld JM, Burton FR. Evidence for the anorexia of aging: gastrointestinal transit and hunger in healthy elderly vs.young adults. Am J Physiol. 1997; 272:R243–8.

44. Rolls BJ, Dimeo KA, Shide DJ. Age-related impairments in the regulation of food intake. Am J Clin Nutr. 1995;62:923–31.

45. Hildebrandt GH, Dominguez LB, Schork MA & Loesche WJ. Functional units, chewing, swallowing, and food avoidance among the elderly. J Prosthet Dent. 1997;77:588–95.

46. Allen PF. Association between diet, social resources and oral health related quality of life in endetulous patients. J Oral Rehabil. 2005;32:6230628.

47. Soini H, Routasalo P, Lagstrom H. Characteristics of the Mini-Nutritional Assessment in elderly home-care patients. Eur J Clin Nutr. 2004;58:64–70.

48. Rammohan M, Juan D, Jung D. Hypophagia among hospitalized elderly. J. Am. Dietet. Assoc. 1989; 89: 1774-1779.

49. Sorenson A, Chapman N, Sundwall DN. Health promotion and disease prevention. In Chernoff R, ed.: Geriatric Nutrition: The Health Professional's Handbook. Gaithersburg, MD: Aspen Publishers, Inc.; 1991.

50. Senate Special Committee on Aging, AARP, Federal Council on the Aging, AoA. Aging America: Trends and Projections 1991 Edition. Washington, DC: USDHHS; 1991.

51. Bureau of the Census (U.S.), Taeuber CM. Current Population Reports, Special Studies, P23-178, Sixty five Plus in America. Washington, DC: U.S. GPO; 1992.

52. Ausman, Russell . Nutrition in the Elderly. In Shils ME, Olson JA, Shike M, ed: Modern Nutrition in Health and Disease, 8th Edition. Philadelphia: Lea & Febiger; 1994.

53. Blumberg JB, Suter P. Pharmacology, nutrition, and the elderly: interactions and implications. In Chernoff R, ed.: Geriatric Nutrition: The Health Professional's Handbook. Gaithersburg, MD: Aspen Publishers, Inc.; 1991.

54. Verbrugge LM. Gender, aging and health. In Markides KS, ed.: Aging and Health: Perspectives on Gender, Race, Ethnicity, and Class. Newbury Park, CA: SAGE Publications, Inc.; 1989.

55. Roe DA. Geriatric Nutrition, Third Edition. Englewood Cliffs, NJ: Prentice Hall, Inc.; 1992

56. Heber D. Cancer and malnutrition. In Morley JE, Glick Z, Rubenstein LZ, d.: Geriatric Nutrition. NY: Raven Press, Ltd.; 1990.

57. Gorbien MJ. Cardiac cachexia. In Morley JE, Glick Z, Rubenstein LZ, ed.: Geriatric Nutrition. NY: Raven Press, Ltd; 1990.

58. Carr JG, et al. Prevalence and hemodynamic correlates of malnutrition in severe congestive heart failure secondary to ischemic or idiopathic dilated cardiomyopathy. Am.J. Card. 1989; 63: 709-713.

59. Roe DA. Geriatric Nutrition, Second Edition. Englewood Cliffs, NJ: Prentice Hall, Inc.; 1987.

60. Dwyer J. Screening Older Americans' Nutritional Health: Current Practices and Future Possibilities. Washington, DC: Nutrition Screening Initiative; 1991.

61. Chernoff R. Nutritional support in the elderly. In Chernoff R, ed.: Geriatric Nutrition: The Health Professional's Handbook. Gaithersburg, MD: Aspen Publishers, Inc.; 1991.

62. Institute of Medicine, Division of Health Promotion and Disease Prevention. The Second Fifty Years: Promoting Health and Preventing Disability. Berg RL, Cassells JS ed.; Washington, DC: National Academy Press; 1990.

63. Martin WE. Oral health in the elderly. In Chernoff R, ed.: Geriatric Nutrition: The Health Professional's Handbook. Gaithersburg, MD: Aspen Publishers, Inc.; 1991.

64. Rhodus NL, Brown J. The association of xerostomia and inadequate intake in older adults. J. Am. Dietet. Assoc. 1990; 90: 1688-1692.

65. Frongillo EA, et al. Characteristics related to elderly persons' not eating for 1 or more days: implications for meal programs. Am. J. Pub. Health. 1992; 82: 600-602.

66. Abbasi AA, Rudman D. Observations on the prevalence of protein calorie undernutrition in VA nursing homes. J. Am. Geriat. Soc. 1993; 41: 117-121.

67. Sullivan DH, et al. Oral health problems and involuntary weight loss in a population of frail elderly. J. Am. Geriat. Soc. 1993; 41: 725-731.

68. Egbert AM. "The dwindles": failure to thrive in older patients. Postgrad. Med. 1993;94: 199-212.

69. Abbasi AA, Rudman D. Observations on the prevalence of protein calorie undernutrition in VA nursing homes. J. Am. Geriat. Soc. 1993; 41: 117-121.

70. Fischer J, Johnson MA. Low body weight and weight loss in the aged. J. Am. Diet. Assoc. 1990; 90: 1697-1706.

71. Silver AJ. Anorexia of aging and protein energy malnutrition. In Morely JE, Glick Z,Rubenstein LZ, ed.: Geriatric Nutrition: A Comprehensive Review. NY: Raven Press, Ltd.; 1990.

72. Heymsfield SB, Tighe A, Wang Z. Nutritional assessment by anthropometric and biochemical methods. In Shils ME, Olson JA, Shike M, ed.: Modern Nutrition in Health and Disease, Eighth Edition. Philadelphia: Lea & Febiger; 1994.

73. Robbins LJ. Evaluation of weight loss in the elderly. Geriat. 1989; 44: 31-37,

74. Thompson MP, Morris LK. Unexplained weight loss in the ambulatory elderly. J. Am. Geriat. Soc. 1991; 39: 497-500.

75. Mowe M, Bohmer T, Kindt E. Reduced nutritional status in an elderly population (70 y) is probable before disease and possibly contributes to the development of disease. Am. J. Clin. Nutr. 1994; 59: 317-324.

76. Rudman D, Feller AG. Protein calorie undernutrition in the nursing home. J. Am.Geriat. Soc. 1989; 37: 173-183.

77. Johnson LE, Dooley PA, Gleick BS. Oral nutritional supplement use in elderly nursing home patients. J. Am. Geriat. Soc. 1993; 41: 947-952.

78. Goodwin JS. Social, psychological and physical factors affecting the nutritional status of elderly subjects: separating cause and effect. Am. J. Clin. Nutr. 1989; 50: 1201-1209.

79. Bartlett BJ. Characterization of anorexia in nursing home patients. Ed. Geront. 1990; 16: 591;600.

80. Goodwin JS. Social, psychological and physical factors affecting the nutritional status of elderly subjects: separating cause and effect. Am. J. Clin. Nutr. 1989; 50: 1201;1209.

81. Rudman D, et al. Epidemiology of malnutrition in nursing homes. In Morley JE, Glick Z, Rubenstein LZ, ed.: Geriatric Nutrition: A Comprehensive Review. NY: Raven Press, Ltd.; 1990.

82. Herbelin K. Infection control in the long term care nursing facility. J. Am. Dietet. Assoc. 1989; 89: 1808-1809.

83. Federal Interagency Forum on Aging-Related Statistics. Older Americans Update 2006: Key Indicators of Well-Being. Washington, DC: US Government Printing Office; May 2006.

84. Gurwitz JH. Polypharmacy: A new paradigm for quality drug therapy in the elderly? Arch Intern Med. 2004;164: 1957-1959.

