NUTRITIONAL STATUS AND DIETARY PATTERN OF THE ELDERLY ATTENDING AN URBAN GERIATRIC CENTRE IN BANGLADESH

**A THESIS SUBMITTED
TO THE UNIVERSITY OF DHAKA
IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF PHILOSOPHY IN NUTRITION**

FERDOUSI YASMEEN

Submitted by:

**EXAM. ROLL NO. 07
RG No. 508
SESSION: 1995-96**

NOVEMBER, 2000

**INSTITUTE OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF DHAKA**

UNIVERSITY OF DHAKA
DHAKA, BANGLADESH

Board of Examiners:

Convenor:

Members:

To my parents

who introduced me to the joys
of understanding the world;
with gratitude, admiration and love

DECLARATION

This thesis is submitted to the University of Dhaka in partial fulfilment of the requirements for the degree of Master of Philosophy (M.Phil) in Nutrition. This study has been carried out in Institute of Nutrition and Food Science, University of Dhaka. No part of this thesis has been submitted for another degree or qualification to any other university or institute.

Ferdousi Yasmeen
M.Phil. Student
RG No. 508
Session 1995-96
Institute of Nutrition
and Food Science
University of Dhaka
Dhaka 1000
Bangladesh

Badrun Nahar

Mrs. Badrun Nahar
Associate Professor
Institute of Nutrition
and Food Science
University of Dhaka
Dhaka 1000
Bangladesh

SUMMARY

This cross-sectional study was carried out with the objective to determine the nutritional status and food habit of urban elderly. A total of 209 male and 206 female with an age range of 60-83 years were included in the study. Basic sociodemographic informations were obtained. The daily intake was estimated using 24-hour recall, and height and weight were measured to determine BMI as indicator of nutritional status. Mean body mass index (BMI) of male and female were 21.7 and 22.4 kg/m^2 respectively. Only 13% participants (15.8% male and 10.2% female) had no health complains. Among the 87% sick participants, 43.6% were suffering from single disease and another 43.4% were suffering from multiple diseases. Most prevalent disease among male was hypertension/cardiovascular diseases (30.6%) and in female it was arthritis (38.8%).

Data on dietary intake were compared with recommended dietary allowance (RDA) (determined for the study population). Both male and female were deficient in energy intake. Mean carbohydrate, zinc, vitamin A and riboflavin intakes were below RDA in both sexes. Mean intakes of protein, calcium, iron, vitamin C and fat were higher than RDA in both male and female. Intakes of all nutrients generally decreased with increasing age.

Significant relationships were found between BMI and education, BMI and per capita monthly income, BMI and intake of energy, protein, fat, iron, zinc, vitamin A, riboflavin and cholesterol in case of male participants and fat, riboflavin, vitamin C and cholesterol in case of female participants. Significant relationships were also found between education and intake of energy, protein, fat, calcium, iron, zinc, riboflavin and cholesterol in case of male participants and protein, fat, calcium, zinc, riboflavin, cholesterol in case of female participants.

Also, significant relationships were found between per capita monthly income and intake of all nutrients except carbohydrate and vitamin C in case of male participants and carbohydrate and vitamin A in case of female participants.

ACKNOWLEDGEMENTS

I am extremely grateful to my supervisor Mrs. Badrun Nahar, Associate Professor, Institute of Nutrition and Food Science (INFS), for her scholastic guidance, constant supervision and encouragement throughout the period of this research work and in completion of this thesis.

I would like to express my heartfelt indebtedness to reverent Professor, Dr. Faruk Ahmed, INFS, University of Dhaka, for his constructive criticism and excellent cooperation in completion of my research work.

I am thankful to all my teachers at the Institute of Nutrition and Food Science for their help and cooperation during the study.

I am also grateful to Mr. Nazrul Islam, Computer Programmer, INFS, and Mrs. Nadira Khatun, Research Associate, INFS, University of Dhaka, for their generous help in statistical analysis.

And last but not the least, I am grateful to my husband, children and to all my family members for their cooperation and encouragement while preparing this thesis.

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LIST OF ABBREVIATIONS

BMI	Body mass index
CED	Chronic energy deficiency
CHO	Carbohydrate
cm	Centimeter
dl	Deciliter
DU	University of Dhaka
g	Gram
h	Hour
Ht	Height
INFS	Institute of Nutrition and Food Science
kCal	Kilocalorie
kg	Kilogram
mg	Milligram
n	Number
ng	Nanogram
NHANES	National Health and Nutrition Examination Surveys
RDA	Recommended dietary allowances
SD	Standard deviation
Tk.	Taka
WHO	World Health Organization
wk	Week
Wt	Weight
μg	Microgram

Chapter One

REVIEW OF LITERATURE

1.1 INTRODUCTION

Life-expectancy has risen sharply this century and is expected to continue to rise in populations throughout the world. As a result, the number of people reaching old age is increasing[1]. Factors responsible for this changing pattern of population aging include a rapid decline in both fertility and premature death[2]. There are currently 580 million people in the world who are aged 60 years and above. This figure is projected to rise to 1000 million by 2020 - a 75% increase compared with 50% for the population as a whole. The proportion of elderly is rising more rapidly in the developing countries than in the developed ones. By the year 2020, it is expected that almost 70% of the world's elderly people will be in the developing countries[1].

With the progress in medical research and technology, increasing affluence, urge for survival, provision of health service, life-expectancy has been increasing in our country[3]. The elderly are rapidly becoming a substantial proportion of the population in Bangladesh. Total aged population in Bangladesh, 60 years and above is about 5.7 million. It is estimated that there will be about 13.5 million population of these age group in 2020[4].

The demand for health and nutritional care are different for the elderly compared to normal adult population. These demands increases with the increasing age and requires special provisions. The health and nutrition planners must, therefore, be aware of these special needs and take them into consideration into the future health and nutrition plan of this country. However, these demands could be particularly stressful in view of the current poor socioeconomic and health services available in the country.

People age in unique ways, depending on a large variety of factors, including their gender, ethnic and cultural backgrounds, and whether they live in the industrialized or developing countries, in urban or rural settings. Climate, geographical locations, family size, life skills and experience are all factors that make people less and less alike as they advance in age. Elderly people thus constitute a very diverse group. Many of them lead active and healthy lives, while some older people have a poor quality of life[1].

To be meaningful, longevity should be associated with increased years of good health, so that elderly people could lead more productive lives for a longer time and also be able to do their routine work without help from others[4].

Epidemiological studies on elderly indicated that good nutritional status is an important determinant of quality of life and there is wide acceptance that good nutrition is an insurance against prevalence of many degenerative diseases among the elderly.

1.1.1 Causes of aging

Aging is inevitable and irreversible - it is not a disease but a normal part of the lifecycle which involves every dimension of our lives: physical, mental, social and spiritual[5].

Aging is a complex phenomenon that includes molecular, cellular, physiological and psychological changes. Numerous theories have been advanced to explain this phenomenon.

One theory of aging holds that, tissue age as a result of random mutations in the DNA of somatic cells, with consequent introduction of cumulative abnormalities. Others hold that cumulative abnormalities are produced by increased cross-linkages of collagen and other proteins, probably as a result of the nonenzymatic combination of glucose with amino groups on these molecules. Third theory is, aging is the cumulative result of damage to tissues by free radicals formed in them[5].

1.1.2 Aging and the digestive system

1.1.2.1 Taste and smell

Aging is associated with increased threshold for taste and smell; smell is affected to a greater degree than taste[6]. Both the number of taste buds per papilla and the number of papillae decrease. The ability to detect sweet and salty taste is affected first; this is consistent with the complain by some older people, that all foods taste bitter or sour. Improved oral hygiene can significantly enhance taste activity in the elderly people[7].

1.1.2.2 Gastric function and emptying

Age-related changes in gastric physiology include decreased secretions of hydrochloric acid, intrinsic factor and pepsin. This decline is apparently caused by the increasing prevalence of atrophic gastritis with advancing age. The majority of elderly who do not have atrophic gastritis continue to secrete hydrochloric acid in normal amounts[7].

Physiological changes that occur with atrophic gastritis include more rapid emptying of liquids, slower emptying of mixed solid-liquid diets[8,9], a rise in the stomach and proximal small bowel pH[10] and increased number of bacteria growing in the stomach and proximal small intestine. Changes in gastric secretion of acid and pepsin could result in impaired digestion and/or absorption of certain nutrients, including iron, calcium, copper, zinc, folic acid, vitamin B_{12} and protein[10]. Divalent cations are also released from fiber in an acid milieu[11]. In the presence of atrophic gastritis, it is possible that there is decreased bioavailability of zinc and calcium when these minerals are eaten with a high fiber diet

These findings are not universal, some researchers have found no differences in intestinal transit time in young versus elderly subjects[12].

1.1.2.3 Liver and biliary function, and pancreatic secretion

Structural and biochemical changes have been well-documented in aging liver. The ratio of liver weight to body weight decreases after about age 50. However, no age-related changes in liver function in persons with histologically normal liver have been reported[7].

Increased fibrosis of the pancreas was seen in nonalcoholic elderly individuals. However, it is unlikely that such histological changes are functionally important[7].

1.1.2.4 Intestinal morphology and function

Some researchers studied jejunal mucosa from necropsies of 32 young victims of sudden death and 39 geriatric patients undergoing rehabilitation after a stroke or for arthritis (age range 67 to 90 years)[13]. There were only minor differences in morphology between the young control group and the geriatric patients, the most striking being a shorter villous height in elderly subjects. A more recent study compared elderly subjects more carefully screened for malabsorption or malnutrition with younger controls. This study found no significant deficits in surface area-to-volume ratio or enterocyte height in the elderly[14].

1.1.2.5 Intestinal microflora

From studies on a small number of elderly without atrophic gastritis; it appeared that only a limited number of bacteria (less than 10^3/ml) normally inhabit in the proximal small bowel. However, in elderly subjects with atrophic gastritis, bacterial numbers increase to levels of 10^6-10^9. The bacterial overgrowth in atrophic gastritis has been termed "simple colonization", being made up largely of streptococci, lactobacilli and bacteria found in the oral cavity. Some of these bacteria are able to deconjugate bile salts, so that fat malabsorption is rarely seen in atrophic gastritis. However, simple colonization may affect the absorption of certain micronutrients such as vitamin B_{12}. Thus, the functional significance of such colonizing bacteria remains uncertain. When bacterial overgrowth with anaerobic, bile-salt-splitting bacteria is the most frequent cause, significant malabsorption is present in an elderly person, [15,16].

1.1.2.6 Energy metabolism

Daily energy expenditure declines progressively throughout adult life in all societies[17]. Under sedentary conditions, the main determinant of energy expenditure is fat-free mass[18], which declines by about 15% between the ages 20-29 and 70-79, contributing to a lower basal metabolic rate in the elderly[8].

1.1.2.7 Carbohydrate metabolism

Increasing age is associated with major changes in whole-body carbohydrate metabolism. The two-hour plasma glucose level during an oral glucose tolerance test increases by an average 5.3 mg/dl per decade and fasting plasma glucose increases by an average of 1 mg/dl per decade. These age-related changes in glucose tolerance is due to diminished sensitivity of the peripheral tissues to insulin and can result in non-insulin-dependent diabetes mellitus (NIDDM). A large survey in the United States that used oral glucose tolerance test showed that 13% of men and women between the ages of 60 and 74 had impaired glucose tolerance and an additional 17% had NIDDM[19]. No such study among the elderly have been conducted in our country.

1.1.2.8 Protein metabolism

The protein content of the body declines with age. In elderly men and women total body protein is about 1.8 kg lower than those of young adults. There is a loss of lean body mass accompanied by a gain in body fat[20]. The loss of body proteins affects particularly skeletal muscles[21]. Skeletal muscles, which in a young man make up about 45% of body weight, accounts for most of the decrease in protein reserves with advancing age[14]. The excretion of urinary creatinine, reflecting muscle creatinine content and total muscle mass, decreases by nearly 50% between the ages of 20 and 90[13]. This reduction is closely associated with age-related reductions in basal metabolic rate. Images obtained by magnetic resonance show a dramatic decrease in muscle size with age together with increased intramuscular and subcutaneous fat. These changes were most pronounced in women[22]. Muscle atrophy result from a gradual and selective loss of muscle fibers. And the loss is more marked in those muscles involved in high-intensity "sprinting" type movement (type II fibers), while those muscles necessary for posture and most low-intensity movement (type I fibers) are preserved[23].

1.1.2.9 Fat metabolism

Aging affects body fat content and fat mobilization. Fat content tends to be greatest among the middle-aged, especially in women. The distribution of body fat also changes with age, with marked accumulation of abdominal fat, especially in men[24]. This type of "android" obesity is associated with a greater risk for diabetes, hypertension and coronary heart disease[25]. In aging women, fat tends to be more evenly distributed between central and subcutaneous deposits and appears to be less hazardous[26].

Aging reduces the capacity of the individual to remove lipids from the circulation, so that they accumulate in the tissues[21].

The levels of circulating triglycerides increase with age by an average 16 mg/dl per decade[27]. Circulating cholesterol also increases with age.

Age-related changes in the concentration of cholesterol in different classes of plasma lipoproteins in the blood of men and women in the United States were studied. The findings showed age-related decline in high density lipoprotein of men while low density lipoprotein continued to climb[28].

1.1.3 Aging and other systems

Renal blood flow and glomerular filtration rate (GFR) decline with age. Generalized weakness is probably due to both a decline in the number of functioning muscle, fibers and decrease in the actual strength of the contractile process itself. Beginning of bone loss in the fifth decade is almost universal. This process proceeds almost twice as fast in women as in men[29]. Finally, the immune system deteriorates with aging with widespread consequences[30].

The age-related deterioration in function is extensively documented in men followed over decades by the Baltimore Longitudinal Study on Aging[31]. These data showed that organ functions erode at different rates throughout adult life.

1.2 ANTHROPOMETRY OF AGING

Anthropometric characteristics of individuals and populations are simple and strong predictors of future ill health, functional impairment and mortality; in turn, they may be modified by disease. In the elderly, however, anthropometry is a new tool and thus difficult to evaluate[32].

The comparative analysis of world populations suggests that the predictive power of anthropometric indicators relative to a specific outcome is likely to vary with a number of factors, such as age-related biological changes, illness, secular changes, childhood diseases, lifelong practices (smoking, diet, exercise) and socioeconomic factors[32].

Decline in height with age has been noted in studies throughout the world[33]. The rate of decline is 1-2 cm/decade and more rapid at older ages due to gradual diminution of bone mass[34]. Loss of bone mass is the result of changes in the mechanisms governing osteogenesis[35].

Weight also declines with age, but the pattern of change is quite different from that of height and varies with sex[33]. In affluent countries, the average weight of both men and women increases through middle ages. Weight gains in men tend to plateau at around 65 years and weight generally declines thereafter; in women, however, the weight increases are frequently greater and the plateau occurs about 10 years later than in men.

In non-European indigenous populations, the increase in average weight in the middle years is not evident, but there is a decline at older ages[32].

Average body mass index in industrialized populations tends to increase in middle age and stabilizes somewhat earlier in men than in women. In men, the plateau may begin at 50-60 years or even at 70 years of age; in women, it starts at 70 years or later. Both sexes generally show a decrease in average BMI after 70-75 years of age[33,36,37].

Body mass index may not decline with age; indeed, it may be higher at age 70 and above than at younger ages because of the age-related changes in both height and weight[32].

For individuals over 65 years of age, the health risk of overweight is unclear; in fact, population data indicate that moderate overweight at older ages is associated with lower mortality[32].

A U-shaped relationship between BMI and mortality has also been reported for Finish men[36]. Lowest mortality occurred at a somewhat higher BMI among men over 75 years of age than among younger men, but the curve showed excess mortality at the tails of the distribution. Among thin men, mortality from cardiovascular causes increased with BMI in the younger cohorts but not in those aged 55-90. Overweight did not reduce life-expectancy in Finnish women aged 65-79 years[37].

A follow-up study in Finland of 95 men and 431 women over 85 years of age showed that low BMI was a more important predictor of risk of death than high BMI[31]. Highest 5-year mortality was reported in the group with BMI <20 kg/m^2 and the lowest in the group with BMI >30 kg/m^2. It was concluded that overweight ceases to be a risk factor for death in this age group. A modest degree of overweight seemed to be protective against death. The most favourable BMI was 27-31 kg/m[32].

Similar results from a follow-up NHANES I study in the USA revealed that the moderate additional risk of death associated with weight apparent in older men was not apparent in older women[28].

Both overweight and thinness appear to carry risk for mortality, but in the elderly, thinness carries a greater risk than overweight. Weight change, especially involuntary weight loss, also poses considerable risk[32].

The prevalence of overweight increases with age and results in the loss of mobility[38], and an increased burden on cardiovascular and pulmonary function. Underweight is frequently associated with depressed immune function. General muscle strength, gait and balance may also be impaired in these elderly, thus increasing the risk of falls and consequent injury[39].

Analysis of height-for-age in 19 studies with adequate population data revealed wide geographical and ethnic differences. Of those aged 70-79 years, Guatemalans had the lowest mean height and Americans (USA), Dutch and Swedes the highest. Height decreased with age in all population; differences ranged from 1.9 to 6.7 cm in men and from 2.0 to 6.0 cm in women[40].

The listed populations showed a decrease in BMI with increasing age. In most populations, BMI is greater in women than in men. If height is unchanged, a decrease in BMI reflects a decrease in body weight; however, when height also decreases, as it does in the elderly, changes in BMI are smaller[40].

Among men, lower BMI were found with samples from central and south America and of individuals of Chinese descent[40].

Regarding women, lowest BMI among those of Chinese origin (in most studies) and in rural Guatemala, the next highest values were in Brazil, northern Europe and the USA, and among Anglo-Australians, and highest values occurred among Australians of Greek origin[40].

An anthropometric survey[41] conducted in an urban area of Karnataka in India revealed that a higher percentage of normal weight subjects were in the age group of 60 to 69 years, and the highest percentage of underweight subjects were in the age group of 70 years and above.

Cross-sectional data generated by National Nutrition Monitoring Bureau (NNMB)[42] indicated that the aged, 70 years and above, were shorter by 3 to 5 cm and lighter by about 4 kg as compared to young adults (20-40 years). The proportion of CED (i.e. BMI <18.5 kg/m^2) was 29% among the 60-69 years age group and nearly 38% among the 70 years and above age group of males. Among females, the corresponding figures were 30.2 and 37.8%, respectively. Mean weight of males were found as 49 and 47 kg in the age group of 60-70 years, and $\geq$70 years. Among females, the corresponding figures were 42 and 39 kg, respectively.

Similar (49 kg) mean weight of male of age group 60-70 years was also found from NNMB 1996[43] survey. Mean weight of female of that age group was 42 kg. Mehta *et al.*[44] found mean weight of women of the age group 60-70 years was 45 and $\geq$70 years age group 43 kg.

Higher mean weights were observed by Sabharwal *et al.*[45]. They found mean weights of males were 62 and 50 kg for the stated two age groups. And the corresponding values for females were 52 and 50 kg, respectively.

Higher mean weights of males were also observed by Gambhir *et al.*[46]. Mean weights were found 63 and 54 kg, respectively, for the two age groups.

In the survey of NNMB 1990-91[42], mean height of males were found 161.3 and 163.0 cm in the age group 60-70 years and $\geq$70 years. Among females, the corresponding figures were 147.9 and 146.0 cm, respectively. Mean weights of male and female participants in the age group of 60-70 years were 161.0 and 147.9 cm in NNMB 1996 survey[43].

Mehta *et al.*[44] found mean height of women of the age group 60-70 years was 149.6 cm and $\geq$70 years age group 146.0 cm.

Higher mean heights of males were observed in the age group of 60-70 years in three studies[45-47]. The values were 163.7, 163.0 and 165.6 cm, respectively. In case of women, the values were 151.1 and 151.0 cm in two studies[45,46].

A survey was conducted among 567 elderly persons in rural area of Thailand. About 62.4% of them had a BMI below 20 kg/m^2. A decreasing proportion of those with higher BMI was observed when age increased. The mean BMI was 19.5 kg/m^2 for men and 18.7 for women. The proportion of women whose BMI was below 20 kg/m^2 (66.3%) was greater than that for men (57.5%). The BMI increased with higher education[48].

Cristina *et al.* conducted a study among 85 male and 106 female (non-institutionalized) and found mean height of men 164.5 cm and that of women 151.1 cm. Mean weights were found 72.1 and 68.8 kg, respectively. The mean BMI were found 26.6 of men and 29.9 kg/m^2 of women[49]. No information is available regarding anthropometry of aging in Bangladesh.

1.3 AGE-RELATED CHANGES IN NUTRIENT INTAKE

As people grow older, they experience changes in food consumption patterns. First, aging reduces appetite for food. Second, changes in food preferences occur in the population in general over the decades[21].

During 1961-1965, a study among middle class men carefully evaluated their intakes of energy and selected nutrients[38]. The findings confirmed that the energy intake declined with advancing decades. With this reduction in energy consumption, there was general diminution in intakes of nutrients providing energy. In the Baltimore Longitudinal Study of Aging, aging was associated with declining intakes of iron, thiamine, riboflavin and niacin, because all of these are related to total energy intake. This was confirmed by data from national surveys such as NHANES II[50], which show a progressive age-related reduction in the thiamine and iron intakes of adults from age 25 to 74 years in parallel with energy intakes. But this declining trend was not observed in Bangladesh National Nutrition Survey[51].

1.3.1 Factors affecting nutritional status of the elderly

The factors affecting nutritional status of the elderly are more varied than that of younger adults because of a variety of age-related changes in social, physiological and pathological status. There are both primary and secondary causes of malnutrition among the elderly[52].

First, there are adverse social and environmental factors as primary causes of malnutrition. These include ignorance of the basic facts of nutrition. Poverty restricts the range of foods available to the elderly person. Physical disabilities also hinders the capacity of some elderly people to get around to a variety of food stores. Social isolation and inability of cooking may restrict availability of food and may cause the elderly single person to lose interest in food.

Secondly, elderly people have malnutrition secondary to pathological conditions. This group includes malabsorption due to gastrointestinal dysfunctions from bacterial overgrowth; major nutrients affected are fat-soluble vitamins, folic acid and vitamin B_{12}. Inefficient mastication due to dental problem can restrict food choices.

Moreover, decrease of appetite due to decreased physical activity, dental and oral problems, or mood disorders with increased age results in overall lower intake of food leading to lowered intakes of energy and other essential nutrients. At this stage, they often show a rapid decline of health and nutritional status[53].

1.3.2 Nutrient intake in different countries

Various studies have been conducted to assess the adequacy of major and minor nutrients in the elderly. Dadd and Nerurkar[54] examined the adequacy of nutrients in the diet of non-institutionalized elderly men in Bombay and found a mean energy intake of 79% of their RDI and vitamin A levels 48% of RDI. Protein intake was reported to be adequate for all the subjects. Brahmam[42] reported the intake levels of micronutrients, such as iron, vitamin A, riboflavin and niacin to be lower than those of RDI for both males and females although their energy and protein intakes were satisfactory. In a study of South Indian elderly in the age group of 60 to 84 years, all nutrients excluding calcium were found to be low when compared to the RDI[55].

Study of elderly women in urban slums of Delhi revealed that mean intake of all nutrients except thiamine and total vitamin A was below the RDI. Iron intake was only 50% of the RDI and there was an energy deficit of 200-400kcals[56].