85. Grabowski H, Vernon J, DiMasi JA. Returns on research and development for 1990s new drug introductions. Pharmacoeconomics. 2002;20:11–29.

86. California Healthcare Foundation/American Geriatrics Society Panel on Improving Care for Elders with Diabetes. Guidelines for improving the care of the older person with diabetes mellitus. J Am Geriatr Soc. 2003;51:S265–S280.

87. National Heart, Lung, and Blood Institute. JNC7 Express: The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. National Institutes of Health pub no 03-5233. May 2003.

88. Hanlon JT, Ruby CM, Guay D, et al. Geriatrics. In: Dipiro JT, Talbert RL, Yee GC, et al, eds. Pharmacotherapy: A Pathophysiologic Approach. 5th ed. New York: McGraw Hill; 2002:79–89.

89. Chapman N, Sorenson A. Health promotion and aging: nutrition. Abdellah FG, Moore SR. Surgeon General's Workshop: Health Promotion and Aging Background Papers; Washington, DC: USPHS; 1988.

90. Roe DA. Geriatric Nutrition, Third Edition. Englewood Cliffs, NJ: PrenticeHall, Inc.; 1992.

91. Rosholm JU, Bjerrum L, Hallas J, et al. Polypharmacy and the risk of drug-drug interactions among Danish elderly. A prescription database study. Dan Med Bull. 1998;45:210–213.

92. Linjakumpu T, Hartikainen S, Klaukka T, et al. Use of medications and polypharmacy are increasing among the elderly. J Clin Epidemiol. 2002;55:809–817.

93. Bjerrum L, Sogaard J, Hallas J, et al. Polypharmacy: correlations with sex, age and drug regimen. A prescription database study. Eur J Clin Pharmacol. 1998;54:197–202.

94. Emily R. Hajjar, Angela C. Cafiero, Joseph T. Hanlon. Polypharmacy in Elderly Patients : AmJ Geriatr Pharmacother. 2007;5:345-351

95. Bjerrum L, Rosholm JU, Hallas J, et al. Methods for estimating the occurrence of polypharmacy by means of a prescription database. Eur J Clin Pharmacol. 1997;53:7–11.

96. Jorgensen T, Johansson S, Kennerfalk A, et al. Prescription drug use, diagnoses, and healthcare utilization among the elderly. Ann Pharmacother. 2001;35:1004–1009.

97. Chen YF, Dewey ME, Avery AJ. Analysis Group of The MRCCFA Study. The Medical Research Council Cognitive Function and Ageing Study (MRC CFAS). Self-reported medication use for older people in England and Wales. J Clin Pharm Ther. 2001;26:129–140.

98. Lassila HC, Stoehr GP, Ganguli M, et al. Use of prescription medications in an elderly rural population: the MoVIES Project. Ann Pharmacother. 1996;30:589–595.

99. Fillit HM, Futterman R, Orland BI, et al. Polypharmacy management in Medicare managed care: changes in prescribing by primary care physicians resulting from a program promoting medication reviews. Am J Manag Care. 1999;5:587–594.

100. Kaufman DW, Kelly JP, Rosenberg L, et al. Recent patterns of medication use in the ambulatory adult population of the United States: the Slone survey. JAMA. 2002;287:337–344.

101. Varma RN. Risk for druginduced malnutrition is unchecked in elderly patients in nursing homes. J. Am. Dietet. Assoc. 1994; 94: 192194.

102. Pirmohamed M, James S, Meakin S, et al. Adverse drug reactions as cause of-admission to hospital: Prospective analysis of-18,820 patients. BMJ. 2004;329:15-19.

103. Mannesse CK, Derkx FH, de Ridder MA, et al. Contribution of-adverse drug reactions to hospital admission of-older patients. Age Ageing. 2000;29:35-39.

104. Veehof'LJ, Stewart RE, Meyboom-deJong B, et al. Adverse drug reactions and polypharmacy in the elderly in general practice. EurJ Clin Pkarmacol. 1999;55:533-536.

105. Espino DV, Bazaldua OV, Palmer RF, et al. Suboptimal medication use and mortality in an older adult community-based cohort: Results from the Hispanic EPESE Study. J GerontolA Biol Sci MedSci. 2006;61:170-175.

106. Fulton MM, Allen ER. Polypharmacy in the elderly: A literature review. J Am Acad Nurse Prad:. 2005;17:1 23-132.

107. Hanlon JT, Schmader KE, Kornkowski MJ, et al. Adverse drug events in high risk older outpatients. J Am Geriatr Soc. 1997;45:945-948.

108. Gurwitz JH, Field TS, Harrold LR, et al. Incidence and preventability of adverse drug events among older persons in the ambulatory setting. JAMA 2003;289:1107-16.

109. Ernst FR, Grizzle AJ. Drug-related morbidity and mortality: updating the cost-of-illness model. J Am Pharm Assoc 2001;41:192-9. Prevost EA, Butterworthe CE Jr. Nutritional care of hospitalized patients. Am J Clin Nutr 1974;27:432.

110. Rhodus NL, Brown J. The association of xerostomia and inadequate intake in older adults. J. Am. Dietet. Assoc. 1990; 90: 1688-1692.

111. Campbell CC. Food insecurity: a nutritional outcome or a predictor variable? J. Nutr. 1991; 121: 408-415.

112. Institute of Medicine, Division of Health Promotion and Disease Prevention. The Second Fifty Years: Promoting Health and Preventing Disability. Berg RL, Cassells JS ed.;Washington, DC: National Academy Press; 1990.

113. Rosenbloom CA, Whittington FJ. The effects of bereavement on eating behaviors and nutrient intakes in elderly widowed persons. J. Gerontol. 1993; 48: S223S229.

114. McCormack, P. (1997) Undernutrition in the elderly population living at home in the community: a review of the literature. J. Adv. Nurs. 26: 856–8.

115. Lesourd, B. M. (1997) Nutrition and immunity in the elderly: modification of immune responses with nutritional treatments. Am. J. Clin. Nutr. 66: 478S–484S.

116. Ritchie, C. S., Burgio, K. L., Lochler, J. L., Cornwell, A., Thomas, D., Hardin, M. & Redden D. (1997) Nutritional status of urban homebound older adults. Am. J. Clin. Nutr. 66: 815–818.

117. Galanos, A. N., Pieper, C., Cornoni-Huntley, J. C., Bales, C. W. & Fillenbaum, G. G. (1994) Nutrition and function: is there a relationship between body mass index and the functional capabilities of community-dwelling elderly? J. Am. Geriatr. Soc. 42: 368–373.

118. Landi, F., Zuccala, G., Gambassi, G., Incalzi, R. A., Manigrasso, L.,Pagano, R., Carbonin, P. U. & Bernabei, R. (1999) Body mass index and mortality among older people living in the community. J. Am. Geriatr. Soc. 47: 1072–1076.

119. Markson, E. W. (1997) Functional, social and psychological disability as causes of loss of weight and independence in older community-living people. Clin. Geriatr. Med. 13: 639–652.

120. Hildebrand, J. K., Joos, S. K. & Lee, M. A. (1997) Use of the diagnosis “failure to thrive” in older veterans. J. Am. Geriatr. Soc. 45: 1113–1117.

121. J. W., Launer, L. J., Witteman, J.C.M., den Breeijen, J. H., Breteler, M.M.B., Grobbee, D. E. & Hofman, A. (1996) Dietary antioxidants and cognitive function in a population-based sample of older persons: the Rotterdam study. Am. J. Epidemiol. 144: 275–280.

122. LaRue, A., Koehler, K. M., Wayne, S. J., Chiulli, S. J., Haaland, K. Y. & Garry, P. J. (1997) Nutritional status and cognitive functioning in a normally aging sample: a 6-y reassessment. Am. J. Clin. Nutr. 65: 20–29.

123. Pennypacker, L. C., Allen, R. H., Kelly, J. P., Matthews, L. M., Grigsby, J., Kaye, K., Lindenbaum, J. & Stabler, S. P. (1992) High prevalence of

cobalamin deficiency in elderly outpatients. J. Am. Geriatr. Soc. 40: 1197–1204.

124. McGandy, R. B., Russell, R. M., Stuart, S. C., Hartz, S. C., Jacob, R. A., Tannenbaum, S., Peters, H., Sahyoun, N. & Otradovec, C. L. (1986) Nutritional status survey of healthy noninstitutionalized elderly: energy and nutrient intakes from three-day diet records and nutrient supplements. Nutr. Res. 6: 785–798

125. Bogan, A. D. (1997) Nutrient intakes of senior women: balancing the low-fat message. Can. J. Public Health 88: 310–313.

126. Ryan, A. S., Craig, L. D. & Finn, S. C. (1992) Nutrient intakes and dietary patterns of older Americans: a national study. J. Gerontol. 47: M145–M150

127. Cid-Ruzafa, J., Caulfield, L. E., Barron, Y. & West, S. K. (1999) Nutrient intakes and adequacy among an older population on the eastern shore of Maryland: the Salisbury Eye Evaluation. J. Am. Diet. Assoc. 99: 564–571.

128. Sullivan DH, Moriarty MS. Chernoff R, et al. Patterns of care: an analysis of the quality of nutritional care routinely provided to elderly hospitalized veterans. JPEN J Parenter Enteral Nutr l989;l3:249-54.

129. Doweiko JP, Nompleggi DJ. The role of albumin in human physiology. Part III: albumin and disease states. JPEN J Parenter Enteral Nutr 1991; 15:476-83.

130. Sullivan DH. Risk factors for early hospital readmission in a select population of geriatric rehabilitation patients. J Am Geriatr Soc 1992;40:792-8.

131. Corti MC, Guralnik JM, Salive ME, et al. Serum albumin level and physical disability as predictors of mortality in older persons. JAMA 1994;272: 1036-42.

132. Rudman D, Mattson DE, Nagraj HS, et al. Prognostic significance of serum cholesterol in nursing home men. JPEN J Parenter Enteral Nutr 1988; 12: 155-8.

133. Forette B, Tortrat D, Wolmark Y. Cholesterol as a risk factor for mortality in elderly women. Lancet 1989;l:868-70.

134. Kaiser FE. Cholesterol and the older adult. South Med J 1993;86:25l 1-4.

135. Incalzi RA, Capparella O, Gemma A, et al. Inadequate caloric intake: a risk factor for mortality of geriatric patients in the acute-care hospital. Age & Ageing. 1998;27:303–310.

136. Wedick NM, Barrett-Connor E, Knoke JD, Wingard DL. The relationship between weight loss and all-cause mortality in older men and women with and without diabetes mellitus: the Rancho Bernado Study. J Am Geriatr Soc 2002; 50:1810-5.

137. Newman AB, Yanez D, Harris T, Duzbury A, Enright PL, Fried LP, et al. Weight change in old age and its association with mortality. J Am Geriatr Soc 2001;49:1309-18.

138. Landi F, Onder G, Gambassi G, Pedone C, Carboni P, Bernabei R. Body mass index and mortality among hospitalized patients. Arch Intern Med 2000;160:2641-4.

139. Miller MD, Crotty M, Giles LC, Bannerman E, Whitehead C, Cobiac L, et al. Corrected arm muscle area: an independent predictor of long-term

mortality in community-dwelling older adults? J Am Geriatr Soc 2002;50:1272-7.

140. Apovian CM, Frey CM. Rogers JZ, McDermott EA, Jensen GL. Body mass index and physical function in obese older women. J Am Geriatr Soc 1996;44:l487-8.

141. Harris TB, Cook EF, Garrison R, et al. Body mass index and mortality among non smoking older persons. The Framingham Heart Study. JAMA 1988;259: 1520-4.

142. Bistrian BR, Sherman M, Blackburn GL, Marshal R, Shaw C. Cellular immunity in adult merasmus. Arch Intern Med 1977;137:1408-11.

143. Sullivan DH, Patch GA, Walls RC, Lipschitz DA. Impact of nutritional status on morbidity and mortality in a select population of geriatric rehabilitation patients. Am J Clin Nutr 1990;51:749-58.

144. Heatley RV, Williams RHP, Lewis MH. Pre-operative intra-venous feeding - a controlled trial. Postgrad Med J 1979;55:541-5.

145. Hanson LC, Weber DJ, Rutala WA, Samsa GP. Risk factors for nosocomial pneumonia in the elderly. Am J Med 1992;92:161-6.

146. Dionigi R, Gnas F, Bonera A, Dominioni L. Nutrition and infection. J Parenter Enteral Nutr 1979;3(2):62-8.

147. Potter J, Klipstein K, Reilly JJ, Roberts R. The nutritional status and clinical course of acute admissions to a geriatric unit. Age Ageing 1995;24:131-6.

148. Sullivan DH, Walls RC. Impact of nutritional status on morbidity in a population of geriatric rehabilitation patients. J Am Ger Soc 1994;42:471-7.

149. Muhlethaler R, Stuck AE, Minder CE, Frey BM. The prognostic significance of protein-energy malnutrition in geriatric patients. Age Ageing 1995;24:193-7.

150. Gordon L Jensen, Janet M Friedmann, Christopher D Coleman, and Helen Smiciklas-Wright, Screening for hospitalization and nutritional risks among community-dwelling older persons, Am J Clin Nutr 2001;74:201–5.

151. Schorah CJ, Morgan DB. Nutritional deficiencies in the elderly. Hosp Update 1985 May:353-60

152. Koehler K. The New Mexico Aging Process Study. Nutr Rev1994;52:S34-7.

153. Visvanathan R. Under-nutrition in older people: a serious and growing global problem! J Postgrad Med 2003;49:352– 60.

154. Thomas DR, Zdrowski CD, Wilson MM, et al. Malnutrition in subacute care. Am J Clin Nutr 2002;75:308 –13.

155. Compan B, di Castri A, Plaze JM, Arnaud-Battandier F. Epidemiological study of malnutrition in elderly patients in acute, sub-acute and long-term care using the MNA. J Nutr Health Aging 1999;3:146 –51.

156. Constans 1, Bacg Y, Brechot II', et al. Protein-energy malnutrition in elderly medical patients. J Am Geriatr Soc 1992;40:263-8.

157. Dey DK, Rothenberg E, Sundh V, Bosaeus I, Steen B. Body mass index, weight change and mortality in the elderly. A 15 y longitudinal population study of 70 y olds. Eur J Clin Nutr 2001;55:482–92.

158. Wallace JI, Schwartz RS, LaCroix AZ, Uhlmann RF, Pearlman RA. Involuntary weight loss in older outpatients: incidence and clinical significance. J Am Geriatr Soc 1995;43:329 –37

159. Sullivan DH, Walls RC. The risk of life-threatening complications in a select population of geriatric patients: the impact of nutritional status. J Am Coll Nutr 1995;14:29 –36.

160. Potter JF, Schafer DF, Bohi RL. In-hospital mortality as a function of body mass index: an age-dependent variable. J Gerontol 1988;43:M59–63.

161. Cederholm T, Jagren C, Hellstrom K. Outcome of protein-energy malnutrition in elderly medical patients. Am J Med 1995;98:67–74.

162. Longjian Liu et al.,Undernutrition and Risk of Mortality in Elderly Patients Within 1 Year of Hospital Discharge ; Journal of Gerontology 57, no. 11 (2002): M741-46.