Garg and Singh[57] in their study of nutritional status of 218 aged in an urban area of Merrut city (UP) have also reported inadequate iron and energy intake. On an average, women consumed not over 1560 kcals and men not over 1900 kcals daily. In the rural areas of Andhra Pradesh, in elderly men, the intake of all nutrients except protein and calcium were below the recommended dietary allowance, while in the case of women, there were no exceptions[58].

A study on Indian institutionalized elderly above 65 years of age[45] revealed adequate energy, protein, calcium thiamine, riboflavin and vitamin C intake as compared to the RDI while iron and vitamin A intakes were lower. A similar trend was reported by Gambhir *et al.*[46] among middle income group of free living elderly, though protein, calcium and vitamin A intakes were comparatively higher. A significant decline in energy, iron, thiamine, ß-carotene and total vitamin A intakes with increase in age was also reported.

Studies[59] on patients attending the geriatric clinic at the All India Institute of Medical Sciences (AIIMS), New Delhi revealed a deficit of 50% of energy; 41.6% for protein, 51.4% for calcium, 68.5% for iron and 50% for thiamine in the diets of elderly men. Similarly, dietary intake of women showed a deficit of 35.5% for energy, 16% for protein, 51% for calcium, 50% for iron and 23% for thiamine compared to RDI.

Mehta *et al.*[44] studied the nutritional status of elderly women in Uttar Pradesh and found a deficit of energy and iron intake in comparison to the RDI and adequate intake of protein in both rural and urban elderly. The intake of calcium, thiamine and riboflavin was higher than RDI in the rural elderly.

Another study[47] on the rural elderly in Pooth Khurd village near Delhi revealed poor cereal and pulse intakes but a higher consumption of milk. On dietary analysis, it was observed that all nutrients except calcium and thiamine, was below the RDI for these rural elderly.

A survey on elderly people of Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu conducted by National Nutrition Monitoring Bureau[42] revealed a decreasing trend in the consumption levels of cereals with age, which constitute the bulk of Indian diets. Consumption of pulses and protective foods such as green leafy vegetables, fruits and milk was also low. Fruit intake was almost nil among the rural group. Fruits were reported to be consumed only during the time of illness.

Due to cultural differences in the dietary habits of the population residing in different parts of India, the elderly in the northern region showed a higher intake of milk and milk products as well as green leafy vegetables while those residing in the southern parts show a higher intake of cereals and pulses[42].

Dietary assessment by Cristina *et al.* among non-institutionalized elderly of Spain showed that mean energy intake of male was 1894 kcal and female 1622 kcal. Protein intakes were 64 and 59 g, respectively, for male and female elderly. Lipid intakes were 73 and 72 g, carbohydrate intakes were

238 and 193 g, calcium intakes were 722 and 793 mg, iron intakes were 11 and 9 mg, riboflavin intakes were 1.2 and 1.2 mg, niacin intakes were 21 and 19 mg, vitamin C intakes were 55 and 54 mg, and vitamin A intakes were 474 and 549 μg, respectively[49].

Very little information is available about nutrient intake of elderly in Bangladesh. In 1995-96 BNNS[5] nutrient intake assessment for the elderly was done as a part of total family member with a very small sample size. Calorie intake of urban male elderly were found 2278 and 2463 kcal for the age groups 60-69 and 70+ years, and those of urban female elderly were 1504 and 1573 kcal for these two age groups respectively. Protein intakes of elderly males were 62 and 83 g and elderly women were 46 and 38 g. Calcium intakes of elderly males were 549 and 422 mg and elderly females were 309 and 275 mg. Iron intakes were 19.8 and 18.7 mg for males and 15.6 and 13.0 mg for females. Vitamin A intakes were 603 and 666 μg for males and 930 and 529 μg for females. Riboflavin intakes were 0.58 and 0.86 mg for males and 0.81 and 0.44 mg for females. Vitamin C intakes were 33 and 45 mg for males and 36 and 41 mg for females.

1.4 RECOMMENDED DIETARY ALLOWANCES FOR THE ELDERLY

1.4.1 Energy

The two dominating changes in the energy requirements of the elderly are the decline in physical activity and the fall in energy needs as the lean body mass declines[60].

A longitudinal study of nutritional intake of men of all ages undertaken over a 15-year period confirmed that total caloric intake per subject declines with age in parallel with a fall in basal metabolic rate and physical activity[61].

However, it has been recognized for many years that the basal metabolic rate of an individual depends on body size, and many equations have been developed to predict the BMR from body weight and from weight and height[60]. Similar equations have been used in FAO/WHO/UNO (1985) Report on the Energy and Protein Requirements[62]. Suggested equations for predicting the BMR of elderly (60 years and above) are:

a) Based on weight (W):

For men : 13.5 W + 487 (kcal/day)

For women : 10.5 W + 596 (kcal/day)

b) Based on weight (W) and height (H):

For men : 8.8 W + 1128 H - 1071 (kcal/day)

For women : 9.2 W + 637 H - 302 (kcal/day)

When the BMR and time allocated to each task and its energy cost had been allocated, it was then possible to assess the total energy expenditure as a multiple of the individual's measured BMR. The overall change in total energy expenditure from 60 to 90 years was substantial, amounting to a decline of 675 kcal for men and 459 kcal for women. When activity is expressed as physical activity ratios (i.e. the ratio of total expenditure to BMR), men show a fall from 1.45 in the 7th decade of life to 1.34 in the ninth decade, with women also becoming more inactive; their ratios fell from 1.41 to 1.32[60].

On a daily kilocalorie basis, the total energy expenditure of men declined by 10% per decade from the age of 60 years and that of women by 8%, but the corresponding data on the BMR changes were -8% and -6% per decade[60]. Dwyer assumed that energy allowances should decrease by about 6% between 51 and 75 years of age, and by another 6% after age 76[63].

In general, energy needs decreases with age, owing to decreases in physical activity and in resting energy expenditure. The major reason for this is that physical activity related to work usually declines at this time and lean body mass which is the metabolically active tissue of the body decreases by about 3 kg per decade after age 50. It is likely that these decline in lean body mass are not totally inevitable, but rather that they reflect the more sedentary lifestyle of older people. There is increasing evidence that the marked decline in physical activity which are observed among the elderly today are undesirable[63]. Cellular metabolic rates also decrease with aging, but these declines are much smaller than physical activity decrements.

FAO/WHO/UNO (1985) calculated energy requirements of elderly by multiplying BMR with a factor 1.51 (physical activity level) which was predicted for healthy retired elderly[62].

1.4.2 Protein

Because of the decreased active cell mass of the elderly, dietary protein needs might be similar or lower than for young persons. This finding is the conclusion of Munro, who reviewed the studies of protein requirements of the elderly. A study on the effect of level of protein intake on the synthesis and breakdown of body protein in elderly subjects showed a requirement not exceeding 0.89 g/kg as the safe level for the old men[64].

National Academy of Sciences[65] prescribed 56 g protein for a 70 kg adult male and 44 g for a 56 kg woman, irrespective of age, i.e. 0.8 g protein per kg of body weight.

In fact, the protein requirements of the elderly are difficult to identify with precision. The achievement of zero nitrogen balance has been used in adults as the endpoint for many years, but cannot provide accurate estimate of small but physiologically important daily losses of body protein as for example, that occur in the age-related reduction of lean body mass. Despite the high protein intake in western countries, people still continue to show progressive reduction in lean tissue with aging. Thus, a high protein intake is unlikely to suppress this phenomenon[64].

Finally, the protein intake of elderly people with chronic diseases are often inadequate to prevent malnutrition[66]. So, elderly with chronic diseases require special consideration from their physicians.

FAO/WHO/UNO (1985) concluded that the safe intake of protein should not be lower than 0.75 g/kg/day for the elderly. This figure is higher than that for younger adults in relation to lean body mass, because it is an accepted fact that protein utilization is less efficient in the elderly[62].

In summary, data on protein requirements are limited and suffer from methodological problems. Despite these limitations, most currently available evidence suggests that, in healthy elderly, a mean intake of 0.8 g of protein/kg body weight daily results in nitrogen balance. Information from nitrogen balance studies suggest that even higher protein intake per kg body weight may be desirable for the elderly. Even though further studies are needed before a recommendation to increase requirements can be made, it appears that protein intakes of 0.9-1.1 g/kg/day may be beneficial in healthy elderly and are not harmful in the general population (i.e. in the absence of renal or hepatic disease)[67].

1.4.3 Trace elements

Trace elements are inorganic micronutrients present in the organism in concentrations of parts per million (μg/g) or parts per billion (ng/g). Pathological conditions affecting gastric secretion, especially gastric acidity, can strongly depress the bioavailability of trace elements, as the acidic milieu of the stomach is essential for chemical reactions that keep dietary trace elements in solution. The risk of atrophic gastritis is known to increase with age, and a 31.5% incidence was found in a recent survey of 359 elderly subjects, average age 76 years, in Boston, USA[68].

Finally, because the intake of trace elements is directly proportional to the total food intake, the substantial decline in food consumption with age reduces the intake of trace elements by approximately one-third. For most nutrients, the FAO/WHO neglects the possibility of different needs of the elderly altogether. They lumped all elderly people with 'adults' and made a single combined recommendation. Available information on trace element requirements suggest that this situation is unsatisfactory and needs urgent review. There is little agreement among countries concerning the ideal nutrient intake of the elderly. Most recommended a reduction of energy intake with advancing age, accompanied by a proportional reduction in the intake of the B vitamins. Some also reduce other nutrients, such as vitamin A, beta-carotene, calcium, iodine and iron, and only one country, the Netherlands, recommends an increased intake of calcium for the elderly[69].

The two age-related changes that affect nutrient metabolism and requirements most extensively are the decline of lean body mass and independently or not, the decline in energy requirements and food intake. Both have important consequences for trace element requirements and status of the elderly[64].

Trace elements are distributed mainly in the lean body mass, where their concentrations are quite stable during adult age. A diminishing body mass, with steady concentrations indicates a diminishing size of the metabolic pools of these elements. Since it is well-established that the obligatory daily loss of trace elements is proportional to the existing pool size, one could conclude that the minimal daily requirements would decline somewhat with progressing age[69].

There is uncertainty concerning the adequacy of trace element nutritional status of the elderly. There is practically no information on whether and how their nutritional status may affect their various health functions. The decline of many physiological functions with age is well known, but there is little agreement which, if any, of these are determined by nutritional status[70].

1.4.3.1 Iron

Dietary iron intake of the elderly is not extensively documented. In the Untied States, mean daily intake of men over 55 years of age exceeded 14 mg and that of women about 10.5 mg[71]. In the absence of gastrointestinal pathology, there is no evidence that elderly absorb iron less readily than younger persons with the same degree of iron stores. But there may have decreased red cell uptake of iron, which may contribute to anemia in the presence of adequate iron stores[72]. The food frequency information reveals that older individuals tend to eat less meat and more cereal grain and legume-derived foods than do younger adults[71]. Although foods derived from whole cereal grains and legumes are good sources of dietary iron, bioavailability of iron is low unless the meals contain meat or ascorbic acid[65,73].

Therefore, the dietary iron requirements of the elderly men and postmenopausal women is thought to be adequately supplied by a daily intake of 10 mg from a diet of a variety of foods[74]. If a person is vegetarian, an intake of 100 mg of ascorbic acid in one or more meals daily will help and ensure adequate iron absorption[69]. But according to

FAO (1988) recommendation, per capita iron requirement for >60 years of male is 11 mg and female is 9 mg, who take diet type 2, i.e. diet containing small amount of meat, fish and some vitamin C[75].

1.4.3.2 Zinc

It is clearly established that zinc is an essential nutrient, necessary for maintaining health throughout life. Several conditions more prevalent to the elderly have been reported to be associated with a compromised zinc status, including decreased taste and smell acuity, suppressed appetite, impaired wound healing and depressed immune response[76]. In addition, the zinc concentration in plasma and other tissues has been reported to be lower in aged individuals compared to younger subjects[77,78]. The elderly should continue to be considered at risk for inadequate zinc nutriture for the following reasons[69]:

- Decreased energy intake
- Significantly less absorption of zinc in the elderly
- Increased susceptibility of elderly to infection, ingestion of prescribed drugs and reduced dietary quality.

Present recommended dietary allowance (RDA) of zinc for men and women over 51 years of age is 15 mg[65]. Recent recommended Nutrient

Intakes for Canadians (1983) suggest 9 mg daily for males and 8 mg for females of 50-74 years[72]. According to Ziegler *et al.*, RDA of zinc for elderly males and females is 15 mg and 12 mg/day respectively[53].

1.4.4 Calcium

Calcium absorption efficiency varies greatly from person to person[78], and there is a decline in absorption efficiency with age[79]. There is a link between calcium intake and bone mass in some people but not in others and in some skeletal sites and not in others[80]. In a recent study, strong links was found between intake of vitamin D and calcium and the amelioration of bone demineralization or osteoporosis[81].

Dietary surveys and milk supply data demonstrate that the calcium intake of many populations is below the recommended levels but there is little evidence that this compromises bone health in terms of fracture risk. And it is found that older women in Africa and Asia have poor bone mineral status, despite their low fracture incidence[82-84]. These findings suggest that calcium intake is important in maintaining bone health but that protective factors, such as vitamin D and physical activity, reduce the likelihood of fracture.

According to Food and Agriculture Organization (FAO), requirement of calcium is 400 mg/day for moderately active male and female elderly assuming average weight of male and female are 60 kg and 50 kg respectively[85].

1.4.5 Vitamins

1.4.5.1 Vitamin A

Although low vitamin A intakes are common among the elderly, few have plasma levels of retinol below 20 μg/ml, and liver stores are well maintained or even increased throughout life. Thus, from the point of view of preventing deficiency, there is no evidence of significant vitamin A deficiency among elderly, and indeed it is possible that the vitamin A requirements for the elderly are appreciably lower than those presently recommended[86].

FAO recommends safe levels of intake for vitamin A for male above 60 years of age is 600 μg retinol/day and for female 500 μg retinol/day[75]. According to Indian Council of Medical Research, RDA for adult males and females is 750 μg/day[85].

1.4.5.2 Vitamin C

In general, dietary intakes of vitamin C decline with increasing age. Although the data on aging are conflicting, most studies have demonstrated an inverse correlation between age (the range being early adulthood to old age) and levels of ascorbate in whole blood[86].

There are no reported changes in vitamin C metabolism with age. The best approach to improve ascorbic acid nutriture in the elderly is by encouraging consumption of vitamin C - rich foods such as fruits. There is at present little evidence for altering ascorbic acid requirements with age[86].

There is also no consistent relationship between sex and ascorbic acid concentration in the different body fluids and blood cells[86]. FAO (1982) recommended vitamin C requirements for elderly above 60 years is 30 mg/day.

1.4.5.3 Riboflavin (B_2)

One of the most important nutrient that has been studied specifically in older people is riboflavin[87]. The riboflavin nutritional status of the elderly is highly variable, the high prevalence of poor riboflavin status in some surveys apparently resulting from poor intake[86]. It had previously been thought that riboflavin requirements would be lower in older people as compared to younger people, because riboflavin is metabolically tied to energy expenditure, and older people expend less energy than younger people[87]. Some study indicate lower metabolic vitamin B_2 requirements in the aged is independent of sex, and related to their lower energy and protein intakes[88]. However, in a recently performed depletion-repletion experiment on older people, it was found that riboflavin requirements were the same in older people as compared to younger people[89]. It should be noted that riboflavin intakes have been linked to at least one chronic non-communicable disease, esophageal cancer. In China, the incidence of this cancer is 100 times that of the Untied States and Western Europe, and 95% of people in this region have riboflavin deficiency as defined by blood levels. In a Chinese intervention study that used a riboflavin and niacin supplement, esophageal cancer incidence and mortality over a 6-8 year period dropped significantly. Although incidence of esophageal cancer among Bangladeshi elderly is not known, findings from other studies indicate that meeting the riboflavin requirement is an important factor to reduce the burden of this chronic disease[87].

In Bangladesh National Nutrition Survey 1995-96 requirement of riboflavin for 60+ years was 1.2 mg/day for both sexes[51], which was recommended in terms of energy 0.6 mg/1000 kcal/day according to the recommendation of FAO/WHO Adhoc Expert Committee (1973)[90].

1.5 HEALTH AND DISEASE OF THE ELDERLY

Over the last few years, there has been an increasing interest in the study of health and disease of the elderly in Bangladesh, but only a few attempt have so far been made. Under the auspices of the World Health Organization (WHO), Bangladesh Association for the Aged and Institute of Geriatric Medicine (BAAIGM) had undertaken a retrospective epidemiological research on health of the elderly in 1988. Data were collected from selected sample areas of whole Bangladesh. It revealed that of the sick persons, 28% were suffering from one disease each and the remaining 72% were suffering from more than one disease[91].

Among the 1150 sick persons (both rural and urban areas), the leading diseases were recorded to be pain (27%), weakness (26%), rheumatism (25%), cold/cough (15%), peptic ulcer (13%), eye disease (13%), asthma (12%), hypertension (11%), fever (9%), diabetes mellitus (7%) and heart trouble (5%). Remaining were suffering from dysentery, paralysis, urinary troubles, constipation, ear disease, piles and skin diseases.

Data collected only from Dhaka city showed that among 312 sick elderly, 25% were suffering from pain, 13% from weakness, 17% from rheumatism, 14% from cold/cough, 12% from peptic ulcer, 14% from eye disease, 9% from asthma, 20% from hypertension, 8% from fever, 13%

from diabetes mellitus and 10% from heart troubles. Remaining were also suffering the previously stated diseases[91].

Another survey was undertaken in the five administrative divisions of Bangladesh in 1992 to assess the morbidity status of elderly. The findings of that survey revealed that among 508 total participants leading diseases were dizziness (78%), cough (70%), high blood pressure (67%), dental problems (67%), arthritis (67%), heart diseases (63%), diabetes mellitus (57%), vision problems (53%), hearing problem (34%), mental anxieties (55%) and skin problems (rash, inflammation, itching; 60%). Other diseases were recorded as fever, ulcer, asthma and tuberculosis in a smaller percentage[92].

Survey findings from rural areas of Thailand showed that overall prevalence rate of hypertension was 18% (102/567). Only 1.6% were found to have diabetes mellitus. A large portion of the elderly (56.1%) were suffering from sleeping disturbances, 32.6% from dental problems, 32% men and 25.7% women from some degree of hearing impairment, 40 cases found blind[48].

1.6 AIMS OF THE STUDY

The assessment of nutritional status of the elderly is a prerequisite for developing appropriate strategies for maintaining, protecting and enhancing the health and quality of life of the elderly in Bangladesh. Currently there is a great paucity of information available on the nutritional status and dietary intake of elderly in Bangladesh. Whatever information available is sketchy and not systematically collected to provide a real insight into the problem to allow a meaningful program development. The dietary information is particularly required as this is the most important factor in the nutritional sense that can be modified and improved.

Therefore, in this study an attempt has been made to assess the nutritional status and dietary pattern of a group of elderly attending a geriatric centre in Dhaka city as this is the only special health centre in Dhaka that provides health care to the elderly. Elderly people attending this centre provided an easy access to study their nutritional status.

1.6.1 General objective

General objective of this study is to assess the nutritional status of the elderly attending the geriatric centre as a mirror image of the geriatric population of urban Bangladesh.

1.6.2 Specific objectives

The specific objectives are:

a) To assess the nutritional status of the elderly by nutritional anthropometry.

b) To determine the dietary intake and food habit of the elderly.

c) To investigate the relationship between various socioeconomic parameters, health status, dietary intake and nutritional status of the elderly.

Chapter Two

MATERIALS AND METHODS

2.1 STUDY SUBJECTS

Elderly male and female, aged 60 years and above, attending an urban geriatric centre, named Bangladesh Association for the Aged and Institute of Geriatric Medicine, Agargaon, Sher-e-Bangla Nagar, Dhaka. For the purpose of the study, a person aged 60 and above was defined as elderly.

2.2 SUBJECT SELECTION

All elderly aged 60 years and above who attended Bangladesh Association for the Aged and Institute of Geriatric Medicine, Agargaon, Sher-e-Bangla Nagar, Dhaka, as outdoor patients, or as patient's attendant or employee or member of the association, were invited to participate in the study. Those elderly who have been living for at least 5 years in Dhaka city and able to answer the questions independently and physically able to stand in erect position without any support were included. Psychogeriatric patients were excluded. A total of 209 male and 206 female accepted to participate in the study.

2.3 STUDY PERIOD

Data were collected every working day except Saturday from January to August, 1999.

2.4 DEVELOPMENT OF QUESTIONNAIRE

A questionnaire was developed to obtain relevant information on the sociodemographic conditions, general health and illness, 24-hour dietary intake and food habits. The dietary questionnaire used has been developed in this institute and tested by various investigators and found satisfactory. The whole questionnaire was pretested and modified on the basis of test results for the present study. The questionnaire used is given in Annexure-1.

2.5 COLLECTION OF DATA

2.5.1 Sociodemographic information

Each participant was asked about his/her age, family income, composition of family, education and marital status.

2.5.2 Anthropometric data

2.5.2.1 Body weight

A lever balance (Detecto-Medic, Detecto Scales Inc., USA) was used to record body weight. The balance was tested every day with a known weight before use for accuracy. Body weight was recorded to the nearest 0.2 kg on bare foot with minimum clothing.

2.5.2.2 Height

Height of the subjects were measured with a standard scale (Detecto-Medic, Detecto Scales Inc., USA) to the nearest 0.1 cm in standing up straight without assistance and wearing minimum clothing, with bare heels close together, legs straight, arms at the sides and shoulders relaxed, looking straight ahead. During measurement, the person was allowed to take a deep breath and stature at maximum inspiration was recorded.

2.5.2.3 Body mass index (BMI)

Body mass index (BMI) was calculated from the body weight and height of the subjects using the following formula:

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

2.5.3 Dietary assessment

Dietary intake of the participants were assessed using 24-hour recall method and details of all foods and drinks consumed by the participants were recorded. The participants were shown various standard utensils such as measuring cups, spoons, glasses, plates and different food models to get nearest possible approximation of the amounts of foods consumed. Intake of snacks/meals outside home was also recorded. The serving weight of different food items were calculated. Equivalent raw food weight was calculated by using a conversion table for Bangladeshi foods formulated at the Institute of Nutrition and Food Science[93]. A program package based on Bangladeshi and Indian food composition tables, developed at the INFS[94] was used to calculate nutrient intake from raw food weight.

Additional questions were asked about selected food items to collect information on food behavior and practices.

Nutrient intakes were compared with recommended dietary allowances formulated for the study population taking into account their age, weight and activity.

2.5.3.1 Calculation of energy requirement

Energy requirement for each individual was calculated in two steps.

In first step, basal metabolic rate (BMR) was calculated by applying the equation based on weight.

In second step, energy requirements were calculated by multiplying BMR with a factor (1.51) which was recommended for healthy retired elderly[62] (Table 2.1).

2.5.3.2 Protein requirement

Protein requirements were estimated as 0.8 g/kg body weight/day[45,65] (Table 2.1).

2.5.3.3 Fat requirement

The range of fat requirement is 20-30% of total energy[70]. We recommended 20% of energy from fat for the present study.