163. McNab H, Restivo R, Ber L, et al. Dietetic quality assurance practices in Chicago area hospitals. J Am Diet Assoc 1987;85:635–7.

164. Kamath SK, Lawler M, Smith AE, et al. Hospital malnutrition: a 33-hospital screening study. J Am Diet Assoc 1986;86:203–6.

165. Tobias AL, Van Itallie TB. Nutritional problems of hospitalized patients. J Am Diet Assoc 1977;71:253–7.

166. Riffer J. Malnourished patients feeding rising costs. Hospitals 1986; 60:86.

167. Sullivan D, Sun S, Walls RC. Protein-energy undernutrition among elderly hospitalized patients: a prospective study. JAMA 1999;281:2013–9.

168. Abraham S, Carroll MD, Dresser CM, et al. Dietary intake of persons 1–74 years of age in the United States. Adv Data 1977:G(March 30).

169. Morley J.E. Why do physicians fail to recognize and treat malnutrition in older persons? J Am Geriatr Soc 1991;39:1139–40.

170. Yitshal N. Berne: Assessment Tools for Nutritional Status in the Elderly. IMAJ 2003;5:365-367.

171. Klein S, Kinney J, Jeejeebhoy K, et al. Nutrition support in clinical practice: review of published data and recommendations for future research directions. Am J Clin Nutr 1997;66:683-706.

172. Guigoz Y, Vellas B & Garry PJ (1994): Mini nutritional assessment: a practical assessment tool for grading the nutritional state of elderly patients. Facts. Res. Gerotol. 4(Suppl 2), 15 – 59.

173. Katz S, Ford AB, Moskowitz RW, et al. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. JAMA 1963;185:914.

174. Vellas B, Guigoz Y, Baumgartner M, Garry PJ, Lauque S, Albarede JL. Relationships between nutritional markers and the mini-nutritional assessement in older persons. J Am Geriatr Soc 2000; 48(10):1300–9.

175. Gazzoti C, Pepinster A, Petermans J & Albert A (1997): Interobserver agreement on MNA nutritional scale of hospitilized elderly patients. J. Nutr. Health Aging 1,23 – 27.

176. Morley JE. Anorexia of aging: physiologic and pathologic. Am J Clin Nutr 1997;66:760.

177. Kagansky N, Berner Y, Koren-Morag N, Perelman L, Knobler H, Levy S. Poor nutritional habits are predictors of poor outcome in very old hospitalized patiens. Am J Clin Nutr 2005; 82(4):784–791.

178. Ruiz-Lopez MD, Artacho R, Oliva P, Moreno-Torres R, Bolanos J, de Teresa C et al. Nutritional risk in institutionalized older women determined by

the Mini Nutritional Assessment test. What are the main factors? Nutr 2003; 19(9):767–71.

179. Beck AM, Ovesen L & Osler M (1999): The mini nutritional assessment (MNA) and the determine your nutritional health checklist (NSI Checklist) as predictors of morbidity and mortality in an elderly Danish population. Br. J. Nutr. 81,31 – 36.

180. Hanson RL, McCance DR, Jacobsson LTH, et al. The U shaped association between body mass index and mortality: relationship with weight gain in a Native American population. J Clin Epidemiol 1995;48:903-16.

181. Van Nes MC, Herrmann FR, Gold G, Michel JP, Rizzoli R. Does the mini nutritional assessment predict hospitalization outcomes in older people? Age Ageing 2001;30:221-6.

182. Seigneuric B, Vellas B, Denat M, Conte J, Albarede JL. Assessment of the nutritional state of the elderly hemodialysis patient by MNA (Mini Nutritional Assessment). In: Bertiere MC, Chumlea WmC, Garry PJ, Sachet P, Vellas B, eds. *Nutrition personnes aˆge´es*. Paris: CERIN, 1997:341.

183. Wissing U & Unosson M (1999): The relationship between nutritional status and physical activity, ulcer history and ulcer-related problems in patients with leg and foot ulcers. Scand. J. Caring Sci. 13, 123 – 128.

184. Saletti A, Johansson L & Cederholm T (1999): Mini nutritional assessment in elderly subjects receiving home nursing care. J. Hum. Nutr. Dietet. 12, 381 – 387.

185. L Christensson, M Unosson and A-C Ek: Evaluation of nutritional assessment techniques in elderly people newly admitted to municipal care. European Journal of Clinical Nutrition (2002) 56, 810 – 818.

186. Friedman PJ, Campbell AJ, Caradoc-Davies TH. Prospective trial of a new diagnostic criterion for severe wasting malnutrition in the elderly. Age Ageing 1985;14:149.

187. Friedman PJ. A prospective comparison of methods to identify lethal wasting malnutrition. Nutr Res 1986;6:139

188. Potter JF, Schafer DF, Bohi RL. In hospital mortality as a function of body mass index: an age-dependent variable. J Gerontol Med Sci 1988;43:M59.

189. Campbell AJ, Spears GFS, Brown JS, et al. Anthropometric measurements as predictors of mortality in a community population aged 70 years and over. Age Ageing 1990;19:131.

190. Milne JS. Longitudinal studies of body weight and skinfold thickness in older people. J Clin Exp Gerontol 1979;1:101.

191. Chumlea WC, Baumgartner RN. Status of anthropometry and body composition data in elderly subjects. Am J Clin Nutr 1989;50:1158.

192. Burr ML, Lennings CI, Milbank JE. The prognostic significance of weight and of vitamin C status in the elderly. Age Ageing 1982;11:249.

193. Rossman I. Anatomic and body composition changes with aging. In: Finch CE, Hayflick L, ed. Handbook of the biology of aging. New York: Van Nostrand Reinhold, 1977:66.

194. Klieber M. The fire of life. Huntington, NY: Robert E. Krieger Publishing, 1985.

195. McGandy RB, Barrows CH, Spanias A, et al. Nutrient intakes and energy expenditure in men of different ages. J Gerontol 1966;21:581.

196. Silver AJ, Morley JE, Storme LS, et al. Nutritional status in an academic nursing home. J Am Geriatr Soc 1988;36:487.

197. Lew EA, Garfinkel L. Variations in mortality by weight among 750,000 men and women. J Chron Dis 1979;32:563.

198. Steen B, Lundgren BK, Isaksson B. Body composition at age 70, 75, 79, and 81 years: a longitudinal population study. In: Chandra RK, ed. Nutrition, immunity and illness in the elderly. New York: Pergamon Press, 1985:144.

199. Sandman PO, Adolfsson R, Nygren C, et al. Nutritional status and dietary intake in institutionalized patients with Alzheimer's disease and multiinfarct dementia. J Am Geriatr Soc 1987;35:31 Allman RM, Laprade CA, Noel LB, et al. Pressure sores among hospitalized patients. Ann Intern Med 1986;105:337.

200. Allman RM, Laprade CA, Noel LB, et al. Pressure sores among hospitalized patients. Ann Intern Med 1986;105:337.

201. Anderson KE, Kvorning SA. Medical aspects of the decubitus ulcer. Int J Dermatol 1982;21:265

202. Pinchcofsky-Devin GD, Kaminski MV. Correlation of pressure sores and nutritional status. J Am Geriatr Soc 1986;34:435.

203. Bienia R, Ratcliff S, Barbour G, et al. Malnutrition in the hospitalized geriatric patient. J Am Geriatr Soc 1982;30:433.

204. Thompson JS, Robbins J, Cooper JK. Nutrition and immune function in the geriatric population. Clin Geriatr Med 1987;3:309.

205. Chandra RK. Nutrition-immunity-infection interactions in old age. In: Chandra RK, ed. Nutrition, immunity and illness in the elderly. New York: Pergamon Press, 1985:173.