2.5.3.4 Carbohydrate requirement

The range of carbohydrate requirement is 50-75% of total energy requirement. We recommended 75% of energy as upper limit of safe ranges for mean requirement[70].

2.5.3.5 Mineral and vitamin requirements

Iron and vitamin C requirements were estimated according to FAO (1988), considering them taking diet 2 which contains small amounts of meat, fish and some vitamin C-rich foods, and it was assumed that 10% of the iron

TABLE 2.1

Recommended dietary allowances for the study population

Dietary allowance	Male	Female
Energy (kcal)	1872	1630
Protein (g)	45.0	38.7
Fat (g)	31	27
Carbohydrate (g)	351	305
Calcium (mg)	400	400
Iron (mg)	11	9
Zinc (mg)	15	12
Vitamin A (μg)	750	750
Riboflavin (mg)	1.12	0.98
Vitamin C (mg)	30	30

was absorbed[75]. Calcium, vitamin A and riboflavin requirements according to reference 85, and zinc requirement according to reference 53 (Table 2.1).

2.5.4 Health information

History of both acute and chronic illnesses were recorded. Blood pressure was measured in sitting position with a sphygmomenometer. Respondents were physically examined to detect clinical sign of nutritional deficiency.

2.6 STATISTICAL ANALYSIS

Mean, standard deviation (SD), frequency distribution (%) and 95% confidence intervals were calculated. The data were analyzed using SPSS/PC (version 9.0, SPSS Inc., Chicago). Means and the differences between groups were assessed using one-way analysis of variance (ANOVA). The data recorded in questionnaire were coded first. The coded data were entered into the computer in SPSS program. Finally, required analysis were done by simple cross-tabulation. The tables and figures were formed in Microsoft Excel 2.5 program.

Chapter Three

RESULTS

3.1 SOCIODEMOGRAPHIC INFORMATION

3.1.1 Age and sex

Table 3.1 shows the percentage distribution of age of the participants by sex. Participants were grouped into three age groups: 60-64 years, 65-69 years and 70+ years. Female participants were comparatively less aged than the male participants. Majority (39.7%) of the male participants were in the age group 70+ years, and majority (52.4%) of the female participants were in the 60-64 years age group.

3.1.2 Marital status

Table 3.2 shows the percentage distribution of the participants by marital status. Both male and female participants were grouped into five groups: married, unmarried, widow/widower, divorced and separated. Majority (90.9%) of the male participants were married. Female participants were almost equally distributed into married and widow groups. A small number (3.4%) of female participants were separated from their husbands.

3.1.3 Education

Table 3.3 shows the percentage distribution of the participants by their level of education. According to the distribution of educational levels, the study participants were divided into four groups: illiterate, primary (informal education, that is up to class ten), secondary school certificate (SSC) and higher secondary certificate (HSC), graduate and above. A good number of both male (27.3%) and female (51.5%) participants were illiterate. Males were almost equally distributed among the four educational groups. A good number (27.3%) of males had also a graduation degree but a very few females belonged to that group.

3.1.4 Per capita income

The study participants were divided into four categories according to the distribution of per capita monthly income: less than Tk.1000, Tk.1000-1999, Tk.2000-2999 and Tk.3000+ (Table 3.4). Majority of the participants, both male (32.1%) and female (38.9%), came from families with per capita income between Tk.1000 to Tk.1999. Rest of the participants were almost equally distributed among the other three groups. Distribution trend of male and female was almost similar.

TABLE 3.1

Distribution of the participants by age and sex

Age group (years)	Male No.	%	Female No.	%	Totai No.	%
60-64	68	33	108	52	176	42
65-69	58	28	40	19	98	24
70+	83	40	58	28	141	34
Total	209	50	206	50	415	100

TABLE 3.2

Distribution of the participants by marital status

Marital status	Male (n=209) No.	%	Female (n=206) No.	%	Total (n=415) No.	%
Married	190	91	87	47	287	69
Unmarried	3	1	1	1	4	1
Widow	0		99	48	99	24
Widower	15	7	0		15	4
Divorced	1	1	2	1	3	1
Separated	0		7	3	7	2

TABLE 3.3

Distribution of the participants according to their educational level

Educational level	Male (n=209) No.	%	Female (n=206) No.	%	Total (n=415) No.	%
Illiterate	57	27	106	52	163	39
Primary	45	22	66	32	111	27
SSC and HSC	50	24	26	13	76	18
Graduate and above	57	27	8	4	65	16

TABLE 3.4

Distribution of participants by income

Per capita income (Taka/month)	Male (n=209) No.	%	Female (n=206) No.	%	Total (n=415) No.	%
<1000	46	22	39	19	85	21
1000-1999	67	32	80	39	147	35
2000-2999	47	23	41	20	88	21
3000+	49	23	46	22	95	23

3.2 NUTRITIONAL STATUS

3.2.1 Anthropometry

3.2.1.1 Height

The mean height of the study participants, both male and female, of the three age groups are shown in Table 3.5. The mean height of the male participants was 160.9 cm and female participants was 147.1 cm. Mean heights decreased with increase of age in both sexes.

3.2.1.2 Body weight

Table 3.5 shows the mean body weight of the study participants. The mean body weight of the male participants was 56.3 kg and female participants was 48.4 kg. Mean body weights also decreased with increase of age in case of both male and female participants.

3.2.1.3 Body mass index (BMI)

The body mass index of the study participants are shown in Table 3.5. The mean BMI of male participants was 21.7 kg/m^2 and female participants was 22.4 kg/m^2. BMIs also decreased with increasing age.

TABLE 3.5

Distribution of participants by mean height, weight and BMI by sex and age group

Age group (years)	Sex	Number	Ht (cm)	Wt (kg)	BMI (kg/m^2)
60-64	Male	68	161.7	57.0	21.8
	Female	108	148.5	51.1	23.1
65-69	Male	58	161.2	57.1	21.8
	Female	40	147.2	48.6	22.3
70+	Male	83	160.2	55.2	21.4
	Female	58	144.3	43.0	20.6
Total	Male	209	160.9	56.3	21.7
	Female	206	147.1	48.4	22.4

3.2.1.4 Prevalence of malnutrition

Table 3.6 shows the prevalence of malnutrition. It was assessed by BMI. BMI was divided into three groups: chronic energy deficiency (BMI <18.50 kg/m^2), normal (BMI between 18.5 to 24.99 kg/m^2) and overweight (BMI >25.00 kg/m^2). Majority of the participants, both male (68%) and female (54%), were normal. Not only chronic energy deficiency (in case of male 18% and female 20%), but also overweight (in case of male 14% and female 26%) was a problem. Prevalence of overweight was almost double in case of females than males.

3.2.2 Morbidity

3.2.2.1 Morbidity status

Table 3.7 shows the morbidity status of the participants. Only 13% participants had no health complain. Around half of the rest (44%) were suffering from single disease and another, almost half (43%), from multiple diseases.

3.2.2.2 Morbidity pattern

Table 3.8 shows the distribution of the participants suffering from diseases. The most prevalent disease was arthritis (total 31%). There were more

TABLE 3.6

Prevalence of malnutrition

Nutritional status	Body mass index (BMI) (kg/m^2)	Male (n=209) No.	%	Female (n=206) No.	%	Total (n=415) No.	%
Chronic energy deficiency (CED)	<18.50	37	18	41	20	78	19
Normal	18.50-24.99	142	68	111	54	253	61
Overweight	>25.00	30	14	54	26	84	20

TABLE 3.7

Morbidity status of the participants by sex

Status	Male (n=209) No.	%	Female (n=206) No.	%	Total (n=415) No.	%
No disease	33	16	21	10	54	13
Single disease	91	43	90	44	181	44
Multiple diseases	85	41	95	46	180	43

TABLE 3.8

Distribution of the participants suffering from diseases

Morbidity status	Male (n=209) No.	%	Female (n=206) No.	%	Total (n=415) No.	%
Hypertension/ heart disease	64	31	55	27	119	29
Diabetes	38	18	29	14	67	16
Arthritis	49	23	80	39	129	31
Asthma	8	4	6	3	14.	3
Cough and cold	16	8	16	8	33	8
Vision problem	26	12	17	8	43	10
Dental problem	7	3	5	2	12	3
GIT disorder	10	5	16	8	26	6
Weakness	15	7	26	13	41	10
Vertigo	6	3	9	4	23	6
Others	14	7	21	10	35	8

female sufferers (39%) than males (23%). Second prevalent disease was cardiovascular disease, including hypertension (total 29%). Males were more sufferers (31% male and 27% female). Third prevalent disease was diabetes (total 16%).

A good number (10%) of participants were suffering from vision problem. Other health complains were weakness, cough and cold, gastrointestinal disorder, vertigo, asthma and dental problem.

3.2.3 Dietary pattern

Food consumption pattern of the participants were assessed by using a food-frequency questionnaire on selected food items.

3.2.3.1 Milk

Figure 3.1 shows the percentage distribution of the participants by frequency of intake of milk. A good number of the participants (35% male and 31% female) consumed milk regularly (6+ times/week). But 16% male and 18% female did not drink any milk. About one-fourth of the participants (25% male and 26% female) drank milk 1-3 times/week. Another one-fourth participants (23% male and 25% female) consumed milk occasionally (<1/week).

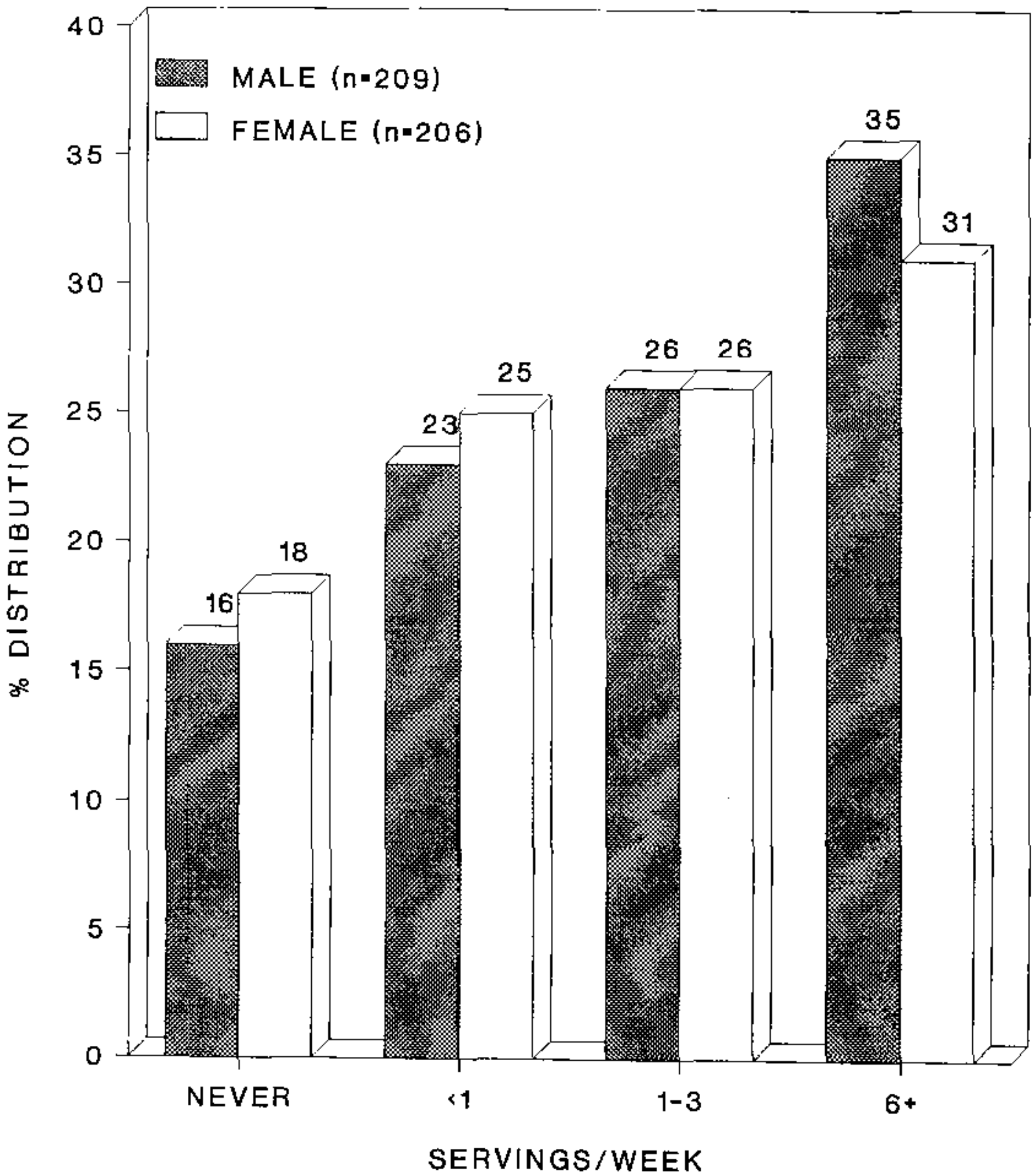

Fig. 3.1. Consumption of milk by the participants.

3.2.3.2 Eggs

The percentage distribution of the participants by frequency of intake of egg is shown in Figure 3.2. Only 15% male and 9% female participants consumed egg on a regular basis (6+/week). A good percentage of the elderly (48% male and 44% female) consumed egg (1-3/week). Ten percent male and 12% female did not eat egg.

3.2.3.3 Beef

Consumption pattern of beef by the participants is shown in Figure 3.3. Only 28% male and another 28% female consumed beef 1-3 times/week. Forty-eight percent male and 54% female used to eat beef occasionally (less than once/week). Twenty-three percent male and 17% female did not eat beef.

3.2.3.4 Poultry

Consumption pattern of poultry by the participants is presented in Figure 3.4. It is observed that 9% male and 8% female consumed poultry on a regular basis (6+ servings/week). A good number (46% male and 43% female) elderly used to take poultry 1-3 servings a week. A small number (5% male and 8% female) did not eat poultry.

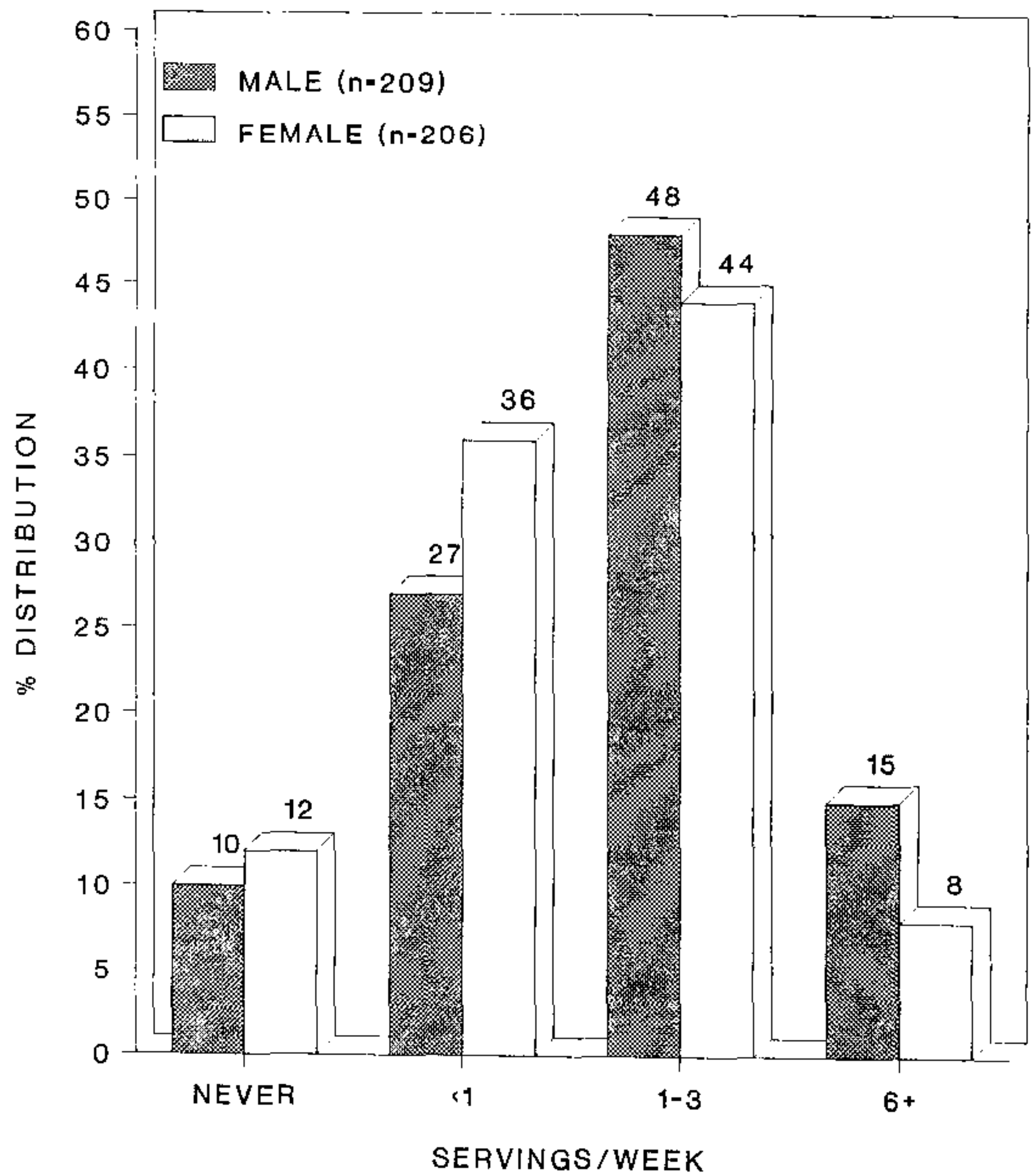

Fig. 3.2. Consumption of egg by the participants.

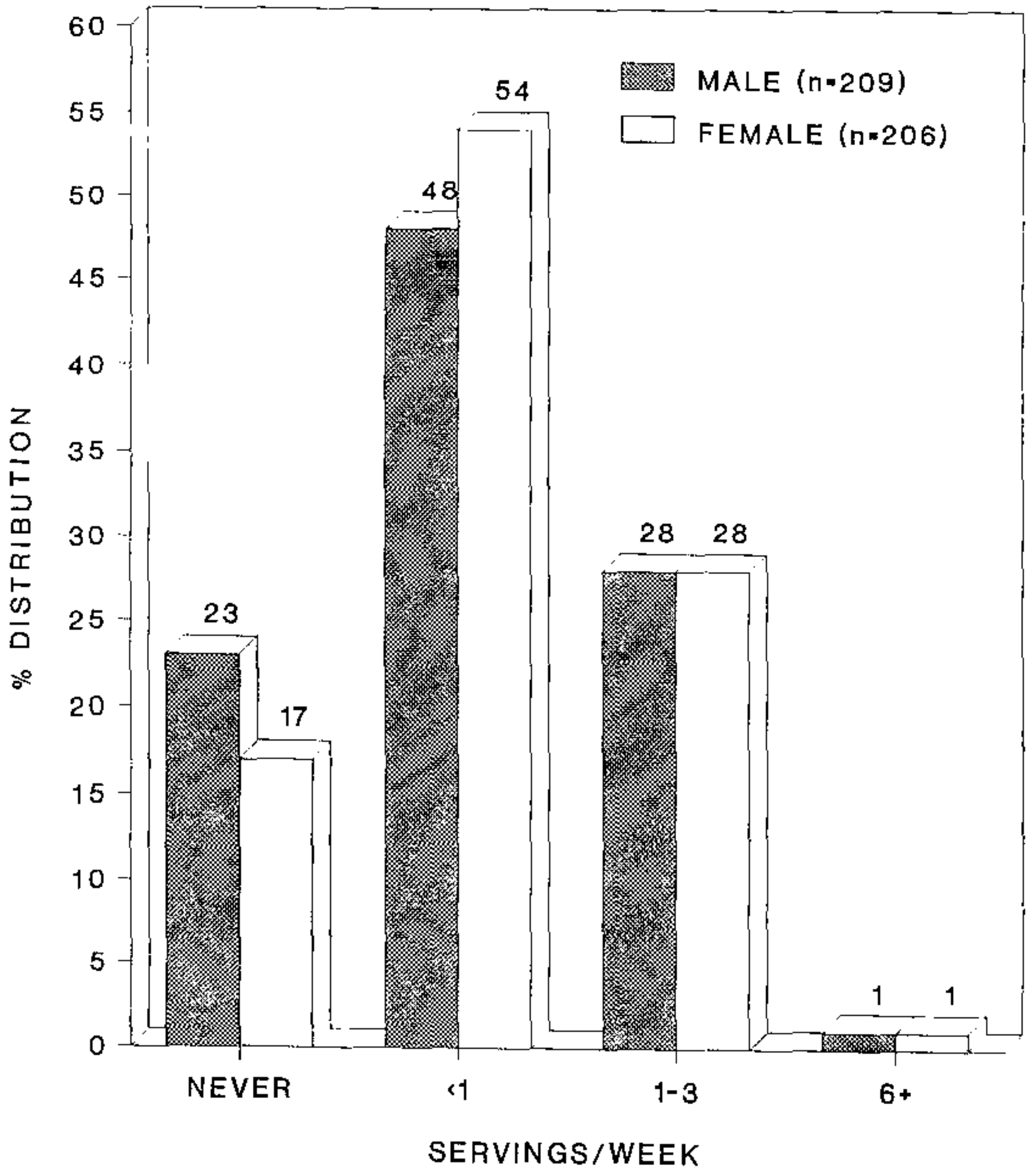

Fig. 3.3. Consumption of beef by the participants.

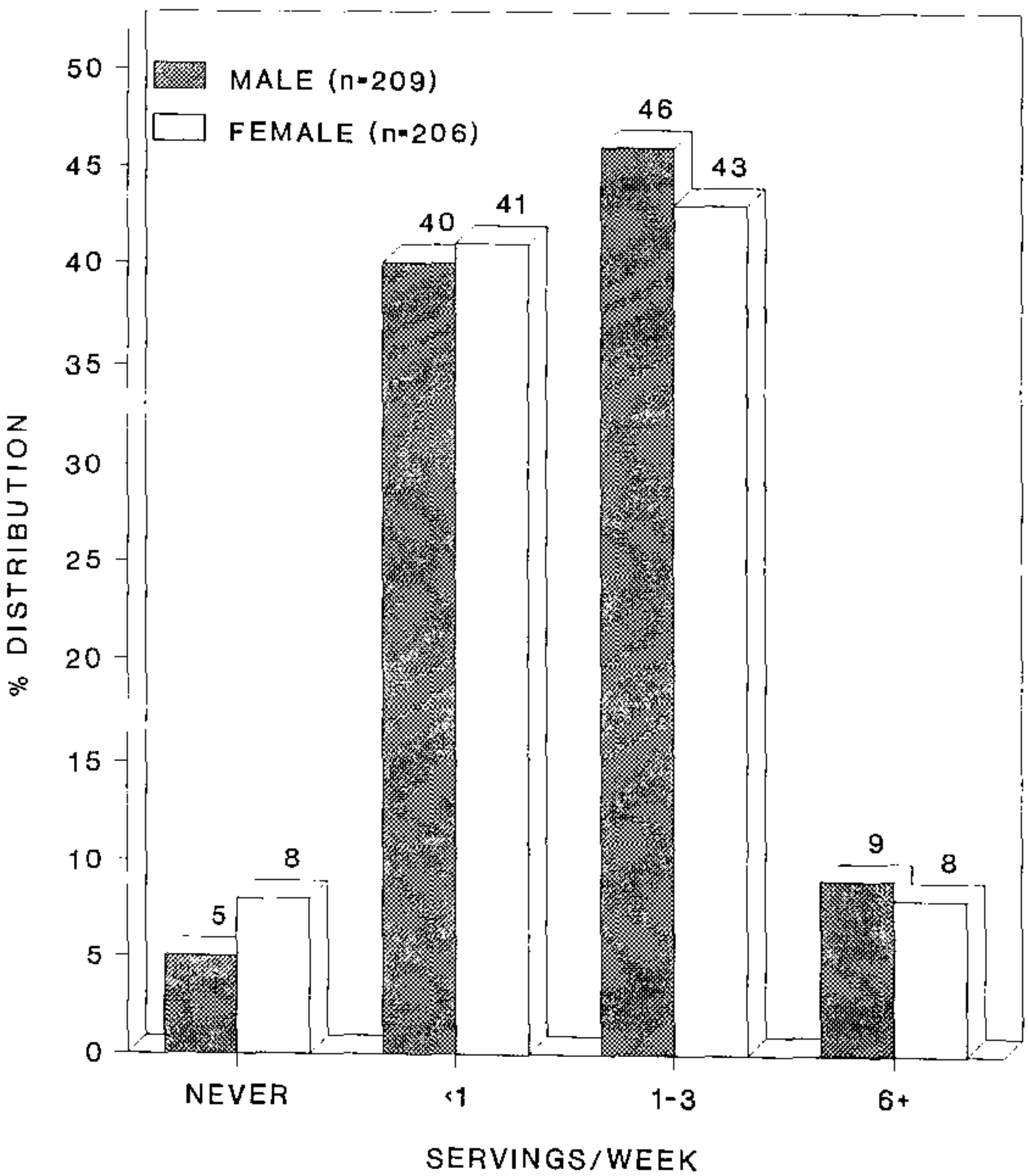

Fig. 3.4. Consumption of poultry by the participants.

3.2.3.5 Mutton

Figure 3.5 shows the consumption pattern of mutton by the participants. Majority (70% male and 69% female) of the elderly used to take mutton occasionally (less than once per week), while a fair number of participants never ate mutton.

3.2.3.6 Large fish

Figure 3.6 shows the consumption pattern of large fish by the participants. Majority (69% male and 65% female) used to consume big fish 1-3 times per week. Only a small percentage (11% male and 12% female) consumed large fish 6+ times per week.

3.2.3.7 Small fish

The percentage distribution of the participants by frequency of intake of small fish is shown in Figure 3.7. Majority of the participants (71% male and 74% female) used to take small fish 1-3 times per week. And only 21% male and 18% female elderly used to take small fish 6+ times per week.

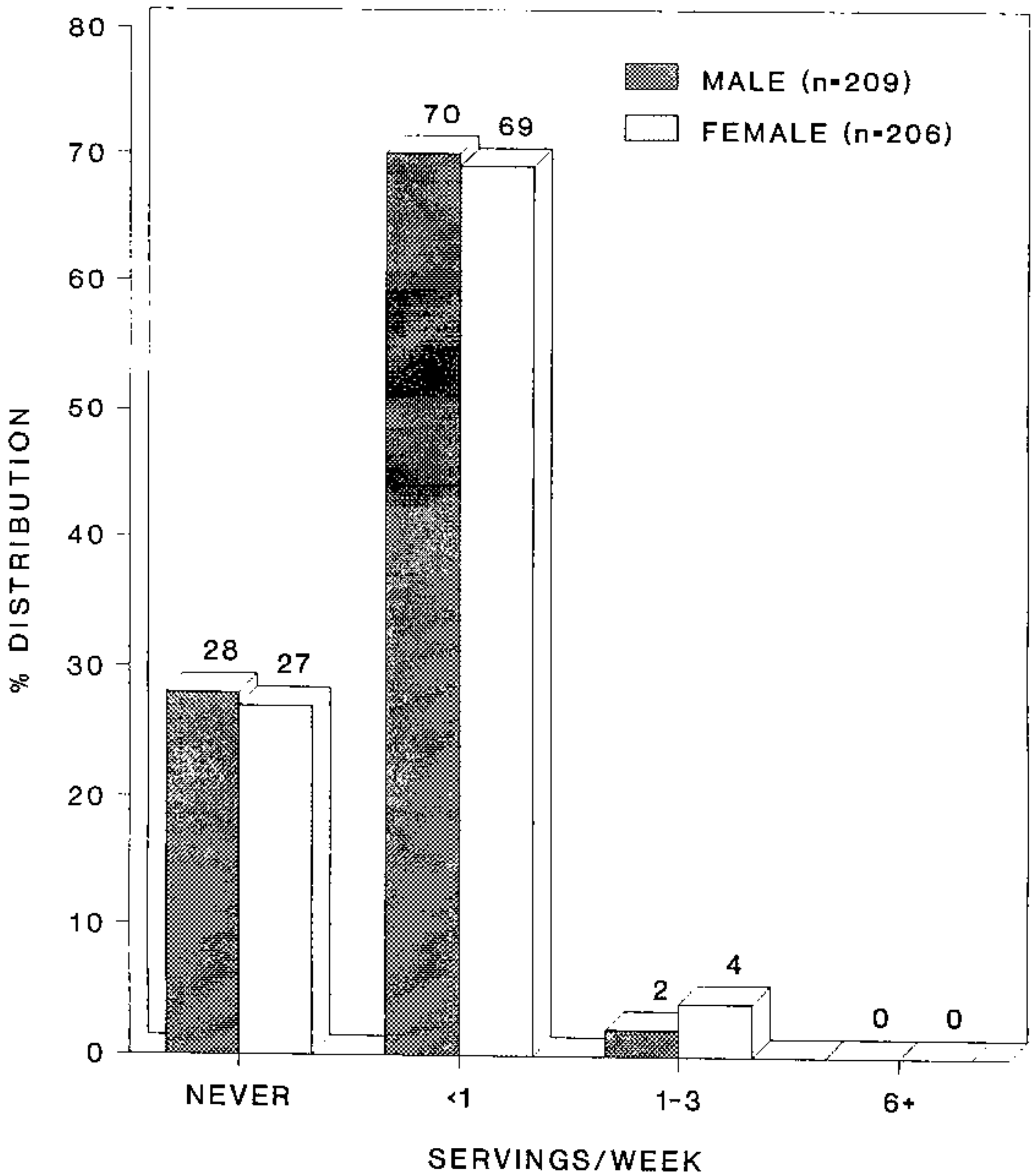

Fig. 3.5. Consumption of mutton by the participants.

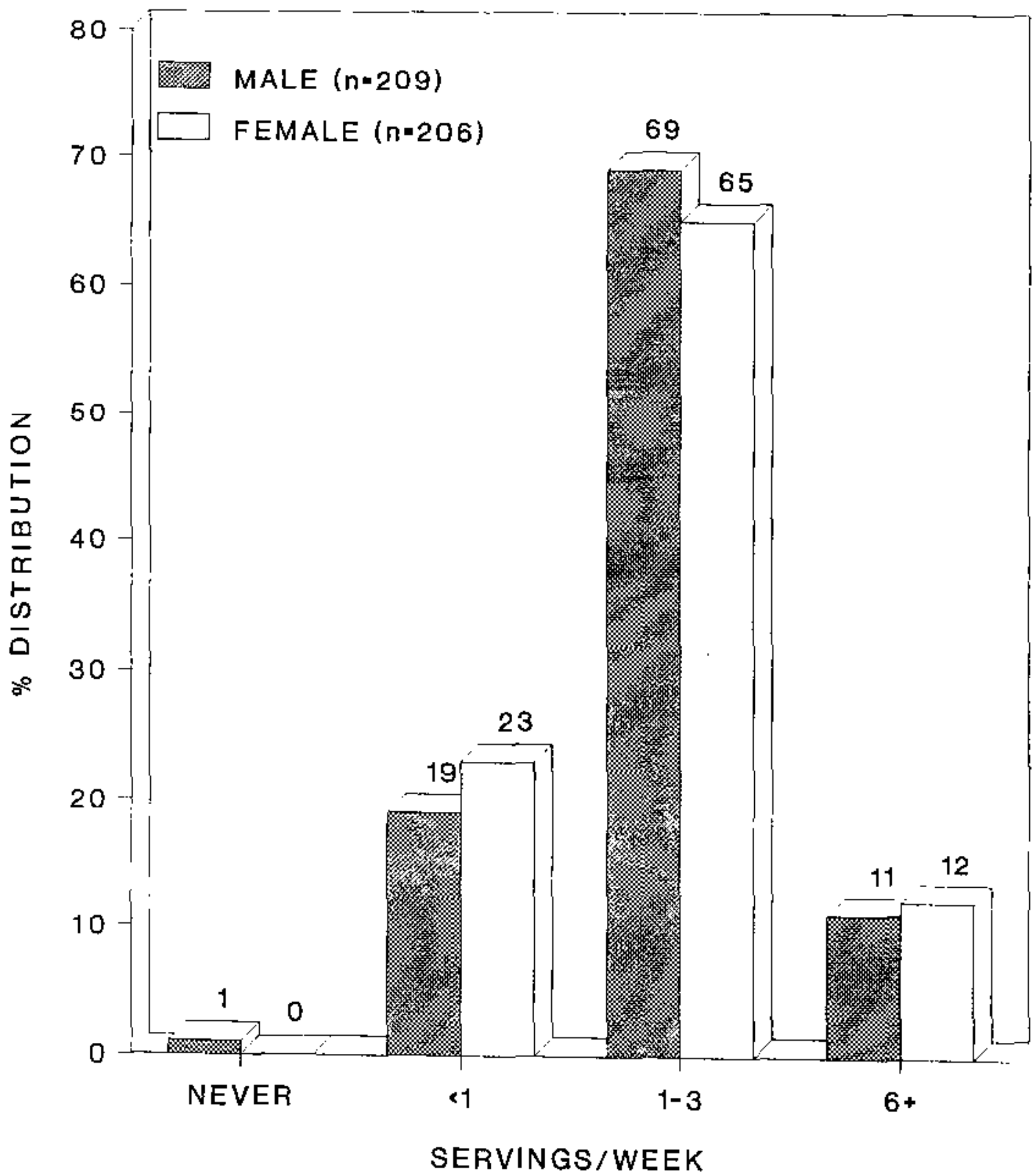

Fig. 3.6. Consumption of large fish by the participants.

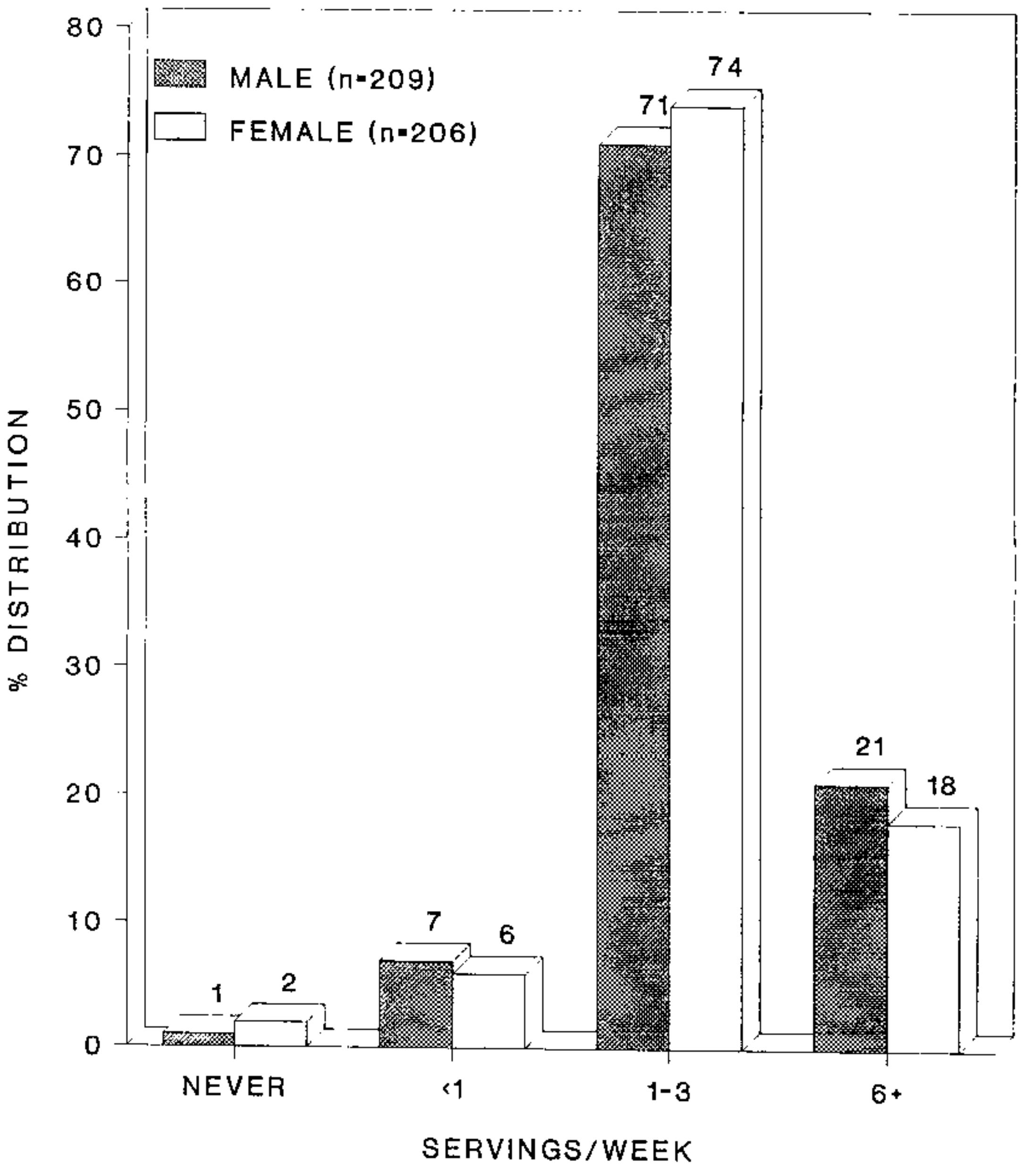

Fig. 3.7. Consumption of small fish by the participants.

3.2.3.8 Dal

Figure 3.8 shows the consumption pattern of *dal* by the participants. Majority of the participants (68% male and 66% female) used to consume *dal* on a regular basis (6+ times/week). And a good number (27% male and another 27% female) consumed *dal* 1-3 times per week.

3.2.3.9 Green leafy vegetables

Figure 3.9 shows the consumption pattern of green leafy vegetables by the elderly. A large number of the participants (77% male and 82% female) used to consume green leafy vegetables 6+ times per week. About 18% male and 15% female used to take green leafy vegetables 1-3 times per week. And a very small percentage (1% male and 2% female) elderly did not take green leafy vegetables.

3.2.3.10 Fruits

Consumption pattern of fruits by the elderly is presented in Figure 3.10. Over half of the participants (56% male and 53% female) used to take fruits 1-3 times per week. Only 19% male and 17% female used to take fruits on a regular basis (6+ times/week). Twenty-four percent male and 29% female used to take fruits occasionally (<1 time per week).

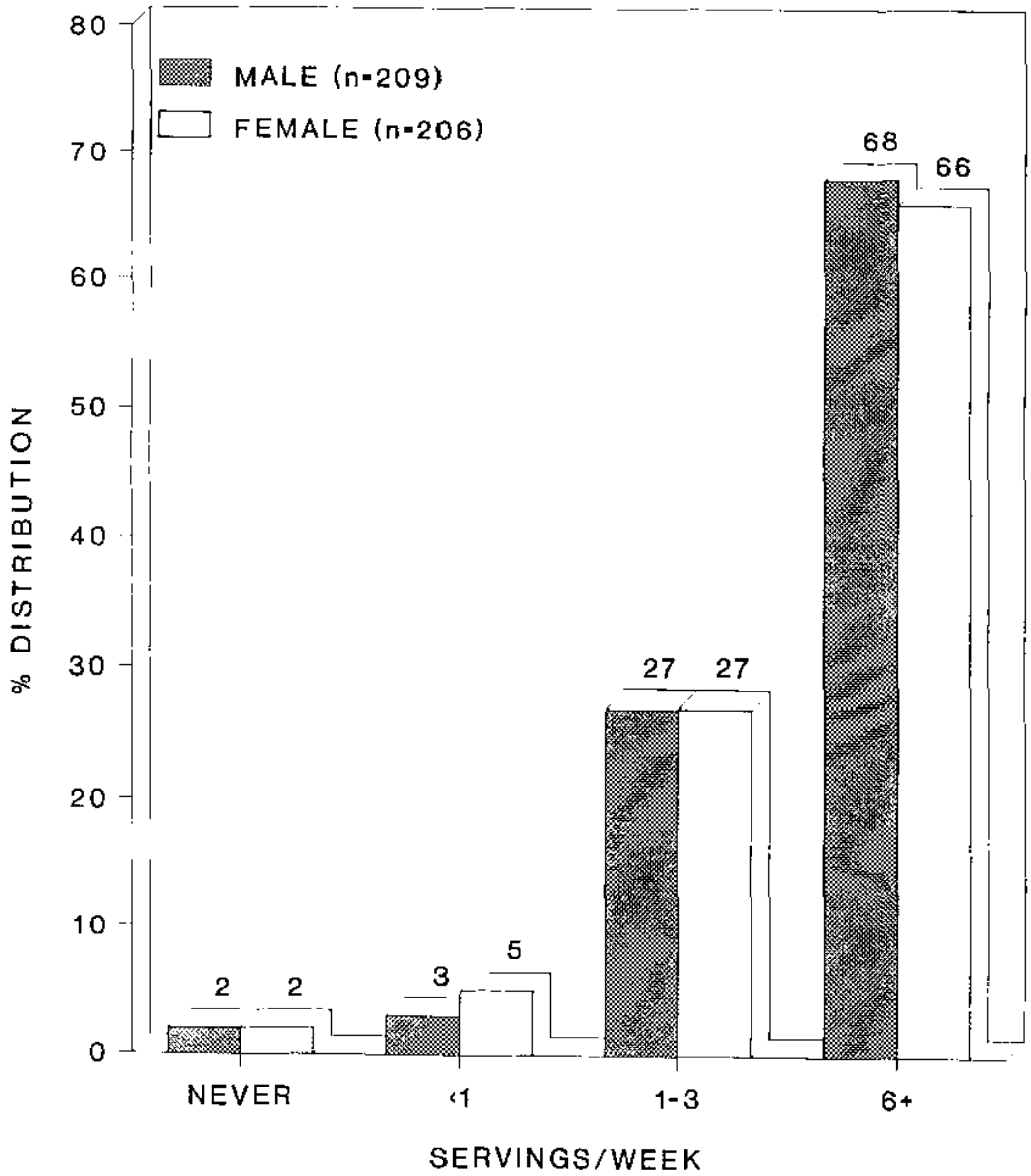

Fig. 3.8. Consumption of *dal* by the participants.

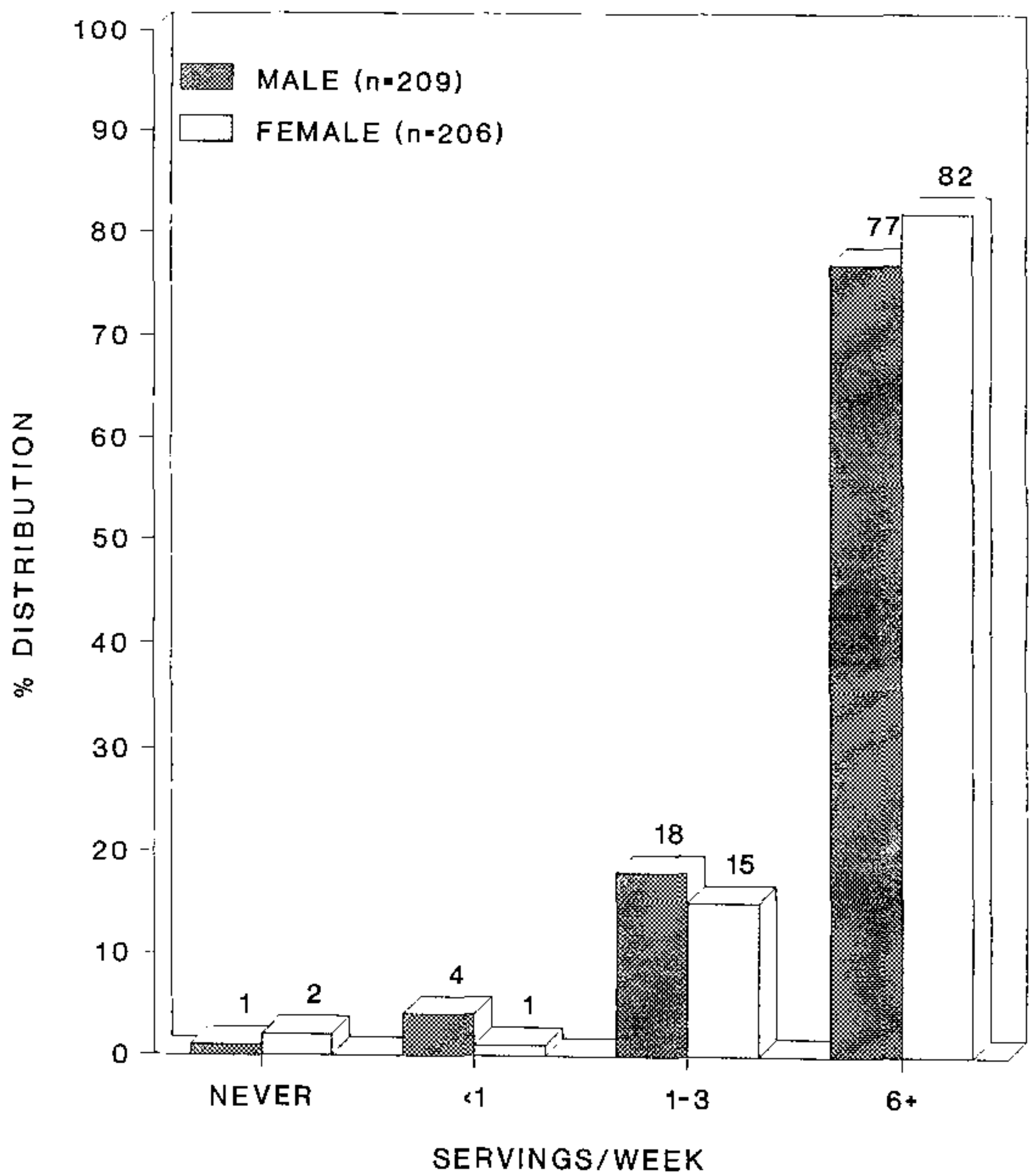

Fig. 3.9. Consumption of green leafy vegetables by the participants.