206. Keys A, Brozek J, Herschel A, et al. The biology of human starvation, vol. 1. Minneapolis: University of Minnesota Press, 1950.

207. Epstein AM, Read JL, Hoefer M. The relation of body weight to length of stay and charges for hospital services for patients undergoing elective surgery: a study of two procedures. Am J Public Health 1987;77:993.

208. Campillo B, Bories PN, Devanley M, et al. Energy expenditure and nutritional status: evidence of denutrition-related hypermetabolism. Ann Nutr Metab 1992; 36:265.

209. Blaum CS, O'Neill EF, Clements KM, et al. Validity of the Minimum Data Set for assessing nutritional status in nursing home residents. Am J Clin Nutr 1997;66:787.

210. Norris AH, Lundy T, Shock NW. Trends in selected indices of body composition in men between the ages 30 and 80 years. Ann NY Acad Sci 1963;110:623.

211. Hertzog KP, Garn SM, Hempy HO. Partitioning the effects of secular trend and aging on adult stature. Am J Phys Anthropol 1969;31:111.

212. Young CM, Blondin J, Tensuan R, et al. Body composition studies of "older" women, thirty to seventy years of age. Ann NY Acad Sci 1963;110:598.

213. Chumlea WC, Garry PJ, Hunt WC, et al. Serial changes in stature and weight in a healthy elderly population. Hum Biol 1988;60:918.

214. Committee on Diet and Health, Food and Nutrition Board, Commission on Life Sciences, National Research Council Diet and Health. Implications for reducing chronic disease risk. Washington DC: National Academy Press, 1989.

215. Garrow JS, Webster J. Quetelet's index (W/H2) as a measure of fatness. Int J Obes 1985; 9:147.

216. Committee on Diet and Health, Food and Nutrition Board, Commission on Life Sciences, National Research Council Diet and Health. Implications for reducing chronic disease risk. Washington DC: National Academy Press, 1989.

217. Shetty P, JamesWPF. Body mass index: a measure of chronic energy deficiency in adults. FAO Food and Nutrition Paper No. 56. Rome: 1994.

218. Micozzi MS, Albanes D, Jones DY. Correlations of body mass indices with weight, stature and body composition in men and women in NHANES I and II.Am J Clin Nutrit 1986:44:725-31

219. Feinleib M. Epidemiology of obesity in relation to health hazards. Ann Intern Med 1985;103:1019.

220. World Health Organization. Health in the elderly. World Health Organ Tech Rep Ser 1989;779.

221. Andres R, Elahi D, Tobin JD, et al. Impact of age on weight goals. Ann Intern Med 1985;103:1030.

222. Andres R. Mortality and obesity. In: Andres R, Bierman EL, Hazzard WR, eds. Principles of geriatric medicine. New York: McGraw-Hill, 1985:99.

223. Dequeker JV, Baeyens JP, Claessens J. The significance of stature as a clinical indicator of aging. J Am Geriatr Soc 1969;15:169.

224. Brozek J, Keys A. Evaluation of leanness-fatness in man: norms and interelationships. Br J Nutr 1951;5:194.

225. Wannamethee G, Shaper AG. Body weight and mortality in middle aged British men: impact of smoking. BMJ 1989;299: 1497-1502.

226. Vandenbroucke JP, Mauritz BJ, de Bruin A, et al. Weight, smoking, and mortality. JAMA 1984;252:2859-60.

227. Yao C-H, Slattery ML, Jacobs DR Jr, et al. Anthropometric predictors of coronary heart disease and total mortality: findings from the US Railroad Study. Am J Epidemiol 1991 ;134: 1278-89.

228. Jarrett RJ, Shipley MJ, Rose G. Weight and mortality in the Whitehall Study. BMJ 1982;285:535-7.

229. Waaler HTh. Height, weight, and mortality: the Norwegian experience. Acta Med Scand 1984;S679:2-56.

230. Pascale LR, Grossman MI, Sloane HS, et al. Correlations between thickness of skinfolds and body density in 88 soldiers. Hum Biol 1956;28:165.

231. Parizkova J. Total body fat and skinfold thickness in children. Metabolism 1961;10:794.

232. Fletcher RF. The measurment of total body fat with skinfold calipers. Clin Sci 1962;22:333.

233. Nutrition Screening Initiative. Nutrition screening manual for Professionals caring for older Americans. Washington, DC: Nutrition Screening Initiative, 1991Behnke AR, Wilmore JH. Evaluation and regulation of body build and composition. Englewood Cliffs, NJ: Prentice Hall, 1974.

234. Noppa H, Anderson M, Bengtsson C, et al. Body composition in middle-aged women with special reference to the correlation between body fat mass and anthropometric data. Am J Clin Nutr 1979;32:1388.

235. Womersley J, Durnin JVGA. A comparison of skinfold method with extent of overweight and various weight-height relationships. Br J Nutr 1977;38:271.

236. Jensen TG, Dudrick SG, Johnson DA. A comparison of triceps skinfold and upper arm circumference measurements taken in standard and supine positions. JPEN 1981;5:519.

237. Chumlea WC, Roche AF, Mukherjee D, et al. Errors of measurement for methods of recumbent nutritional anthropometry in the elderly. J Nutr Elder 1985;5:3.

238. Sullivan DH, Patch GA, Baden AI, et al. An approach to assessing the reliability of anthropometrics in elderly patients. J Am Geriatr Soc 1989; 37:607.

239. Huang Y, Shinzawa H, Togashi H, et al. Interleukin-6 down-regulates expressions of the aldolase B and albumin genes through a pathway involving the activation of tyrosine kinase. Arch Biochem Biophys 1995;320:203–9.

240. Covinsky KE, Covinsky MH, Palmer RM, Sehgal AR. Serum albumin concentration and clinical assessments of nutritional status in hospitalized older people: different sides of different coins? J Am Geriatr Soc 2002;5:631–7.

241. Maria Ponzetto, Barbara Maero, Paola Maina, Rosalba Rosato, Giovannino Ciccone, Franco Merletti, Laurence Z. Rubenstein and Fabrizio Fabris. Risk Factors for Early and Late Mortality in Hospitalized Older

Patients: The Continuing Importance of Functional Status. J Gerontol A Biol Sci Med Sci. 2003 Nov;58(11):1049-54.

242. Kohout P. Výživa u pacientů s idiopatickými střevními závody. Praha: Maxdorf; 2004.

243. Sahyoun NR, Jacques PF, Dallal G, et al. Use of albumin as a predictor of mortality in community-dwelling and institutionalized elderly populations. J Clin Epidemiol 1996;49:981– 8.

244. Fried LP, Kronmal RA, Newman AB, et al. Risk factors for 5-year mortality in older adults. JAMA 1998;279:585–92.

245. Corti M, Guralnik JM, Salive ME, Sorkin JD. Serum albumin level and physical disability as predictors of mortality in older persons. JAMA 1994;272:1036–42.

246. Anderson CF. Wochos DN. The utility of serum albumin values in the nutritional assessment of hospitalized patients. Mayo Clin Proc 1982; 57:181-4.

247. Zadák Z. Výživa v intenzivní péči. Praha: Grada Publishing; 2002.

248. Wu AW, Yasui Y, Alzola C, et al. Predicting functional status outcomes in hospitalized patients aged 80 years and older. J Am Geriatr Soc 2000;48(suppl):S6 –15.

249. Jensen GL, Kita K, Fish J, Heydt D, Frey C. Nutrition risk screening characteristics of rural older persons: relation to functional limitations and health care charges. Am J Clin Nutr 1997;66:819 –28.

250. Ferrucci L, Penninx BW, Leveille SG, et al. Characteristics of nondisabled older persons who perform poorly in objective tests of lower extremity function. J Am Geriatr Soc 2000;48:1102–10.