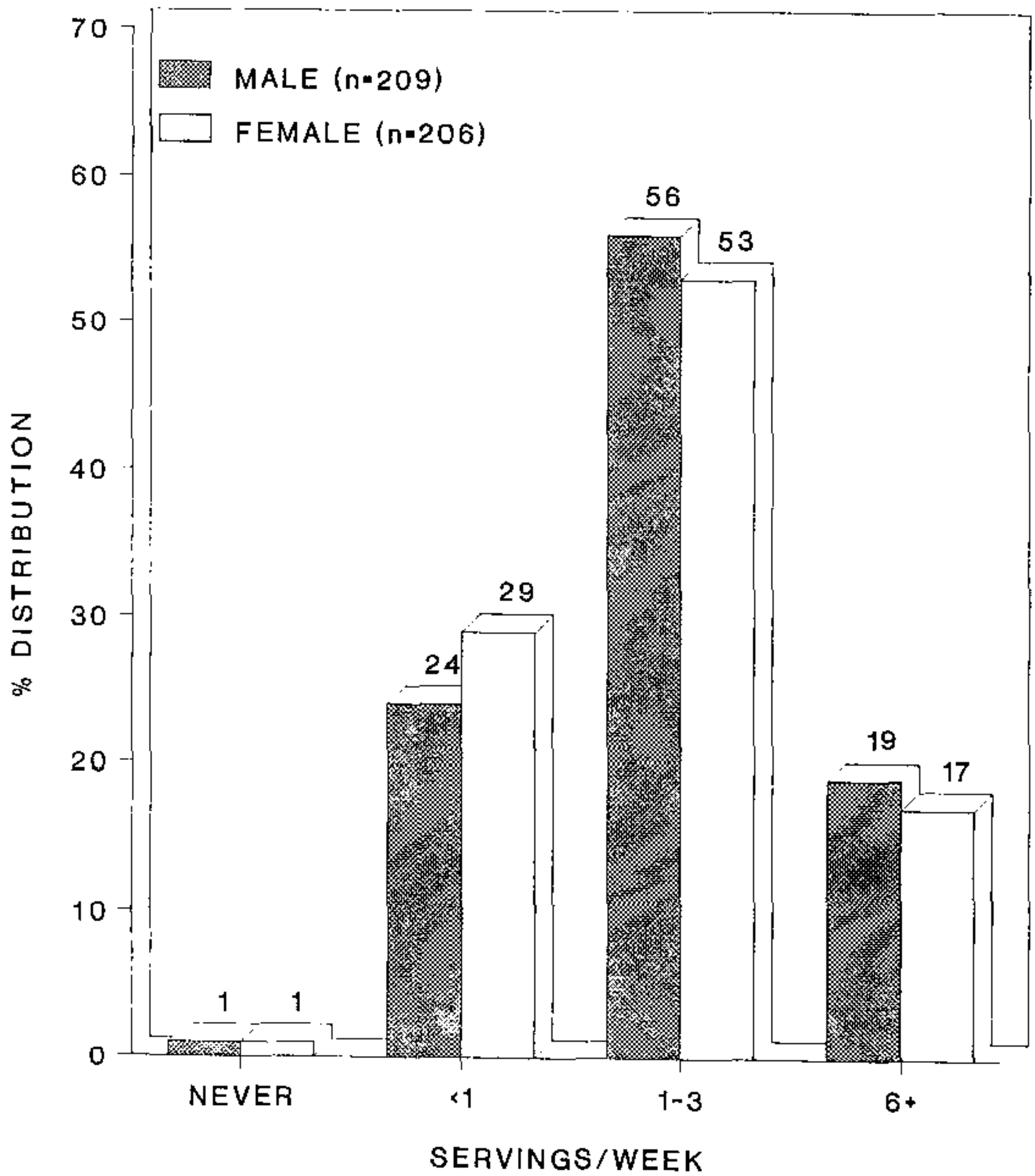

Fig. 3.10. Consumption of fruits by the participants.

3.2.4 Dietary intake

3.2.4.1 Energy

Mean (±SD) energy intake of the male participants was determined as 1598 (±272) kcal per day meeting 85% of the RDA (Table 3.9 and Figure 3.21). Mean (±SD) energy intake of the female participants was found as 1493 (±249) kcal per day and it met 92% of the RDA (Table 3.9 and Figure 3.21).

Figure 3.11 shows the distribution of male and female participants according to their energy intake in comparison with RDA. Only 17% males and 31% females fulfilled their daily energy requirements.

3.2.4.2 Protein

Mean (±SD) protein intake of the male participants was 48 (±13) g/day and it met 106% of the RDA (Table 3.9 and Figure 3.21). Mean (±SD) protein intake of the female participants was 41 (±10) g/day, and it was 105% of the RDA (Table 3.9 and Figure 3.21). Mean intake of animal protein of male participants was 17.2 g and female participants was 13.4 g.

Figure 3.12 shows the distribution of the participants according to their protein intake compared with RDA. Majority of the participants (57% male and 58% female) fulfilled the RDA of protein. In all age groups of

TABLE 3.9

Daily mean intake of macronutrients in relation to RDA of the participants

	Male (n=209)		Female (n=206)	
Macronutrients	Mean±SD	Meeting % of RDA*	Mean±SD	Meeting % of RDA*
Energy (kcal)	1598±272	85	1493±249	92
Protein (g)	48±13	106	41±10	105
Animal protein (g)	17.2		13.4	
Fat (g)	35±12	113	34±12	126
Carbohydrate (g)	267±58	76	251±53	82

*RDA of energy for male and female were 1872 and 1630 kcal respectively

*RDA of protein for male and female were 45.0 and 38.7 g respectively

*RDA fat for male and female were 31 and 27 g respectively

*RDA of carbohydrate for male and female were 351 and 305 g respectively

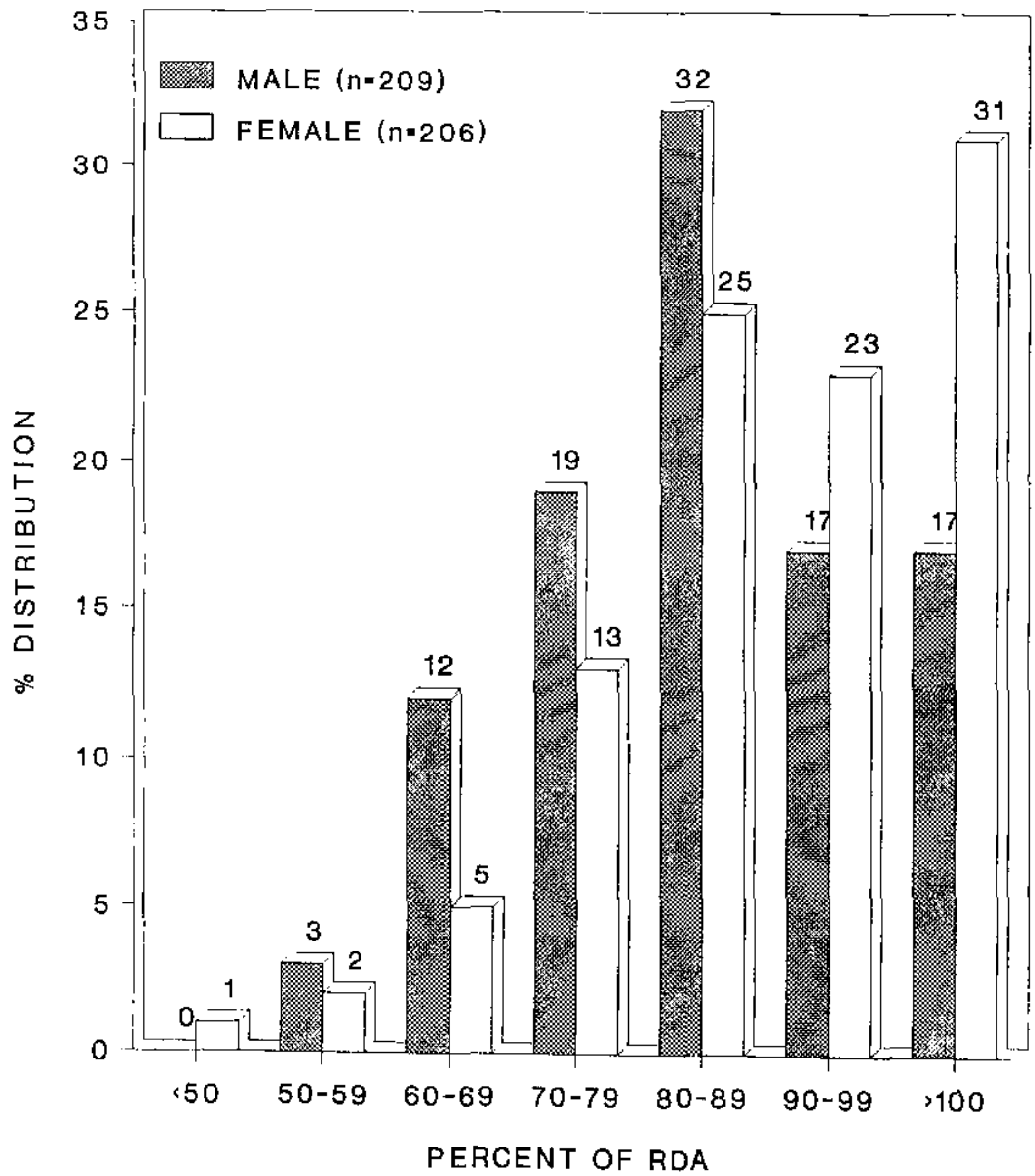

Fig. 3.11. Distribution of the participants by energy intake

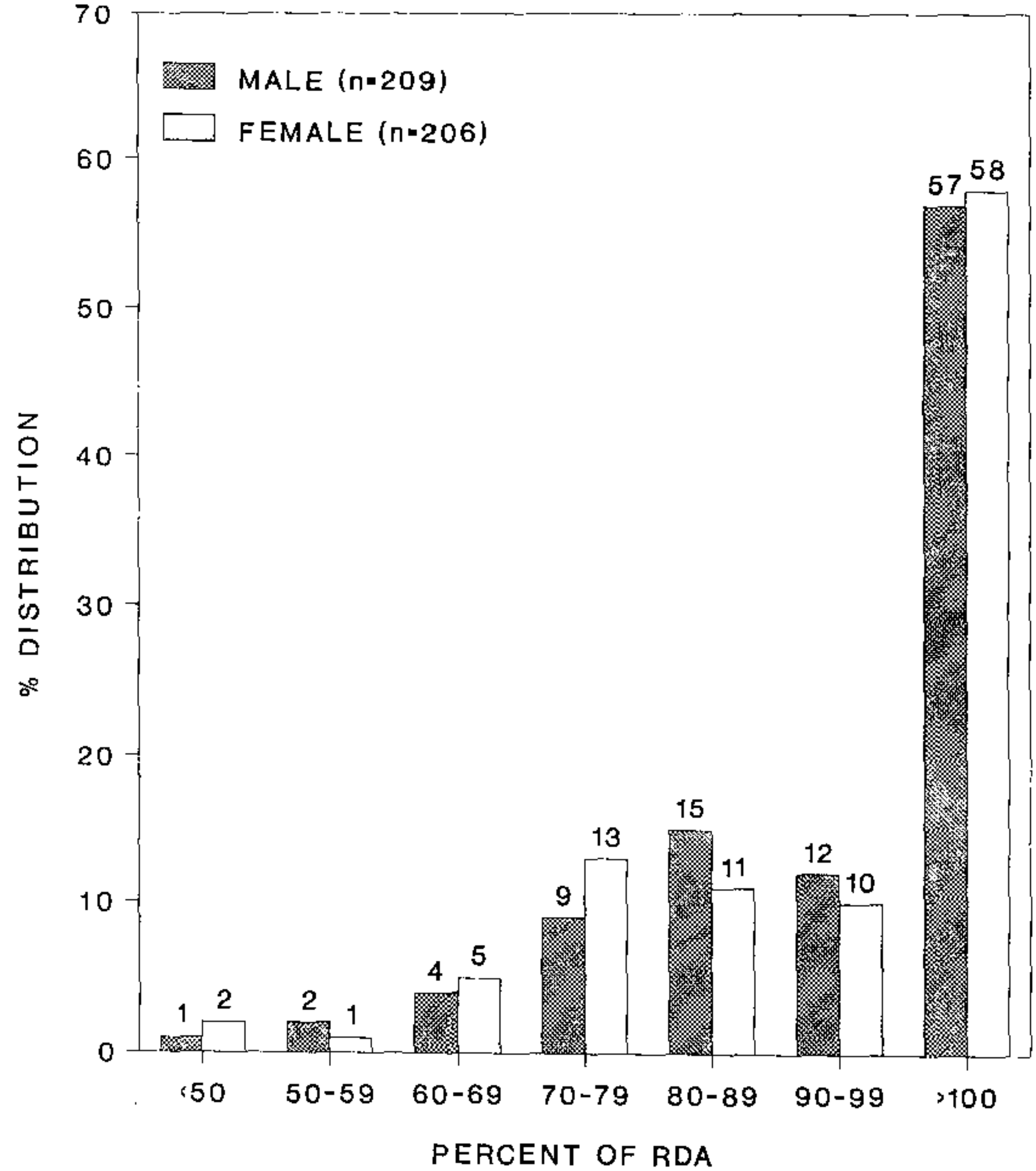

Fig. 3.12. Distribution of the participants by protein intake

male participants, 12% energy came from protein sources (Table 3.11) and in case of females, it was 11%, which was adequate and meet the recommended levels of animal protein intake.

3.2.4.3 Fat

The mean (±SD) fat intake of the male participants was 35 (±12) g/day, and it was 113% of the RDA (Table 3.9 and Figure 3.21). Mean (±SD) fat intake of the female participants was 34 (±12) g/day, and it was 126% of the RDA (Table 3.9 and Figure 3.21).

Above half of the participants (64% male and 71% female) fulfilled their RDA of fat (Figure 3.13).

In case of male, 20% energy came from fat source (Table 3.11) and in case of female, it was 21%.

3.2.4.4 Carbohydrate

Mean (±SD) carbohydrate intake of male elderly was 267 (±58) g/day, and it was 76% of RDA (Table 3.9 and Figure 3.21). Mean (±SD) carbohydrate intake of female elderly was 251 (±53) g/day, and it was 82% of the RDA (Table 3.9 and Figure 3.21).

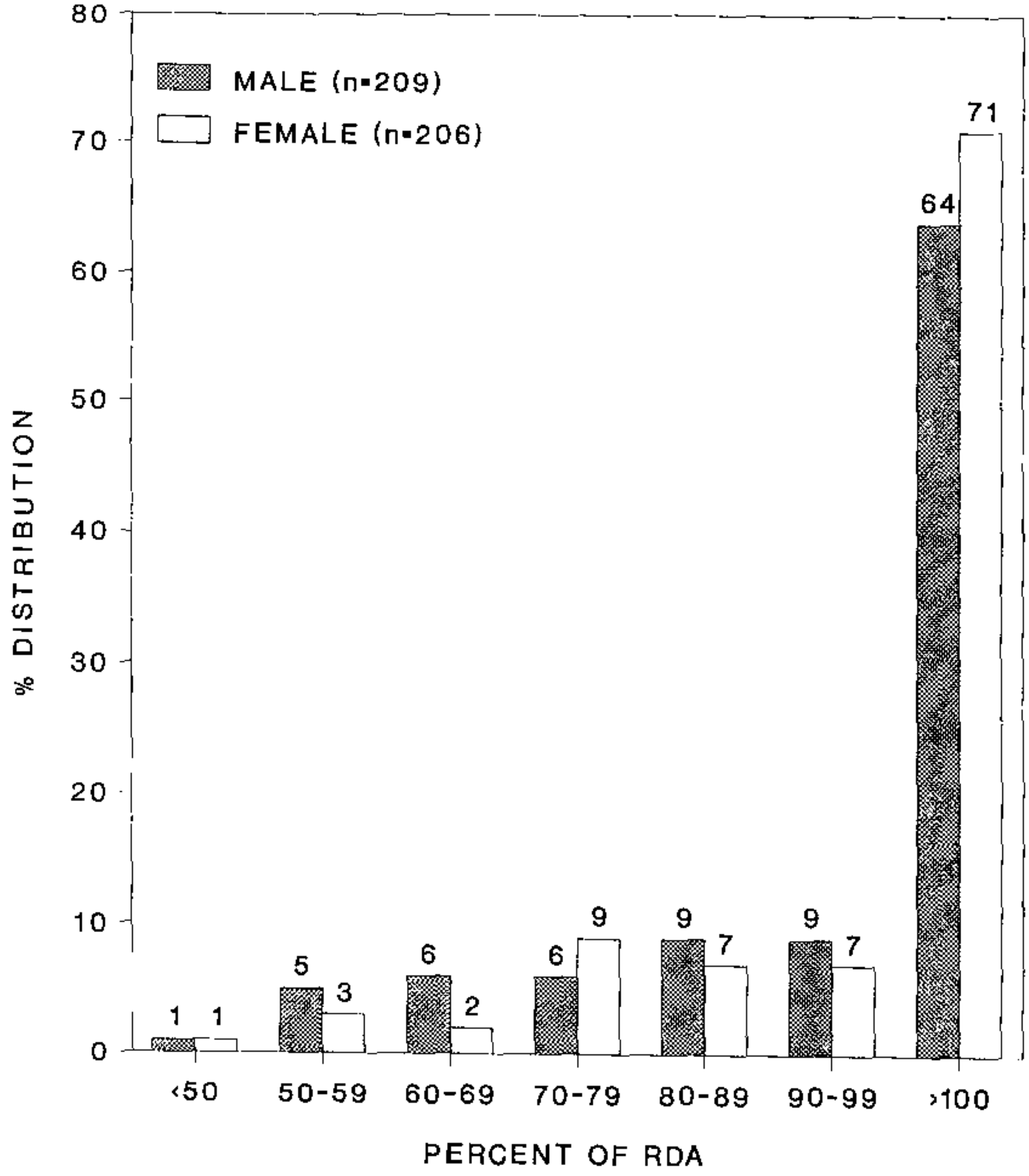

Fig. 3.13. Distribution of the participants by fat intake

Figure 3.14 shows the distribution of the participants according to their carbohydrate intake compared with RDA. Only 12% male and 20% female participants met the RDA.

In case of both male and female elderly, 68% energy came from carbohydrate sources (Table 3.11).

3.2.4.5 *Calcium*

Mean (±SD) calcium intake of male participants was 470 (±279) mg/day, and it was 118% of RDA (Table 3.10 and Figure 3.21). Mean (±SD) calcium intake of female participants was 404 (±258) mg/day, and it was 101% of RDA (Table 3.10 and Figure 3.21).

Figure 3.15 shows the distribution of the participants according to their calcium intake in relation to RDA. Around half of the participants (54% male and 42% female) met their RDA for calcium. But a good percentage (20% male and 22% female) of elderly met less than 50% of RDA.

3.2.4.6 *Iron*

Mean (±SD) iron intake of male participants was 14 (±7) mg/day, and it was 125% of RDA (Table 3.10 and Figure 3.21). And mean (±SD) iron intake of female participants was 13 (±7) mg/day, and it was 140% of RDA (Table 3.10 and Figure 3.22).

TABLE 3.10

Daily mean intake of micronutrients in relation to RDA of the participants

	Male (n=209)		Female (n=206)	
Micronutrients	Mean±SD	Meeting % of RDA*	Mean±SD	Meeting % of RDA*
Calcium (mg)	470±279	118	404±258	101
Iron (mg)	14±7	125	13±7	140
Zinc (mg)	7±2	45	6±2	50
Vitamin A (μg)	561±602	79	695±792	93
Riboflavin (mg)	0.7±0.3	60	0.6±0.3	58
Vitamin C (mg)	31±30	103	31±31	105

*RDA of calcium for both male and female was 400 mg

*RDA of iron for male was 11 mg and female was 9 mg

*RDA of zinc for male was 15 mg and female was 12 mg

*RDA of vitamin A for both male and female was 750 μg

*RDA of riboflavin for male was 1.12 mg and female was 0.98 mg

*RDA of vitamin C for both male and female was 30 mg

TABLE 3.11

Sources (%) of energy from macronutrients in different age and sex groups

Age group (years)	Macronutrients					
	Protein (% of calorie)		Fat (% of calorie)		Carbohydrate (% of calorie)	
	Male	Female	Male	Female	Male	Female
60-64	12	11	20	21	68	68
65-69	12	11	20	21	68	68
70+	12	11	21	20	67	69
Total	12	11	20	21	68	68