251. Zuliani G, Romagnoni F, Volpato S, et al. Nutritional parameters, body composition, and progression of disability in older disabled residents living in nursing homes. J Gerontol A Biol Sci Med Sci 2001;56: M212–6.

252. Ferguson RP, O'Connor P, Crabtree B, Batchelor A, Mitchell J, Coppola D. Serum albumin and prealbumin as predictors of clinical outcomes of hospitalized elderly nursing home residents. J Am Geriatr Soc. 1993;41:545-549.

253. Herrmann FR, Safran C, Levkoff SE, Minaker KL. Serum albumin level on admission as a predictor of death, length of stay, and readmission. Arch Intern Med.1992;152:125-130.

254. Lowrie E, Lew N. Death risk in hemodialysis patients: the predictive value of commonly measured variables and an evaluation of death rate differences between facilities. Am J Kidney Dis 1990;15:458.

255. Goldwasser P, Feldman J. Association of serum albumin and mortality risk. J Clin Epidemiol 1997;50:693.

256. Rall LC, Roubenoff R, Harris TB. Albumin as a marker of nutritional and health status. In: Rosenberg IH, ed. Nutritional assessment of elderly populations, vol.13. New York: Raven Press, 1995:40.

257. Tietz N, Shuey D, Wekstein R. Laboratory values in fit aging individuals sexagenarians through centenarians. Clin Chem 1992;38:1167.

258. Courtney ME, Greene HL, Folk CC, et al. Rapidly declining serum albumin values in newly hospitalized patients: prevalence, severity, and contributory factors. JPEN 1982;6:143.

259. Statland BE, Bokelund H, Winkel P. Factors contributing to intra-individual variation of serum constituents in healthy subject. Clin Chem 1974;20:1513.

260. Dixon M, Paterson CR. Posture and the composition of plasma. Clin Chem 1978;24:824.

261. Rothschild MA, Oratz M, Schreiber SS. Serum albumin. Hepatology 1988;8: 385.

262. Doweiko JP, Nompleggi DJ. The role of albumin in human physiology and pathophysiology, part III: albumin and disease states. JPEN 1991;15:476.

263. Grimble R. Serum albumin and mortality (letter). Lancet 1990;335:350.

264. Dana Hrnciarikova, Bozena Juraskova, Zdenek Zadakb, Miloslav Hronek. Present state of evaluating malnutrition in the elderly – analyzing indicators. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2006, 150(2):217–221.

265. Friedman PJ, Campbell AJ, Caradoc-Davies TH. Prospective trial of a new diagnostic criterion for severe wasting malnutrition in the elderly. Age Ageing 1985;14:149-54.

266. Matthias Pirlich , Tatjana Schutz, Kristina Norman, Sylvia Gastell. The German hospital malnutrition study. Clinical Nutrition (2006) 25, 563–572.

267. Tracy Dixon, Mary Shaw, Stephen Frankel, Shah Ebrahim Hospital admissions, age, and death: retrospective cohort study. BMJ 2004 328: 0.

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268. James Gibbs, William Cull, William Henderson, Preoperative Serum Albumin Level as a Predictor of Operative Mortality and Morbidity. Arch Surg. 1999;134:36-42.

269. Marıa M, Claudia H, Farah,Annlia Paganini, Association of Body Mass Index and Weight Change with All-Cause Mortality in the Elderly. Am J Epidemiol 2006;163:938–949.

ANNEXURE C: CLINICAL PROFORMA FOR EVALUATION OF PATIENTS

INCLUDED IN STUDY OF NUTRITIONAL STATUS AMONG ELDERLY PATIENTS WITH ACUTE MEDICAL ILLNESS.

Patient/Control

1. **Name**: ..... 2. **Age**: ..... 3. **Hospital no**.

4. **Weight**: ..... kgs 5. **Height**: ..... cms 6. **BMI**: .....

7. **Duration of illness**: ..... Days/Months/Years

8. **Date of admission**: ..... 9. **Date of Discharge**: .....

10. **Diagnosis**:
.....

11. **Principal Symptoms**
...../NA
...../NA
...../NA

12. **Co-Morbidities**:

13. **Medications**:

14. **MNA Score**: .....

15. **Mid Arm Circumference**: .....

16. **Serum Albumin**: .....

17. **Condition on Discharge**: Cured/Improved/Same/Died

MINI NUTRITIONAL ASSESSMENT
MNA®

ID# _____

Last Name: _____ First Name: _____ M.I. _____ Sex: _____ Date: _____

Age: _____ Weight, kg: _____ Height, cm: _____ Knee Height, cm: _____

Complete the form by writing the numbers in the boxes. Add the numbers in the boxes and compare the total assessment to the Malnutrition Indicator Score.

ANTHROPOMETRIC ASSESSMENT

	Points
1. Body Mass Index (BMI) (weight in kg) / (height in m)² a. BMI < 19 = 0 points b. BMI 19 to < 21 = 1 point c. BMI 21 to < 23 = 2 points d. BMI ≥ 23 = 3 points	☐
2. Mid-arm circumference (MAC) in cm a. MAC < 21 = 0.0 points b. MAC 21 ≤ 22 = 0.5 points c. MAC > 22 = 1.0 points	☐.☐
3. Calf circumference (CC) in cm a. CC < 31 = 0 points b. CC ≥ 31 = 1 point	☐
4. Weight loss during last 3 months a. weight loss greater than 3kg (6.6 lbs) = 0 points b. does not know = 1 point c. weight loss between 1 and 3 kg (2.2 and 6.6 lbs) = 2 points d. no weight loss = 3 points	☐

GENERAL ASSESSMENT

5. Lives independently (not in a nursing home or hospital) a. no = 0 points b. yes = 1 point	☐
6. Takes more than 3 prescription drugs per day a. yes = 0 points b. no = 1 point	☐
7. Has suffered psychological stress or acute disease in the past 3 months a. yes = 0 points b. no = 2 points	☐
8. Mobility a. bed or chair bound = 0 points b. able to get out of bed/chair but does not go out = 1 point c. goes out = 2 points	☐
9. Neuropsychological problems a. severe dementia or depression = 0 points b. mild dementia = 1 point c. no psychological problems = 2 points	☐
10. Pressure sores or skin ulcers a. yes = 0 points b. no = 1 point	☐

DIETARY ASSESSMENT

11. How many full meals does the patient eat daily? a. 1 meal = 0 points b. 2 meals = 1 point c. 3 meals = 2 points	☐

	Points
12. Selected consumption markers for protein intake • At least one serving of dairy products (milk, cheese, yogurt) per day? yes ☐ no ☐ • Two or more servings of legumes or eggs per week? yes ☐ no ☐ • Meat, fish or poultry every day? yes ☐ no ☐ a. if 0 or 1 yes = 0.0 points b. if 2 yes = 0.5 points c. if 3 yes = 1.0 points	☐.☐
13. Consumes two or more servings of fruits or vegetables per day? a. no = 0 points b. yes = 1 point	☐
14. Has food intake declined over the past three months due to loss of appetite, digestive problems, chewing or swallowing difficulties? a. severe loss of appetite = 0 points b. moderate loss of appetite = 1 point c. no loss of appetite = 2 points	☐
15. How much fluid (water, juice, coffee, tea, milk,...) is consumed per day? (1 cup = 8 oz.) a. less than 3 cups = 0.0 points b. 3 to 5 cups = 0.5 points c. more than 5 cups = 1.0 points	☐.☐
16. Mode of feeding a. Unable to eat without assistance = 0 points b. self-fed with some difficulty = 1 point c. self-fed without any problem = 2 points	☐

SELF ASSESSMENT

17. Do they view themselves as having nutritional problems? a. major malnutrition = 0 points b. does not know or moderate malnutrition = 1 point c. no nutritional problem = 2 points	☐
18. In comparison with other people of the same age, how do they consider their health status? a. not as good = 0.0 points b. does not know = 0.5 points c. as good = 1.0 points d. better = 2.0 points	☐.☐

ASSESSMENT TOTAL (max. 30 points): ☐☐.☐

MALNUTRITION INDICATOR SCORE		
≥ 24 points	well-nourished	☐
17 to 23.5 points	at risk of malnutrition	☐
< 17 points	malnourished	☐

Ref.: Guigoz Y, Vellas B and Garry PJ. 1994. Mini Nutritional Assessment: A practical assessment tool for grading the nutritional state of elderly patients. *Facts and Research in Gerontology.* Supplement #2: 15-59.