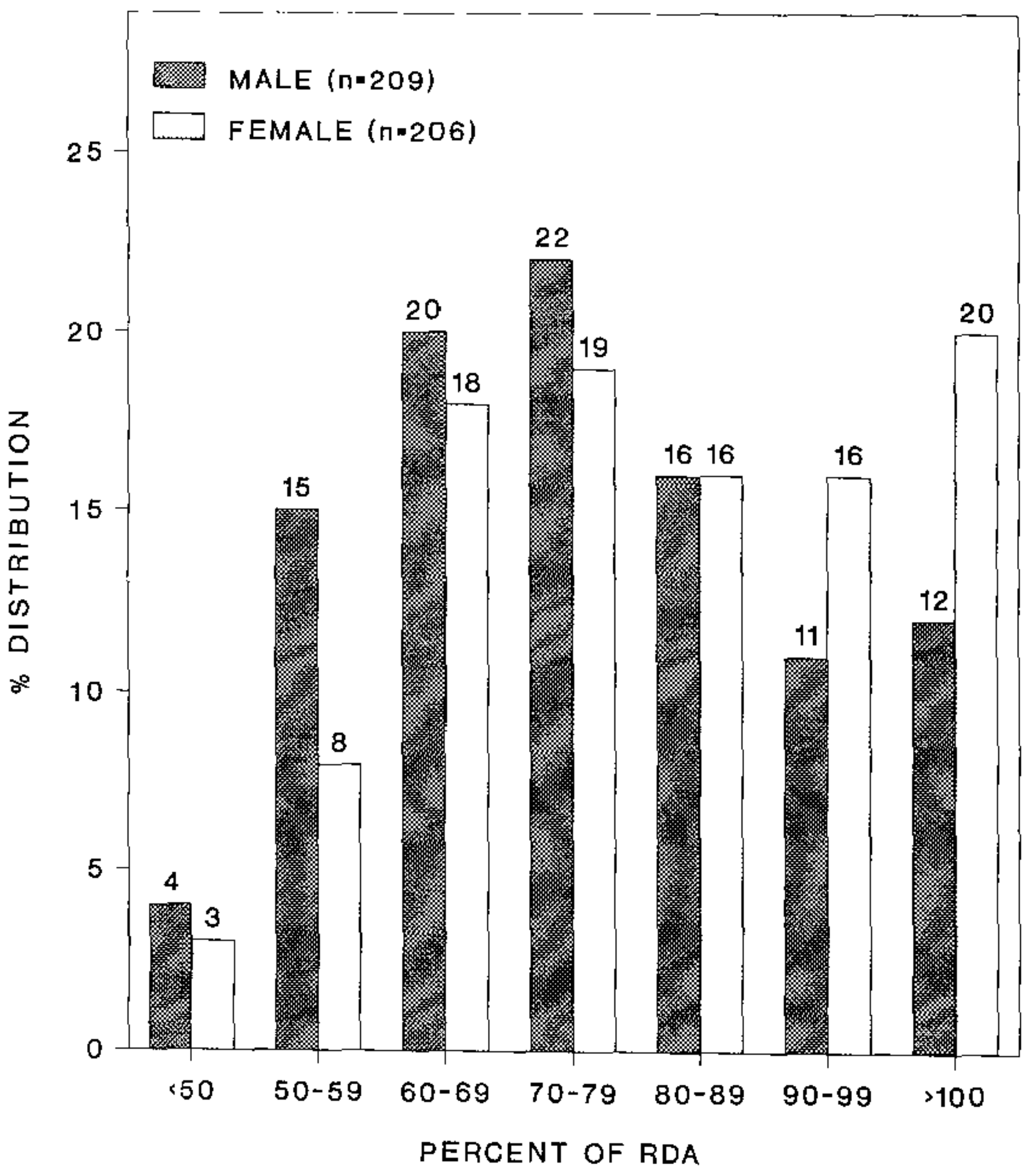

Fig. 3.14. Distribution of the participants by carbohydrate intake

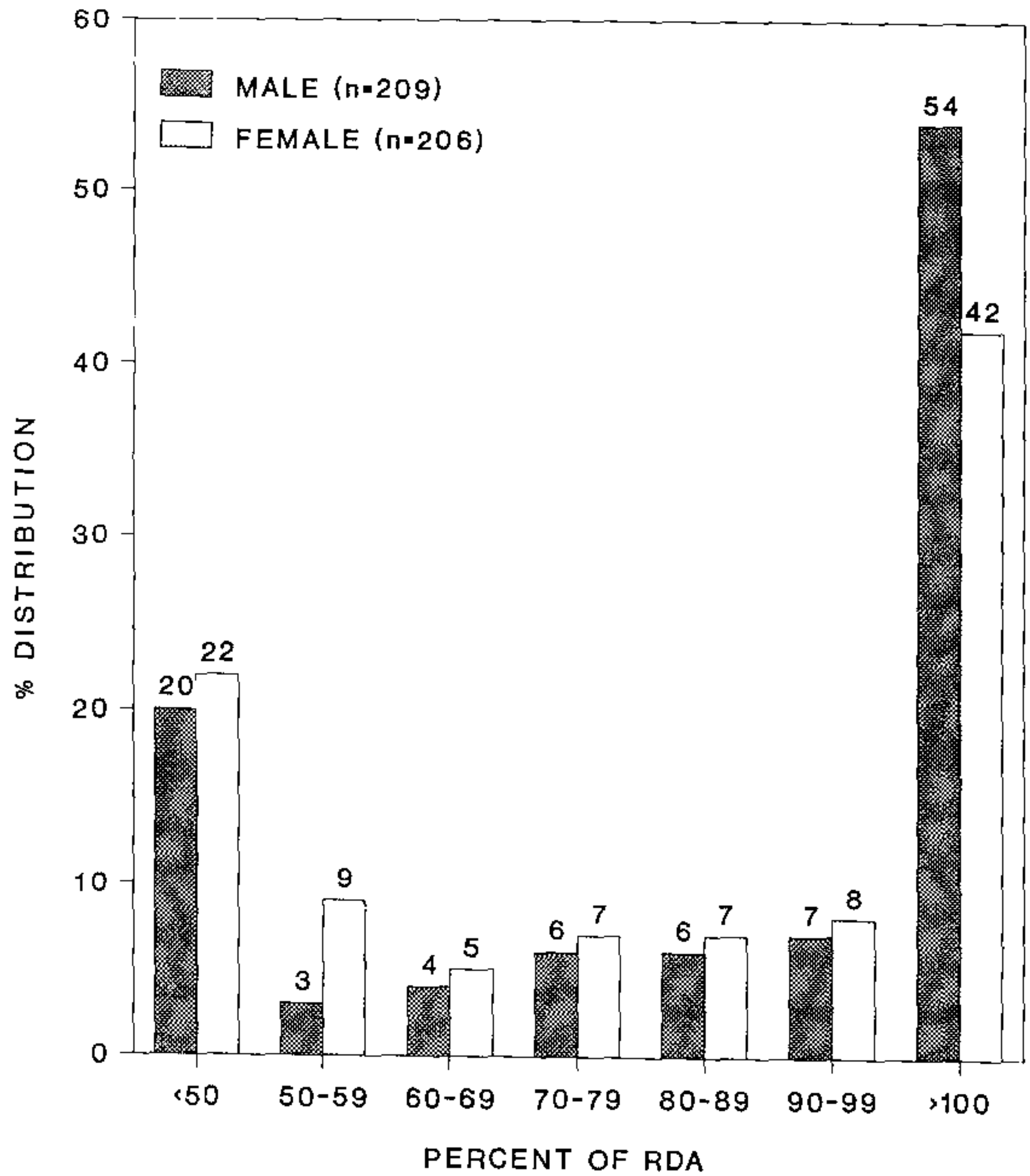

Fig. 3.15. Distribution of the participants by calcium intake

Figure 3.16 shows the frequency distribution of the participants in relation to RDA. A major portion of male (60%) and female (49%) met their RDA for iron.

3.2.4.7 Zinc

Mean (±SD) zinc intake of the male participants was found only 7 (±2) mg/day, and it was only 45% of RDA (Table 3.10 and Figure 3.21). Mean (±SD) zinc intake of the female participants was found 6 (±2) mg/day, and it was also only 50% of RDA (Table 3.10 and Figure 3.22).

As shown in Figure 3.17, major portion of male (67%) and female (54%) elderly had intake below 50% of RDA. And no one fulfilled their RDA for zinc.

3.2.4.8 Vitamin A

Mean (±SD) vitamin A intake of the male participants was 561 (±602) μg/day, and it was 79% of the RDA. Mean (±SD) vitamin A intake of the female participants was 695 (±792) μg/day, and it was about 93% of RDA (Table 3.10 and Figure 3.21).

Figure 3.18 shows the frequency distribution of the participants according to their vitamin A intake in relation to RDA. Only 23% male and 34%

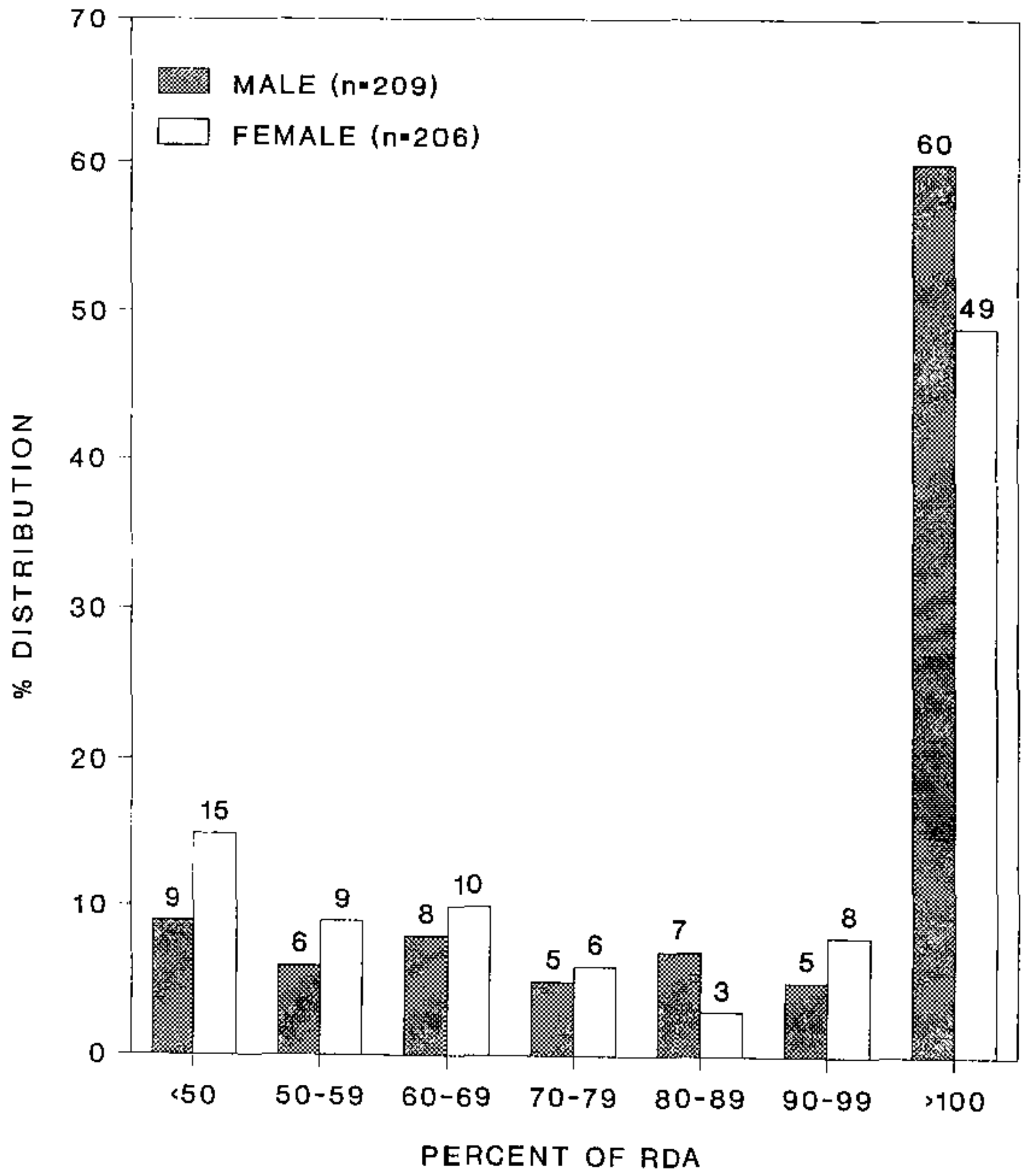

Fig. 3.16. Distribution of the participants by iron intake

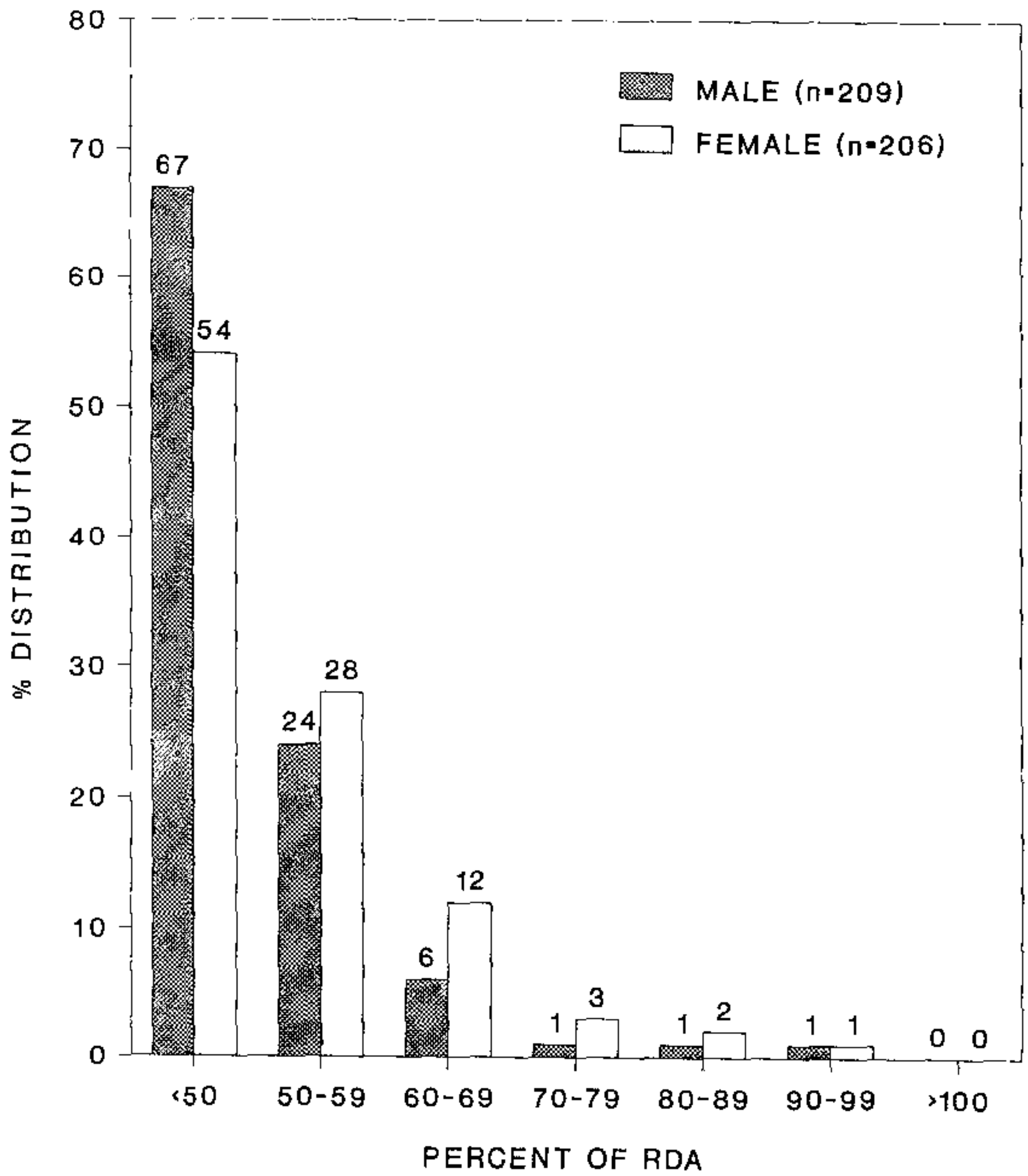

Fig. 3.17. Distribution of the participants by zinc intake

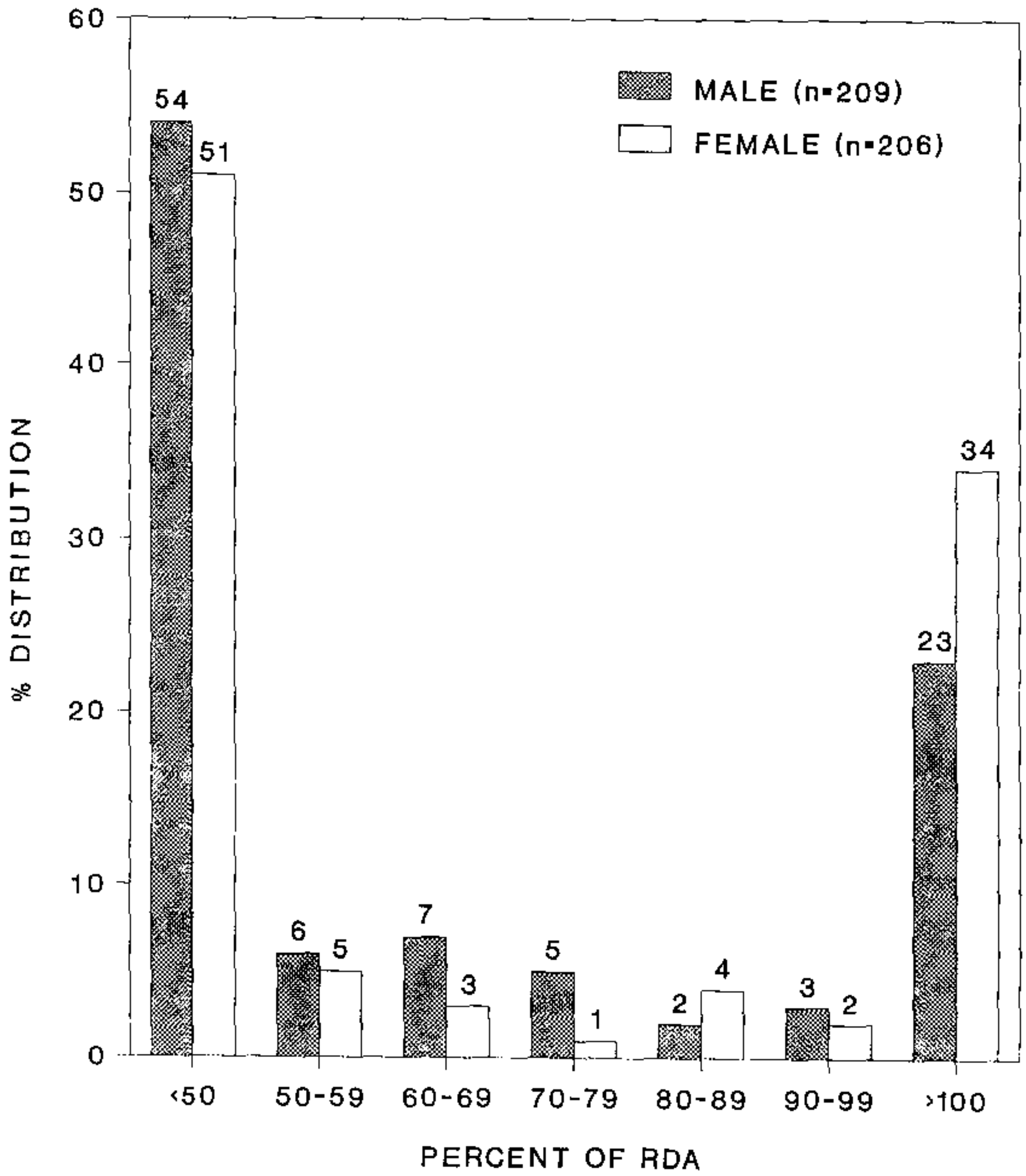

Fig. 3.18. Distribution of the participants by vitamin A intake

female elderly fulfilled their RDA for vitamin A. And a large portion (54% male and 51% female) elderly had intake below 50% of their RDA.

3.2.4.9 Riboflavin

Mean (±SD) riboflavin intake of male participants was found 0.7 (±0.3) mg/day, and it was only 60% of RDA (Table 3.10 and Figure 3.21). And mean (±SD) riboflavin intake of female participants was found 0.6 (±0.3) mg/day, and it was also much lower (58%) of RDA.

Figure 3.19 shows only a small percentage of elderly (9% male and 7% female) met their RDA. And a large number (43% male and 46% female) had intake below 50% of RDA.

3.2.4.10 Vitamin C

Mean (±SD) vitamin C intake of male elderly was 31 (±30) mg/day, and it was about 103% of RDA. Mean (±SD) vitamin C intake of female elderly was 31 (±31) mg/day, and it was about 105% of RDA (Table 3.10 and Figure 3.21).

Figure 3.20 shows the distribution of the participants by vitamin C intake in relation to RDA. Thirty-seven percent male and 38% female elderly met their RDA. And 37% male and 35% female consumed below 50% of the RDA only.

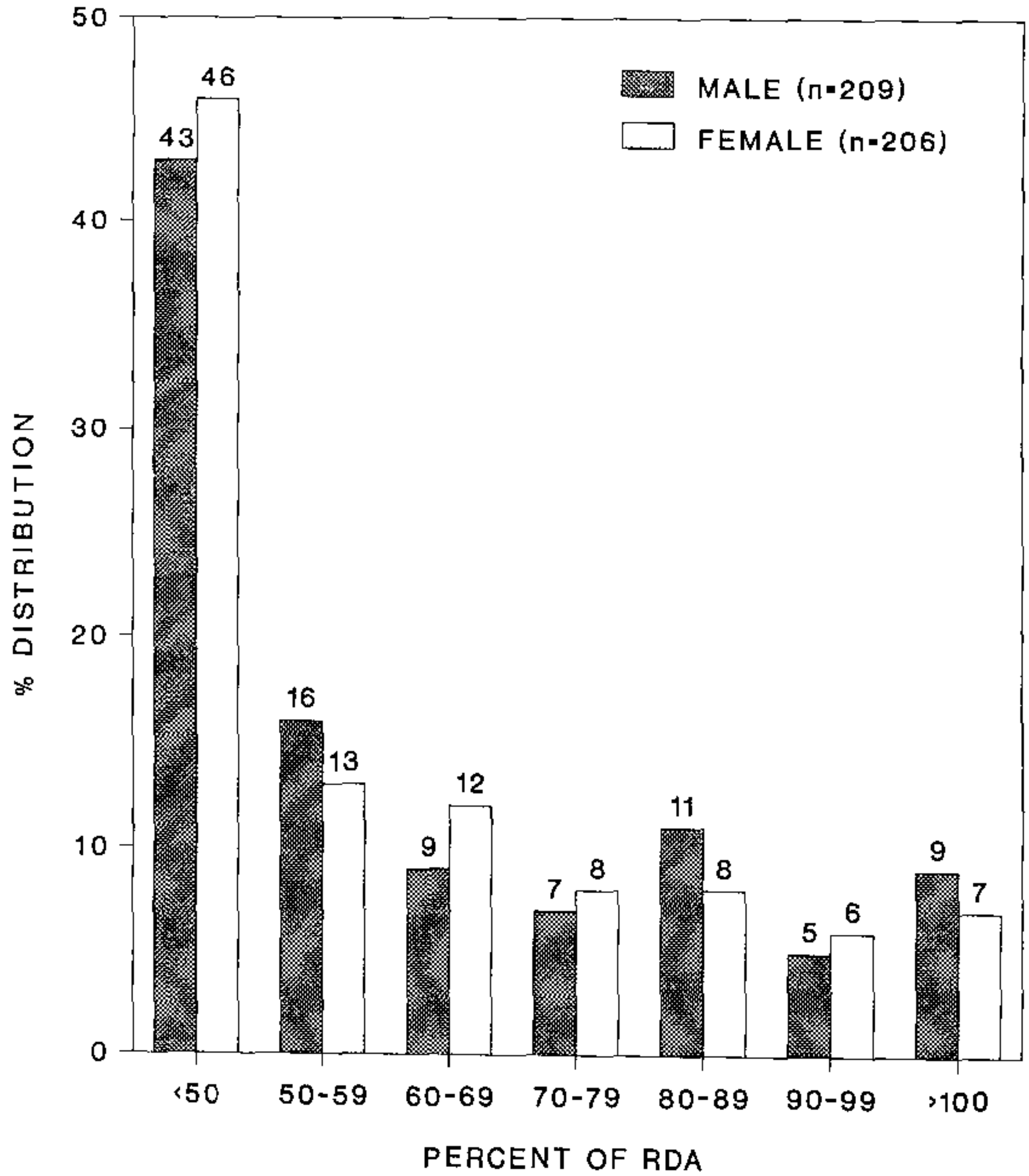

Fig. 3.19. Distribution of the participants by riboflavin intake

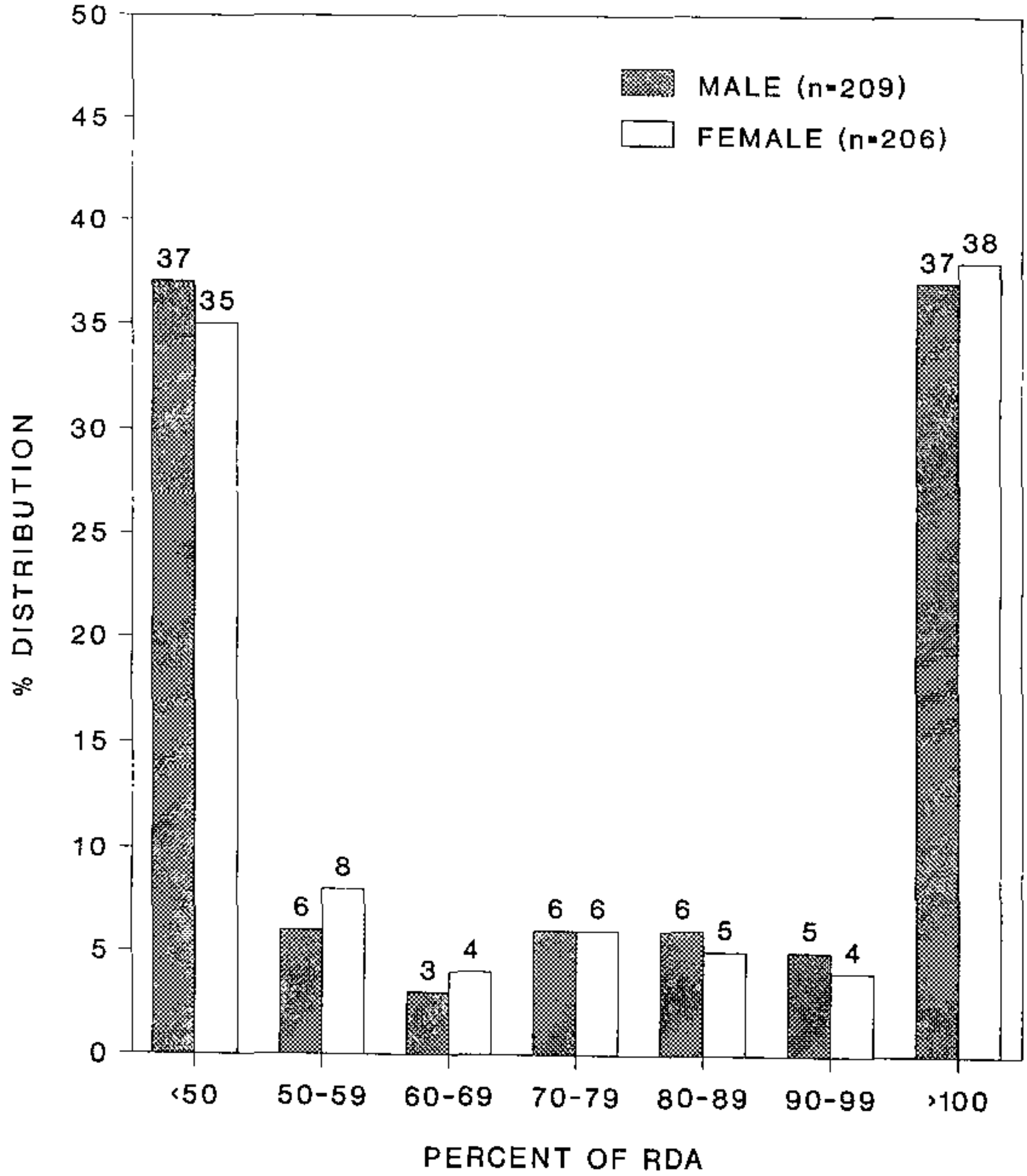

Fig. 3.20. Distribution of the participants by vitamin C intake

A = Energy (kcal)
B = Protein (g)
C = Fat (g)
D = Carbohydrate (g)
E = Calcium (mg)
F = Iron (mg)
G = Zinc (mg)
H = Vitamin A (μg)
I = Riboflavin (mg)
J = Vitamin C (mg)