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ANNEXURE B: BASIC DATA OF ELDERLY PATIENTS WITH ACUTE MEDICAL ILLNESS (CASES) FOR EVALUATION OF PATIENTS INCLUDED IN STUDY OF NUTRITIONAL STATUS AMONG ELDERLY PATIENTS WITH ACUTE MEDICAL ILLNESS.

Name	Hospital no	Age	Sex	Weight	Height	BMI	Co morbidities	Drugs	No Of Drugs	MNS	MNA	TOTAL	MAC	Albumin
Vitto Bai	827762A	79	female	46	153.2	19.6	6	7	5	6	6.5	12.5	19.2	2.9
Chitta Nandi	188690D	62	male	55	167.0	19.7	0	12	3	3	8.0	11.0	21.5	3.3
Ganesan	874941C	61	male	38	149.0	17.1	3	8	6	8	6.0	14.0	20.0	3.9
Krishnan	107435C	74	male	60	164.0	22.4	2	6	6	13	99.0	13.0	26.0	2.6
Anandan	183018D	65	male	60	164.0	22.4	0	1	3	14	99.0	14.0	24.0	4.5
Thomas	194162D	79	male	60	166.0	21.8	5	10	3	6	10.0	16.0	20.6	2.5
Yasodhammal	190809D	65	female	42	146.0	19.7	3	4	6	12	99.0	12.0	21.0	3.1
Meera	623321C	67	female	87	158.0	34.9	5	6	5	14	99.0	14.0	30.0	3.3
Jothi	353101B	67	female	104	154.0	43.9	6	8	6	13	99.0	13.0	30.0	2.8
Mariappan	189999D	65	male	56	166.0	20.3	6	10	5	6	6.0	12.0	21.8	2.9
Venkatappa.B	189849D	79	male	55	171.0	18.8	5	10	3	5	8.0	13.0	20.5	2.5
Pushpa Rani	186224D	70	female	60	146.0	28.1	0	1	6	14	99.0	14.0	27.8	2.8
Krishnaswamy	260318D	65	female	60	156.0	24.7	2	2	3	8	8.0	16.0	24.0	3.9
Chinnammal A	065191C	66	female	50	151.0	21.9	2	2	2	9	7.5	16.5	24.0	3.6
Chinnaswamy	325959B	87	male	62	162.0	23.3	6	10	5	12	99.0	12.0	22.4	2.5
Sita Agarwal	177726D	60	female	66	161.0	25.5	6	11	4	14	99.0	14.0	26.0	2.6
Thangaraj	706319B	74	male	56	164.0	20.8	6	10	5	3	6.0	9.0	21.0	2.5
Pullamma	182842D	74	female	74	164.0	29.0	6	8	6	12	99.0	12.0	25.0	4.7
Ponnuvel	175461D	66	male	54	160.0	21.1	3	4	5	13	99.0	13.0	24.0	3.6
Murugesh	397620C	62	male	66	162.0	25.1	5	8	6	13	99.0	13.0	24.2	3.9
Lakshmamma	181011D	65	female	66	156.0	27.1	5	10	6	14	99.0	14.0	26.0	3.9
Shantha kumari	413818D	62	female	51	158.0	20.4	4	3	3	10	6.5	16.5	21.0	3.3
Ramadass	099691D	61	male	67	163.2	25.3	2	8	5	13	99.0	13.0	22.0	3.4
Thameem Bai	671771B	71	male	51	160.2	20.0	5	11	4	12	99.0	12.0	21.4	4.2
Soundarian	781732B	62	female	62	158.4	24.7	2	6	5	13	99.0	13.0	23.3	4.6

Boologan	189811D	67	male	52	156.0	21.4	6	11	4	13	99.0	13.0	20.4	2.0
Venkatesh	194164D	64	male	58	163.3	21.7	0	1	3	12	99.0	12.0	21.3	3.4
Radhamma.Y	259157D	76	female	58	155.2	24.1	2	6	2	14	99.0	14.0	22.2	3.0
Dhanapal.K	296718B	71	male	51	160.0	19.9	0	1	2	9	8.5	17.5	20.3	3.0
Subramani.S	359326A	84	male	49	160.0	19.3	1	2	6	8	9.0	17.0	24.0	3.7
Alagesan.A.	163818D	60	male	55	164.0	20.4	2	3	4	12	99.0	12.0	26.0	3.3
Rehmath Bee	267347D	71	female	70	159.2	27.2	6	8	4	14	99.0	14.0	24.2	3.5
Shanmuga M	278168D	74	male	74	168.0	26.2	5	11	5	12	99.0	12.0	26.4	3.1
Kuppuswamy	284026D	80	male	56	158.0	22.4	0	4	6	9	9.5	18.5	21.6	3.8
Mahalingam N	277857D	61	male	72	164.0	26.8	0	1	2	14	99.0	14.0	24.0	3.7
Pulla Reddy.S	273032D	65	male	67	163.0	25.4	6	13	4	11	10.0	21.0	22.4	1.8
Zabrunissa	275239D	60	female	70	159.0	27.7	1	13	6	12	99.0	12.0	24.0	3.9
Anandan.P.C	756203C	65	male	55	164.0	20.4	1	7	4	12	99.0	12.0	20.4	3.4
Muniamma	88512	69	female	71	156.0	29.2	1	13	6	14	99.0	14.0	26.0	4.4
Verappan.C	192408D	79	male	52	160.0	20.3	6	11	4	9	7.0	16.0	22.0	4.1
Kasiammal.m	257685D	78	female	46	154.0	19.4	0	1	3	12	99.0	12.0	20.3	2.4
Chinnakulanda	402538C	65	female	46	155.0	20.0	5	8	6	12	99.0	12.0	22.2	2.5
Subashini	251698D	65	female	76	153.4	32.3	6	8	6	14	99.0	14.0	28.0	3.2
Dasaradhan	955777C	71	male	58	162.2	22.0	1	7	6	13	99.0	13.0	24.0	4.4
Parasmul.B	255917D	69	male	68	164.0	25.3	6	8	4	13	99.0	13.0	24.0	3.2
Maragatham.K	194782D	66	female	50	155.0	20.8	5	11	5	11	8.0	19.0	21.0	2.1
Syed Abdulla	273088D	64	male	68	164.0	25.3	2	11	6	14	99.0	14.0	22.0	4.6
Balakrishnan	260243A	68	male	48	161.6	18.5	5	5	4	8	8.0	16.0	20.4	4.0
Ganesa Chetti	394467A	75	male	52	164.0	19.3	6	13	5	8	9.5	17.5	21.2	3.8
Eathirajulu G.	259441D	77	male	58	163.0	21.8	6	11	4	10	8.5	18.5	22.0	3.0