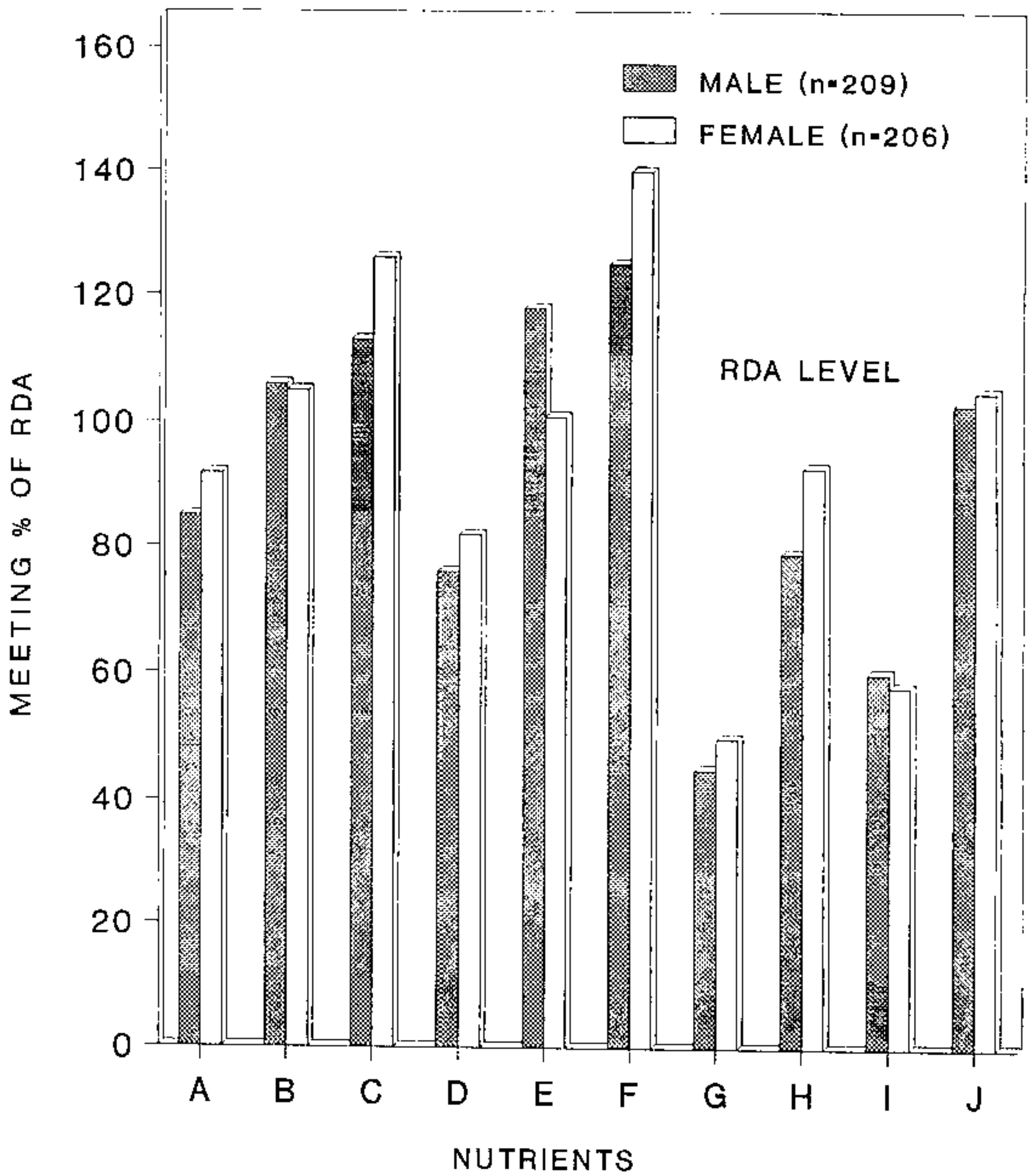

Fig. 3.21. Intake of nutrients in relation to RDA of the participants

3.2.5 Food consumption by food groups

The mean consumption of food by groups from different food sources are shown in Table 3.12. Mean cereal intake of male and female participants were 288 and 271 g, respectively.

Mean intake of pulses and nuts of male and female participants were same (25 g).

Mean intake of green leafy vegetables of male and female participants were only 13 and 21 g, respectively. Mean fruit intake were 27 and 32 g in case of male and female participants.

Mean intake of milk and milk products, eggs, meat and fish of male and female participants were 79 and 66 g, 13 and 9 g, 21 and 15 g, 34 and 28 g, respectively. Mean intake of fats and oils of male and female participants were same (24 g).

TABLE 3.12

Consumption of foods by food groups

	Male (n=209)		Female (n=206)	
Food group	Mean (g)	±SD	Mean (g)	±SD
Cereal	288	±67	271	±67
Roots and tubers	25	±35	23	±30
Pulses and nuts	25	±23	25	±23
Vegetables:				
Green leafy	13	±25	21	±33
Yellow	38	±42	31	±39
Others	14	±29	11	±25
Fruits	27	±67	32	±79
Milk and milk products	79	±108	66	±98
Eggs	13	±24	9	±18
Meat	21	±34	15	±25
Fish	34	±31	28	±27
Sugar	8	±11	6	±9
Fats and oils	24	±8	24	±9

3.3 RELATIONSHIPS

3.3.1 Relationship between socioeconomic parameters, dietary intake, health status and BMI

In the examination of these relationships, BMI was taken as indicator of nutritional status of the participants. The BMI was divided into three groups according to the recommendations of international organizations (FAO 1994)[95].

3.3.1.1 Age

Table 3.13 shows the effect of age on nutritional status (BMI) of male and female participants. Mean BMI of male participants decreased slightly in 70+ age groups than other 2 age groups, but it was not statistically significant. Mean BMI of female participants gradually decreased with advancing age and this relationship was highly statistically significant (P=0.00).

3.3.1.2 Level of education

Table 3.14 shows the effect of education on nutritional status of male and female participants. The prevalence of overweight was higher among male participants (19%) who has higher educational level than those with lower

TABLE 3.13

Relationship between BMI and age

Age groups (years)	BMI (kg/m^2)			
	Male (n=209)		Female (n=206)	
	Mean±SD	P value*	Mean±SD	P value*
60-64	21.8±3.4		23.1±4.1	
65-69	21.8±3.0	0.70	22.3±3.1	0.00
70+	21.4±3.8		20.6±4.4	

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.14

Relationship between BMI and educational level

BMI	Educational level: Male (n=209) <SSC (n=102) No.	%	SSC+ (n=107) No.	%	P value*	Female (n=206) <SSC (n=172) No.	%	SSC+ (n=34) No.	%	P value*
CED	29	28	8	7		39	23	2	6	
Normal	63	62	79	74	0.00	94	54	17	50	0.01
Over-weight	10	10	20	19		39	23	15	44	

*Calculated using Chi-square test

educational level (10%). The effect was statistically highly significant (P=0.00).

Again, female participants who had lower educational level were suffering more (23%) from chronic energy deficiency than those of higher educational level (6%). On the other hand, overweight was more common among those female participants who had higher level of education (44%) than less educated ones (23%). And this relationship was also statistically highly significant (P=0.01).

3.3.1.3 Per capita monthly income

Table 3.15 shows the effect of per capita monthly income on nutritional status of male and female participants.

Male participants who had lower per capita income were suffering from chronic energy deficiency more (29%) than those who had higher per capita income (4%). On the other hand, obesity was more common among those male participants who belonged to higher per capita income family. These relationships were statistically highly significant (P=0.00).

Again, female participants who belonged to lower per capita income family were suffering more (30%) from chronic energy deficiency than higher per capita income family (6%). On the contrary, obesity was more common (39%) among those female participants who belonged to higher per capita

TABLE 3.15

Relationship between BMI and per capita monthly income

BMI	Per capita monthly income (Taka)									
	Male (n=209)					Female (n=206)				
	<2000 (n=113)		>2000 (n=96)		P value*	<2000 (n=119)		>2000 (n=87)		P value*
	No.	%	No.	%		No.	%	No.	%	
CED	33	29	4	4		36	30	5	6	
Normal	71	63	71	74	0.00	63	53	48	55	0.00
Over-weight	9	8	21	22		20	17	34	39	

*Calculated using Chi-square test

income family than those from lower ones (17%). This relationship was also statistically highly significant (P=0.00).

3.3.1.4 Relationship between BMI and energy and nutrient intake

Table 3.16 shows the relationship between BMI and energy and nutrient intake of male participants. Intake of all the nutrients except vitamin C and cholesterol was found to rise gradually from CED to normal and overweight male participants. And the difference was statistically significant in case of energy, protein, fat, iron, zinc, vitamin A, riboflavin and cholesterol intake (P=0.00, P=0.00, P=0.00, P=0.00, P=0.00, P=0.02, P=0.00, P=0.01, respectively).

Relationship between BMI and energy and nutrient intake of female participants is shown in Table 3.17. Intake of protein, fat, calcium, iron, riboflavin, vitamin C and cholesterol was found to rise gradually higher from CED to normal and to overweight female participants . However, the difference was statistically significant only in case of fat, riboflavin, vitamin C and cholesterol intake (P=0.00, P=0.00, P=0.02, P=0.00, respectively).

TABLE 3.16

Relationship between BMI and nutrient intakes
of male participants

Variables	Body mass index (BMI) CED (n=37) (Mean±SD)	Normal (n=142) (Mean±SD)	Obese (n=30) (Mean±SD)	P value*
Energy (kcal/d)	1443±247	1617±273	1699±222	0.00
Protein (g/d)	41±14	47±12	53±13	0.00
Fat (g/d)	27±12	36±12	39±10	0.00
Carbohydrate (g/d)	256±51	267±60	278±58	0.29
Calcium (mg/d)	381±338	481±268	530±235	0.07
Iron (mg/d)	10±4	14±7	17±7	0.00
Zinc (mg/d)	6±2	7±2	8±2	0.00
Vitamin A (μg/d)	313±409	598±597	694±744	0.02
Riboflavin (mg/d)	0.5±0.3	0.7±0.3	0.8±0.3	0.00
Vitamin C (mg/d)	24±26	33±30	30±28	0.25
Cholesterol (mg/d)	55±87	129±134	106±112	0.01

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.17

Relationship between BMI and nutrient intakes of female participants

Variables	Body mass index (BMI) CED (n=41) (Mean±SD)	Normal (n=111) (Mean±SD)	Obese (n=54) (Mean±SD)	P value*
Energy (kcal/d)	1457±231	1505±268	1495±223	0.57
Protein (g/d)	39±11	40±10	42±10	0.34
Fat (g/d)	29±12	33±12	39±10	0.00
Carbohydrate (g/d)	256±50	256±57	237±44	0.08
Calcium (mg/d)	384±338	395±241	442±221	0.46
Iron (mg/d)	11±8	13±7	14±7	0.14
Zinc (mg/d)	6±1	6±2	6±1	0.11
Vitamin A (μg/d)	605±674	720±764	714±929	0.71
Riboflavin (mg/d)	0.5±0.2	0.6±0.3	0.7±0.2	0.00
Vitamin C (mg/d)	22±19	31±32	40±35	0.02
Cholesterol (mg/d)	47±53	76±90	119±115	0.00

*Calculated using one-way analysis of variance (ANOVA)

3.3.1.5 Relationship between health status and BMI

To examine the relationship between health status and BMI, the participants (male and female) in each BMI group were also divided into two groups: health problem present and health problem absent on the basis of self-stated health complains.

Table 3.18 shows that there was no significant relationship between health status and BMI in case of both male and female participants.

3.3.2 Relationship between different socioeconomic parameters and energy and nutrient intake

3.3.2.1 Relationship between education and energy and nutrient intake of the participants

The male participants who were graduate had higher energy, protein, fat, calcium, iron, zinc, riboflavin and cholesterol intake than that of the participants with lower educational level (Table 3.19). The increase was gradual in case of protein, fat and calcium intake. And the differences reached the level of statistical significance in case of energy, protein, fat, calcium, iron, zinc, riboflavin and cholesterol intake ($P=0.02$, $P=0.00$, $P=0.00$, $P=0.00$, $P=0.01$, $P=0.00$, $P=0.00$, $P=0.00$, respectively).

The female participants who were illiterate had lower energy, protein, fat, calcium, zinc, riboflavin and cholesterol intake than those of the

TABLE 3.18

Relationship between health status and BMI

	Health problem									
	Male (n=209)					Female (n=206)				
BMI	Present (n=176) No.	%	Absent (n=33) No.	%	P value*	Present (n=185) No.	%	Absent (n=21) No.	%	P value*
CED	29	17	8	24		37	20	4	19	
Normal	121	69	21	64	0.55	100	5	11	52	0.97
Obese	26	15	4	12		48	26	6	29	

*Calculated using Chi-square test

TABLE 3.19

Relationship between education and nutrient intakes of male participants

Nutrient	Illiterate (n=57) (Mean±SD)	Primary (n=45) (Mean±SD)	SSC & HSC (n=50) (Mean±SD)	Graduate and above (n=57) (Mean±SD)	P value*
Energy (kcal/d)	1511±305	1585±229	1651±275	1648±248	0.02
Protein (g/d)	41±13	45±11	51±10	53±13	0.00
Fat (g/d)	27±10	31±10	40±10	44±11	0.00
Carbohy-drate (g/d)	272±63	278±53	265±60	254±54	0.16
Calcium (mg/d)	386±303	420±271	512±223	558±282	0.00
Iron (mg/d)	12±8	13±7	16±7	14±7	0.01
Zinc (mg/d)	6±2	6±1	7±1	7±2	0.00
Vitamin A (μg/d)	518±593	425±481	699±650	590±649	0.15
Riboflavin (mg/d)	0.5±0.3	0.6±0.3	0.8±0.3	0.8±0.3	0.00
Vitamin C (mg/d)	27±27	26±26	32±29	37±34	0.16
Cholest-erol (mg/d)	49±62	97±122	165±162	141±114	0.00

*Calculated using one-way analysis of variance (ANOVA)

participants with higher educational level. The decrease was gradual in case of protein, fat, calcium and cholesterol intake (Table 3.20). The differences were statistically significant in case of protein, fat, calcium, zinc, riboflavin and cholesterol intake (P=0.00, P=0.00, P=0.01, P=0.00, P=0.00, P=0.01, respectively).

3.3.2.2 Relationship between per capita monthly income and energy and nutrient intake

Figure 3.21 shows the male participants who had per capita monthly income more than Tk.3000 had higher energy and all the nutrient intake except carbohydrate than those of the participants with lower per capita monthly income. And the increase was gradual in case of protein, fat, calcium, zinc, riboflavin, vitamin C and cholesterol intake from lower to higher income group. The relationships were statistically significant in case of energy, protein, fat, calcium, iron, zinc, vitamin A, riboflavin and cholesterol intake (P=0.00, P=0.00, P=0.00, P=0.00, P=0.02, P=0.00, P=0.03, P=0.00, P=0.00, respectively).

Table 3.22 shows that the female participants who belonged to higher per capita income family had higher energy intake of all nutrients except carbohydrate and vitamin A intake than that of the lower per capita income family. And the increase was gradual in case of energy, protein, fat and calcium intake. The differences were also statistically significant in case of

TABLE 3.20

Relationship between education and nutrient intakes of female participants

Nutrient	Illiterate (n=106) (Mean±SD)	Primary (n=66) (Mean±SD)	SSC & HSC (n=26) (Mean±SD)	Graduate and above (n=8) (Mean±SD)	P value*
Energy (kcal/d)	1451±261	1530±225	1552±237	1556±267	0.09
Protein (g/d)	38±10	43±9	44±12	46±16	0.00
Fat (g/d)	28±10	38±11	41±9	47±11	0.00
Carbohy-drate (g/d)	257±55	247±46	247±62	227±49	0.35
Calcium (mg/d)	348±247	451±272	484±217	528±262	0.01
Iron (mg/d)	11±7	14±7	15±7	11±4	0.06
Zinc (mg/d)	6±1	6±1	7±2	6±2	0.00
Vitamin A (μg/d)	630±696	839±992	668±662	461±288	0.31
Riboflavin (mg/d)	0.5±0.2	0.6±0.3	0.7±0.3	0.7±0.3	0.00
Vitamin C (mg/d)	27±30	35±35	39±29	30±22	0.23
Cholest-erol (mg/d)	63±75	93±107	105±113	151±118	0.01

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.21

Relationship between per capita monthly income and nutrient intakes of male participants

Nutrient	<Tk.1000 (n=46) (Mean±SD)	Tk.1000-1999 (n=67) (Mean±SD)	Tk.2000 2999 (n=47) (Mean±SD)	>Tk.3000 (n=49) (Mean±SD)	P value*
Energy (kcal/d)	1478±297	1596±276	1660±207	1652±269	0.00
Protein (g/d)	40±12	46±14	51±11	53±11	0.00
Fat (g/d)	24±10	33±10	39±8	46±10	0.00
Carbohydrate (g/d)	273±68	274±56	268±48	249±59	0.09
Calcium (mg/d)	298±228	468±265	548±298	561±257	0.00
Iron (mg/d)	11±8	13±7	15±7	15±6	0.02
Zinc (mg/d)	6.0±1.9	6.5±1.7	7.2±1.8	7.4±1.4	0.00
Vitamin A (μg/d)	378±487	581±599	746±782	529±447	0.03
Riboflavin (mg/d)	0.5±0.2	0.6±0.3	0.8±0.3	0.8±0.3	0.00
Vitamin C (mg/d)	23±24	30±30	34±32	37±31	0.12
Cholesterol (mg/d)	55±72	94±113	147±158	157±124	0.00

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.22

Relationship between per capita monthly income
and nutrient intakes of female participants

Nutrient	<Tk.1000 (n=39) (Mean±SD)	Tk.1000-1999 (n=80) (Mean±SD)	Tk.2000 2999 (n=41) (Mean±SD)	>Tk.3000 (n=46) (Mean±SD)	P value*
Energy (kcal/d)	1392±307	1463±233	1556±197	1574±231	0.00
Protein (g/d)	36±11	38±9	44±10	46±7	0.00
Fat (g/d)	23±11	30±8	39±9	44±10	0.00
Carbohy-drate (g/d)	257±63	256±51	248±46	240±52	0.31
Calcium (mg/d)	296±266	341±197	510±270	515±266	0.00
Iron (mg/d)	11±8	11±6	17±9	13±6	0.00
Zinc (mg/d)	5.2±1.4	5.8±1.4	6.5±1.3	6.5±1.7	0.00
Vitamin A (μg/d)	585±736	630±756	896±1026	722±634	0.27
Riboflavin (mg/d)	0.5±0.2	0.5±0.2	0.7±0.3	0.7±0.3	0.00
Vitamin C (mg/d)	19±20	30±25	42±41	35±34	0.01
Cholest-erol (mg/d)	65±81	51±61	96±103	134±78	0.00

*Calculated using one-way analysis of variance (ANOVA)

energy, protein, fat, calcium, iron, zinc, riboflavin, vitamin C and cholesterol intake (P=0.00, P=0.00, P=0.00, P=0.00, P=0.00, P=0.00, P=0.00, P=0.01, P=0.00, respectively).

3.3.2.3 Relationship between age and energy and nutrient intake

Table 3.23 shows that intake of energy and carbohydrate gradually decreased with advancing age in case of male participants and those were found statistically significant (P=0.00, P=0.00, respectively). Regarding female participants, gradual decrease in intake with advancing age was observed in case of carbohydrate, vitamin A, riboflavin and cholesterol. Energy intake was lower in 70+ age group than two earlier age groups. But those were not statistically significant.

3.3.2.4 Relationship between health status and food and nutrient intake

Table 3.24 and 3.25 show the relationship between health status and food intake of male and female participants. No significant relationships were observed. Table 3.26 and 3.27 show the relationship between health status and energy and nutrient intake of male and female participants. No significant relationships were observed.