Dischargestatus	Durationofillness	Diagnosisatadmission	Durationadmitted
cured	5	3	6
same	7	4	9
improved	3	1	4
cured	5	1	6
cured	5	1	5
cured	2	1	8
cured	7	1	5
cured	7	1	14

cured	1	2	3
improved	7	1	11
improved	7	1	15
cured	5	3	12
improved	1	2	35
improved	5	2	12
cured	3	1	8
cured	4	1	11
died	4	2	4
improved	1	4	10
cured	3	1	15
improved	5	2	5
cured	7	1	7
improved	1	2	8
improved	7	1	8
cured	4	1	29
cured	7	3	6
cured	5	1	10
cured	2	1	4
cured	4	1	5
cured	2	1	14
improved	6	4	9
cured	6	1	16
cured	3	2	4
cured	3	1	7
cured	6	1	3
cured	5	1	4
improved	7	1	8
improved	4	1	8
cured	1	2	9
died	1	2	3
cured	4	1	7
cured	5	1	5
cured	1	4	3
cured	1	1	14

improved	1	1	5
improved	7	2	8
cured	4	1	25
cured	2	1	4
improved	6	2	11
same	3	2	5
died	2	1	9

ANNEXURE C: BASIC DATA OF COMMUNITY DWELLING ELDERLY PATIENTS (CONTROLS) FOR EVALUATION OF PATIENTS INCLUDED IN STUDY OF NUTRITIONAL STATUS AMONG ELDERLY PATIENTS WITH ACUTE MEDICAL ILLNESS.

Name	Hospitalno	Age	Sex	Weight	Height	BMI	Comorbidities	Drugs	NoOfDrugs	MNS	MNA	TOTAL	MAC	Albumin
Balamani	194462D	61	female	68	154.5	28.3	0	99	99	14	99.0	14.0	26.5	99.0
Salammal	654334B	77	female	74	155.4	30.6	0	99	99	13	99.0	13.0	35.0	3.9
Chellammal	649281C	60	female	60	156.0	21.4	0	99	99	13	99.0	13.0	24.6	4.2
Shanmugam	127361D	65	male	78	165.4	28.5	0	99	99	14	99.0	14.0	25.4	4.7
Malliga	572177B	60	female	97	136.0	52.4	0	12	3	13	99.0	13.0	26.4	4.2
Subba Lakshmi	049653B	60	female	64	146.0	30.0	0	99	99	14	99.0	14.0	25.6	4.2
Venkatesan	998141C	65	male	51	158.0	20.5	0	99	99	13	99.0	13.0	21.6	4.1
Saratha.D	184012D	65	female	45	145.4	21.1	0	99	99	12	99.0	12.0	21.2	4.4
Jamuna Dhara	941581C	62	female	57	152.4	24.5	0	99	99	14	99.0	14.0	26.4	4.4
Saratha.D	184012D	65	female	43	145.2	20.2	0	99	99	11	13.0	24.0	23.2	4.4
Asit Barun Hazra	194759D	72	male	72	164.0	26.8	0	99	99	14	99.0	14.0	25.2	4.6
Saraswathi	700792A	68	female	58	154.4	24.3	0	99	99	13	99.0	13.0	25.2	4.4
Ranjitham	299361O	68	male	72	162.0	27.4	0	99	99	14	99.0	14.0	24.6	4.2
Amsavalli	714860C	72	female	47	153.0	20.0	2	2	3	12	99.0	12.0	21.6	4.3
Chabi Paul	194770D	75	female	63	158.0	15.2	0	0	99	13	99.0	13.0	24.6	4.0
Kalpana Lodh	193328D	68	female	66	156.4	27.1	0	0	99	14	99.0	14.0	24.2	4.6
Sivaprakasam	154308O	62	male	45	153.0	19.2	3	5	2	12	99.0	12.0	22.4	4.5
Arumugam	663628B	73	male	57	164.0	21.9	0	99	99	13	99.0	13.0	25.8	4.1
Vijayalakshmi	368156A	63	female	80	148.0	36.5	1	7	1	14	99.0	14.0	32.0	3.6

Dhanalakshmi	655066B	66	female	59	155.0	24.5	1	7	2	14	99.0	14.0	27.5	4.0
Lakshmanan	055093D	60	male	65	155.0	27.0	1	7	3	14	99.0	14.0	31.0	3.1
Meenakshi	730662O	60	female	59	151.0	23.9	0	99	99	14	99.0	14.0	27.0	99.0
Jayamani	611891A	61	female	55	142.0	27.3	0	99	99	14	99.0	14.0	28.0	4.4
Saroja	005163B	60	female	56	148.0	25.5	0	99	99	14	99.0	14.0	28.0	3.9
Daisy	260135A	62	female	56	150.0	24.8	0	99	99	14	99.0	14.0	25.0	4.4
Purushothaman	368770A	73	male	67	157.0	27.2	0	99	99	14	99.0	14.0	26.0	4.3
Roxon	266400	63	male	58	162.2	22.0	0	99	99	14	99.0	14.0	23.4	4.6
Mahadevan	828807C	66	male	59	166.0	21.4	0	99	99	13	99.0	13.0	25.2	4.1
Manikyam	375803B	67	female	59	159.0	23.7	2	2	5	12	99.0	12.0	23.4	3.9
Shantha Monik	883986B	60	female	58	153.3	23.8	0	99	99	14	99.0	14.0	23.4	4.5
Natarajan D.	490443A	62	male	64	163.0	24.1	2	2	3	14	99.0	14.0	24.2	4.6
Arumuga Natar	233869B	64	male	64	162.3	24.3	6	5	2	14	99.0	14.0	25.5	3.8
Devanesam	725471B	80	female	46	146.0	21.6	0	99	99	13	99.0	13.0	23.0	4.3
Mina Ganguly	889450B	62	female	60	151.0	26.3	0	99	99	7	7.0	14.0	24.4	4.7
Jayalakshmi.R	014630C	61	female	46	146.2	21.5	2	2	4	13	99.0	13.0	20.6	4.7
Gopal V	387336B	67	male	60	157.4	24.2	0	99	99	14	99.0	14.0	24.2	4.8
Radhakrishnan	726722	67	male	58	155.0	23.9	2	2	6	14	99.0	14.0	25.0	4.2
Tilak Raj	648053C	77	male	74	165.2	28.9	0	99	99	14	99.0	14.0	26.0	3.9
Savithri	580022	63	female	62	152.0	27.5	0	99	99	14	99.0	14.0	28.0	4.3
Kamala Pakras	690853C	64	female	59	146.0	27.7	1	3	1	11	14.0	25.0	30.0	4.2
Kanniyammal	758524C	68	female	35	146.0	16.2	2	2	6	11	10.0	21.0	20.2	3.8
Padmanabhan	228611	65	male	45	159.0	17.6	2	3	2	11	12.5	23.5	21.5	3.9
Kanagarani	033033A	65	female	42	151.0	18.4	6	10	2	8	8.0	16.0	23.5	4.2
Yeasupatham	113693C	76	male	79	161.0	30.5	0	99	99	14	99.0	14.0	32.0	4.4
Vellammal.S	281957C	63	female	97	154.0	40.9	0	99	99	14	99.0	14.0	42.5	4.2
Gnanapoo	189888C	65	female	55	160.0	21.4	2	2	99	13	99.0	13.0	24.1	4.4
Bholanath	168859D	54	male	57	165.0	20.9	1	3	5	12	99.0	12.0	26.0	4.6
Chandbasha.M	190025D	63	male	58	155.0	23.9	0	99	99	14	99.0	14.0	25.0	4.6
Varadarajan	228411D	62	male	64	156.0	26.0	1	3	1	14	99.0	14.0	28.0	3.6
Kesavelu	8025	66	male	56	156.0	23.0	0	99	99	14	99.0	14.0	26.8	4.2