TABLE 3.23

Nutrient intakes of the elderly by age

Variables	Age group (years)							
	Male (n=209)				Female (n=206)			
	60-64	65-69	70+	P value	60-64	65-69	70+	P value
Energy (kcal/d)	1669	1623	1521	0.00	1505	1507	1461	0.52
Protein (g/d)	48	49	46	0.21	41	43	38	0.09
Fat (g/d)	36	32	35	0.86	34	34	32	0.57
Carbohy-drate (g/d)	282	272	250	0.00	253	251	248	0.87
Calcium (mg/d)	484	519	425	0.13	398	473	371	0.15
Iron (mg/d)	12	15	14	0.04	13	13	11	0.32
Zinc (mg/d)	7	7	6	0.65	6	6	6	0.24
Vitamin A (μg/d)	614	517	549	0.76	780	649	569	0.24
Riboflavin (mg/d)	0.65	0.69	0.66	0.17	0.60	0.57	0.53	0.93
Vitamin C (mg/d)	36	27	29	0.04	31	33	30	0.02
Choleste-rol (mg/d)	119	96	117	0.08	88	82	69	0.10

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.24

Relationship between health status and daily food intakes (g) of male participants

Variables	Health problems		P value*
	Present (n=176) (Mean±SD)	Absent (n=33) (Mean±SD)	
Cereals	289±68	281±62	0.50
Roots and tubers	27±36	15±21	0.06
Sugars	7±11	9±8	0.39
Pulses and nuts	24±23	29±21	0.28
Vegetables	64±53	70±59	0.60
Green leafy vegetables	14±20	12±24	0.76
Fruits	29±71	14±34	0.23
Meat	22±35	20±32	0.73
Fish	33±31	37±33	0.44
Eggs	13±22	12±31	0.86
Milk and milk products	80±112	72±89	0.68
Fats and oils	24±8	25±8	0.54

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.25

Relationship between health status and daily food intakes (g) of female participants

Variables	Health problems		P value*
	Present (n=185) (Mean±SD)	Absent (n=21) (Mean±SD)	
Cereals	269±66	286±68	0.26
Roots and tubers	24±30	19±25	0.49
Sugars	6±9	5±7	0.97
Pulses and nuts	25±23	24±23	0.85
Vegetables	64±56	52±38	0.35
Green leafy vegetables	20±34	22±26	0.78
Fruits	30±71	48±131	0.33
Meat	14±25	15±25	0.91
Fish	27±27	29±26	0.78
Eggs	9±19	8±18	0.79
Milk and milk products	67±99	61±89	0.80
Fats and oils	24±8	26±9	0.41

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.26

Relationship between health status and nutrient intakes of male participants

Variables	Health problems		P value*
	Present (n=176) (Mean±SD)	Absent (n=33) (Mean±SD)	
Energy (kcal/d)	1600±277	1587±245	0.80
Protein (g/d)	47±13	48±10	0.82
Fat (g/d)	35±12	37±13	0.48
Carbohydrate (g/d)	268±60	261±50	0.53
Calcium (mg/d)	463±288	512±232	0.36
Iron (mg/d)	14±7	13±7	0.35
Zinc (mg/d)	7±2	7±2	0.89
Vitamin A (μg/d)	557±581	584±714	0.82
Riboflavin (mg/d)	0.7±0.3	0.6±0.3	0.50
Vitamin C (mg/dl)	31±30	30±29	0.79
Cholesterol (mg/d)	113±120	108±156	0.85

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.27

Relationship between health status and nutrient intakes of female participants

Variables	Health problems		P value*
	Present (n=185) (Mean±SD)	Absent (n=21) (Mean±SD)	
Energy (kcal/d)	1486±245	1554±284	0.24
Protein (g/d)	41±10	40±14	0.63
Fat (g/d)	34±12	34±14	0.91
Carbohydrate (g/d)	249±53	267±51	0.14
Calcium (mg/d)	410±263	360±210	0.40
Iron (mg/d)	14±7	13±7	0.44
Zinc (mg/d)	6±2	6±2	0.48
Vitamin A (μg/d)	697±814	678±577	0.92
Riboflavin (mg/d)	0.6±0.3	0.5±0.2	0.36
Vitamin C (mg/dl)	31±29	37±44	0.37
Cholesterol (mg/d)	82±94	74±100	0.71

*Calculated using one-way analysis of variance (ANOVA)

3.3.2.5 Relationship between marital status and nutrient intake

Table 3.28 shows that the married male participants had higher energy and all nutrient intake except vitamin C compared with that of the single male participants. However, the difference reached the level of statistical significance only for protein (P-0.02).

Mean energy, protein, fat, calcium, iron, vitamin A, riboflavin and vitamin C intake of the married female participants were higher than that of the single female participants (Table 3.29). However, the difference reached the level of statistical significance only for zinc (P=0.01).

TABLE 3.28

Relationship between marital status and nutrient intakes of male participants

Variables	Marital status		P value*
	Married couple (n=190) (Mean±SD)	Single (n=19) (Mean±SD)	
Energy (kcal/d)	1606±270	1512±285	0.15
Protein (g/d)	48±13	41±15	0.02
Fat (g/d)	35±12	34±14	0.63
Carbohydrate (g/d)	265±59	254±50	0.34
Calcium (mg/d)	479±279	389±278	0.19
Iron (mg/d)	14±7	13±6	0.61
Zinc (mg/d)	7±2	6±2	0.11
Vitamin A (μg/d)	568±606	495±569	0.62
Riboflavin (mg/d)	0.7±0.3	0.6±0.3	0.44
Vitamin C (mg/d)	31±30	31±30	0.45

*Calculated using one-way analysis of variance (ANOVA)

TABLE 3.29

Relationship between marital status and nutrient intakes of female participants

Variables	Marital status		P value*
	Married couple (n=97) (Mean±SD)	Single (n=109) (Mean±SD)	
Energy (kcal/d)	1502±250	1485±250	0.63
Protein (g/d)	42±10	39±11	0.08
Fat (g/d)	35±12	33±11	0.11
Carbohydrate (g/d)	250±54	252±52	0.80
Calcium (mg/d)	419±248	392±267	0.45
Iron (mg/d)	14±8	12±7	0.07
Zinc (mg/d)	6±1	6±2	0.01
Vitamin A (μg/d)	750±909	647±672	0.36
Riboflavin (mg/d)	0.6±0.3	0.5±0.3	0.08
Vitamin C (mg/d)	35±32	28±30	0.10

*Calculated using one-way analysis of variance (ANOVA)

Chapter Four

DISCUSSION

Malnutrition is widely prevalent among the population of Bangladesh, but most vulnerable groups of population are infants, preschool children, pregnant and lactating women and the elderly. Up to the present time, almost all studies assessed the nutritional status and factors for their causation of malnutrition. Nutrition improvement programs were also directed towards infants, preschool children, pregnant and lactating women. The nutritional status and programs for nutritional improvement of the elderly was almost totally neglected. In view of the increasing number of people reaching old age in Bangladesh and projection of further increase in years to come, there is an urgent need to assess the nutritional status of the elderly population

To date no one has investigated the nutritional status and dietary pattern of elderly in our country as a specific group. In recent survey[51], information on only 60 elderly people was included as members of the surveyed family, which were inadequate to contribute to the assessment of nutritional status of the group.

The present study examined the nutritional status and dietary pattern of 415 elderly (209 male and 206 female) who attended a geriatric centre in Dhaka city and identifies various factors which have significant association with their nutritional status. The elderly population attending the geriatric centre provided a convenient source for reaching and investigating the elderly. It is the expectation of this study that findings of the study will correctly reflect the nutritional situation of the urban elderly in the country.

In this study, the mean height of the male participants was 160.9 cm (Table 3.5) and it was 1.9 cm lower than mean height of adult urban male of Bangladesh[51] and 3.4 cm lower than upper middle income group adult male height of India[96]. Mean height of female participants was 147.1 cm (Table 3.5) which was 3.1 cm lower than mean height (150.2 m) of adult female of Bangladesh[97] and 2.3 cm lower than upper middle income group of female height in India[96]. These are natural phenomena.

Mean heights of elderly males and females were also lower than mean heights of elderly males and females reported in India in different studies[42-44,46,47]. But approximately similar heights were recorded in one study[97]. These differences between the Indian and Bangladeshi elderly heights may be due to social, dietary and other environmental factors.

Mean height of elderly males also decreased with advances in age and a stepwise decrease occurred in the later years (Table 3.5) (0.3% and 0.6% in last two age groups). Almost similar trends of decrease were also observed in different studies from other countries[45-47,98].

Mean heights of elderly females also decreased with advance in age and a stepwise decrease also occurred in the later years (Table 3.5) (0.9% and

2.0%). Almost similar trend of decrease were also observed in different foreign studies[42,44,45,47,56,98].

Decrease of height was more pronounced among female elderly. This decrease may be natural, because loss of bone accelerates in women after menopause. And this acceleration is directly related to the lack of estrogen[99].

The mean body weight of the male and female elderly were 56.3 and 48.4 kg, respectively (Table 3.5). In comparison with different studies in India, mean weight of elderly male of this study is higher in some instances[43,47,54,98] and lower in others[45,46]. Mean weight of elderly female of this study population is also higher[42,44,47,56,98] except in case of one study[45]. These differences between Bangladeshi and Indian elderly suggest prevalence of more obese people in our study and points towards better nutrition.

In this study, BMI is accepted as the main indicator of nutritional anthropometry and thus nutritional status. WHO, however, suggested that conventional cutoffs for defining CED may not be appropriate for older people 70 years and over, because of age-related changes in body composition and decline on body weight. In the absence of a more appropriate alternative, we used the conventional values, but feel strongly that research is needed on this subject.

Mean BMI of male participants was 21.7 kg/m^2 (Table 3.5). This figure is much higher than found in a survey conducted in rural area of Thailand[48] and India[98], but much lower than that observed by Cristina *et al.*[49] in Spain. Mean BMI of female elderly of this study was 22.4 kg/m^2, which is also higher than elderly women of Thailand[48] and India[98] but lower than in Spain[49]. These differences may be due to differences in lifestyle pattern in rural and urban areas and other environmental factors conducive to better nutrition in Bangladeshi elderly and suggests the prevalence of higher mean body weight among Bangladeshi elderly.

Using BMI to classify nutritional status, 68% male and 54% female elderly were well-nourished (Table 3.6). Not only chronic energy deficiency (18% male, 26% female), but also overweight (14% male and 26% female) were problems of these groups of elderly. Prevalence of overweight was almost double in case of female than in case of male (Table 3.6). Prevalence of overweights were also recorded in a study in an affluent urban population of Thailand[100], where only 2% male and 6% female were reported to be underweight and a significant number (24% male and 39% female) were overweight. Another Greek study[101] showed highest prevalence of obesity (BMI $\geq$30 kg/m^2) (women 45% and men 30%) and the risk of protein energy malnutrition was low (overall $<$10%). On the contrary, more prevalence of undernutrition (BMI $<$18.5 kg/m^2) was recorded by NNMB in India during the years 1990 and 1991[43]. In spite of mean inadequate energy intake (male 91% and female 92% of

RDA), a good number of our study population were overweight. This may be due to the fact that fat was gradually accumulated in their body during a prolong period of their lifetime, and that they might have low physical activity.

In 1995-96 Bangladesh National Nutrition Survey (BNNS), it was observed that among the age group 25-60 years, overweight was more common among urban adults than rural and highest among the urban females[51]. They also identified urban lifestyle as a cause of overweight of some urban females. This finding supports the findings of the present study.

It was revealed from this study that both education and per capita monthly income had positive effect on BMI and age had negative effect on BMI in case of females. Effect of education was more pronounced in case of male. In male participants who had higher educational level were associated more with overweight (19%) than participants with lower educational level (10%) (Table 3.14). Witaya Swaddiwudhipong[48] also found such a relationship in Thailand. The effect of education was less pronounced in females. This may be due to the fact that their food intake was primarily influenced by their husbands and children than their own educational level.

Many studies have shown that overweight and obesity are associated with an increased risk of chronic diseases, such as hypertension and diabetes mellitus[102-105]. The high proportion of overweight elderly in our study may be playing a role for high prevalence of hypertension and diabetes mellitus in the group. Some recent studies, including elderly in Finland[106] ($\geq$85 years) with BMIs <22 kg/m^2, Sweden[107] (70-79 years) with BMIs <24 kg/m^2, and in the USA[108] with similarly low BMIs have lived shorter lives than those with higher BMIs. Higher BMI may thus be desirable and may suggest a better nutritional status and indicator for longevity among the elderly.

It is a well-established fact that BMI increases with increased energy intake. This is true in case of male participants (Table 3.16), but in case of females, there is a slight reduction in mean energy intake (Table 3.17). This reduction is only of the magnitude of about 10 kcal/d (Table 3.17) from the normal BMI group which is insignificant. Decreased physical activity among the high BMI group might also have contributed to the lower intake.

The elderly are usually prone to various diseases due to their old age and weak physical conditions and as such they often fall ill. Early detection of health problems by geriatric health screening programs with subsequent proper management can postpone the onset of chronic disease and reduce subsequent disabilities. In relation to the morbidity status, it was observed that only 16% male and 10% female participants had reported no health complain. Around half of the rest (male 43%, female 44%) were suffering from single disease and another almost half (41% male and 46% female) from multiple diseases (Table 3.7). Similar findings were observed by Bangladesh Association for the Aged and Institute of Geriatric Medicine (BAAIGM)[91] where 16% male and 9% female had no health complains, but more elderly were reported to suffer from multiple diseases. Similar findings were also observed by Elango in rural areas of Tamil Nadu[109], where 17.5% elderly were found to have no apparent illness.

The prevalence rate of hypertension (Table 3.8) among the elderly in this study was similar to those reported by BAAIGM[91] in Dhaka city and higher than those reported in rural area of Thailand[91] and in rural Malaysia[110]. Similar urban lifestyles in Bangladesh, Thailand and Malaysia may be responsible for this similarity in these disease incidence.

The diabetic prevalence rate was also similar to BAAIGM[91] in Dhaka city and much higher than rural Thailand[48] and lower than the report of Carmen[111] who found that 25% of the world's total population are suffering from diabetes mellitus. The reasons for these similarities and discrepancies may include differences in the study methods, lifestyle and sociocultural factors of the population. Dietary intakes and BMI were not significantly related with any of these physical complains and diseases and suggests that other environmental factors may be responsible for disease prevalence in Bangladeshi urban elderly.

The prevalence rate of arthritis of this study population was more than reported by BAAIGM[91] and rural health centre in Haryana[112]. This higher rate may be due to availability of better treatment facilities (physiotherapy) for arthritis in this geriatric centre. The study also found that more females suffered from arthritis than males (23% male and 39% female) (Table 3.8). This is acceptable because most common arthritis (rheumatoid arthritis) occurs more frequently in women than in men, the proportion averaging three to one[35] even though the etiology of rheumatoid arthritis is unknown[113].

Prevalence of asthma was lower than reported by BAAIGM[91]. This may be due to seasonal variation. Prevalence of vision problem was almost similar to those reported by BAAIGM[91].

It is difficult to make exact dietary comparison for a number of reasons. The most important factor relates to dietary methodology. We used 24-hour recall method. While there is continuing debate about the best method to be used to obtain accurate data about dietary intakes[114,115], we believe that our 24-hour recall probably underestimated intakes. This is partially based on the fact that we did not collect weekend dietary intake information. There is some indication that weekend food intakes are higher than during the week[115]. Secondly, interpretation of dietary result is complicated because of tentative standards of comparison[116].

Considering these difficulties, the present dietary survey demonstrated that in terms of current dietary recommendations, the diet of the elderly are deficient in energy intake. As a percentage of RDA, male and female participants fulfilled 85 and 92%, respectively (Table 3.9). According to FAO/WHO/UNW expert consultation, 1985[62], daily calorie requirement of the participants of the present study should be 1872 kcal for male and 1630 kcal for female, assuming that the population is retired (sedentary) and healthy. The participants of the present study consumed less energy than the 1995-96 BNNS survey.

Average daily calorie intake of the elderly was reported as 2299 and 2073 kcal for males and 1839 and 1876 kcal for females (age group 60-69 and 70+ years) by NNMB 1991[98], 1828 and 1421 kcal for male and female elderly by Garg and Singh[57], 1894 and 1623 kcal by Cristina *et al.*[49], 2525 and 2076 kcal by Yadav and Singh[117], 1725 kcal (both male and female) by Pamela *et al.*[118]. All the data revealed that the energy intakes of the elderly of this study were lower than their counterparts in other countries. This may be due to different sociodemographic conditions as well as different requirements.

On the other hand, Dodd and Nerunkar[54] in Bombay, India, found a mean energy intake of 79% of their RDI. Garg and Singh[57], Mehta *et al.*[44] also reported inadequate energy intake when compared with RDI. Studies on patients attending the geriatric clinic at the All India Institute of Medical Sciences (AIIMS), New Delhi[59] also revealed an energy deficit of 50% for male and 35.5% for female.

The above review of the dietary intake studies of elderly reported from various countries indicated both similarities and dissimilarities of energy intake. This is expected in view of the different sampling techniques, methodology of study and different determinants of dietary intake in various countries.

When we examined the relationship between age and energy intake in our population, we found a significant decrease in case of men but not for women (Table 3.23). Similar findings were also observed by Garry *et al.*[119] and Brahman[98].

Average protein intake of the male participants was 48 g/day and it was 106% of the RDA and for the female participants, intake was 41 g/day and it was 105% of the RDA. In contrast to the findings of the present study, BNNS[51] showed that in urban area, protein intake of the elderly males were 62 and 83 g and elderly females were 46 and 38 g for the two age groups.

Average daily protein intake of the elderly male and female of other countries were reported as 50 and 47 g in India[57], 63 and 59 g in Spain[49], 72 and 58 g in India[117], 90 g in the United States[118] (male and female both). In India, Brahman[98] also reported protein intakes of 59 and 54 g by males and 47 and 48 g by females (60-69 and $\geq$70 years). In other studies, Natrajan *et al.*[55] and Srivastava[59] reported low protein intake in relation to RDI.

Although protein intakes of our study population were lower than those reported for other countries, in relation to RDA, these intakes were adequate. Thus, the result of this study is in agreement with the findings of several other studies when considered in relation to RDA[42,44-46,54] and in terms of health, this may be an advantage.

Considering the percentage of energy coming from protein, fat and carbohydrate sources, our study population were consuming an adequate diet (Table 3.11). The mean protein intake as percentage of total energy is almost similar to the 12% value reported for the United States population as a whole[119] and lower than observed by Garry *et al.*[120] among the elderly. Of some interest was the finding that the percentage of energy from fat was 21% compared to 37% observed by Garry *et al.*[120] among elderly, 42% reported for the United States general population as a whole[119], and 28% consumed by old Asians residing in the USA[118]. This probably reflects that many of our elderly were restricting their cholesterol intake. As a result of lower fat intake, energy from carbohydrate was much more than observed in these three studies cited above. Region of study and economic condition may be the additional reasons of these differences.

There is a strong relationship between calcium intake and the bone demineralization or osteoporosis[81]. Intake of calcium of the participants of the present study fulfilled their RDA (Table 3.10). But frequency distribution (Figure 3.15) showed that 97 male and 120 female failed to meet their RDA. And a good number (42 male and 45 female) had intake below 50% of their RDA. Therefore, this low intake in a large number of elderly are of considerable concern. In 1995-96 survey, daily calcium intake was found 549 and 422 mg in case of male and 309 and 275 mg in case of female (age group 60-69 and 70+ years)[51]. These values were slightly higher (60-69 age group) in case of male but lower in case of females. Survey reports from other countries showed a wide range of variation. Higher intake of calcium were observed in many studies[43-46,49,55,57,118] and lower intake by some[59,117].

In this study, iron intake was 14 mg/day in case of male and 13 mg/day in case of female. Males fulfilled 125% and female 140% of their RDA. Similar intake was reported by NHANES[39] for USA. On the contrary, inadequate iron intakes were reported by several other studies[42,44,55,57,59]. These differences may be due to the use of different standards to measure adequacy of iron. Adequacy of the iron intake, in the absence of biochemical indicators of iron deficiency, could not be assessed in this study.

In the present study mean zinc intake was found extremely low (Table 3.10). Male participants consumed only 7 mg/day and it was only 45% of RDA. Female participants consumed only 6 mg/day and it was also only 50% of RDA. So, it is alarming because several conditions more prevalent in the elderly have been reported to be associated with a compromised zinc status, including decreased taste and smell acuity, suppressed appetite, impaired wound healing, depressed immunocompetence and increased free radical activity[121],

Data of zinc intake in Bangladesh is not available. A lower zinc intake by the elderly (7-11 mg) was reported living in the United States by Fosmire *et al.*[122], in Australia by Flint *et al.*[123], in Canada by Gibson *et al.*[124], in Great Britain by Bunker *et al.*[128] and in Sweden by Abdulla *et al.*[126]. Nevertheless, numerous studies have failed to show unequivocal evidence of zinc deficiency in elderly populations consuming less than the RDA. In this respect, the Canadians recommend 9 and 8 mg zinc/day for 50-74 years male and female. On the other hand there remains the possibility that less than optimal intake may result in subclinical conditions that are difficult to diagnose[69]. So, further research is needed to determine RDA to provide better standard for assessment of dietary intake of zinc, particularly for the population of Bangladesh, as no such studies are currently available.

Mean riboflavin intake of male participants was found 0.7 mg and it was only 60% of RDA and that of female participants was found 0.6 mg/day, and it was also much lower (58%) than RDA (Table 3.10). Only 9% male and 7% female met their RDA. And a large number (43% male and 46% female) had intakes below 50% of RDA (Figure 3.18). This study findings are almost similar to our last national survey[51].

There is a wide spectrum of riboflavin intakes among various elderly populations studied in different countries. Lower riboflavin intakes than RDI were observed in a number of studies[42,43,55,58]. On the contrary, riboflavin intakes higher than RDI were recorded by some researchers[45-47].

As it was established that riboflavin intakes have been linked to at least one chronic non-communicable disease, esophageal cancer[81], we should take much care about riboflavin either by increased dietary intake or supplementation to reduce the burden of this disease.

Both male and female participants of our study did not fulfill their RDA for vitamin A. Male fulfilled 79% and female 93% of their RDA. Frequency distribution of the participants showed that only 23% male and 34% female met their RDA. And a large portion, 54% male and 51% female, had intake below 50% of RDA (Figure 2.19). Different surveys in other countries as well as in our country also showed lower intakes in relation to RDA[43,45,51,54,55,88,127].

As vitamin A content of food varies widely, and there is a wide range of seasonal variation of availability, surveys based on 24-hour recalls are only indicative of the intake in a particular season. A review of reported studies among elderly indicated that only a few have plasma levels of retinol below 20 μg/ml, and liver stores were well maintained or even increased throughout life[127]. Thus, from the point of view of preventing deficiency, there is no evidence for significant vitamin A deficiency among senior citizens and indeed it is possible that the vitamin A requirements for the elderly are appreciably lower than those presently recommended. This will require further study.

In our study, vitamin C intakes were found sufficient to meet the RDA in both sexes considering average cooking loss. But distribution of intakes showed that only 37% male and 38% female met their RDA, and 37% male and 35% female consumed below 50% of RDA (Figure 3.20). Above findings showed a broad range of vitamin C intake by the elderly. In 1995-97 survey in our country, intakes of vitamin C in urban elderly were satisfactory[51]. Adequate vitamin C intakes were also reported in some other countries[43,45,46,49]. On the contrary, lower intakes were reported by others[128,129].

In general, dietary intake of vitamin C declines with increasing age[70] and Garry and Hung[130] observed that elderly subjects with low plasma ascorbic acid levels have impaired cognitive functions. Improvement of ascorbic acid nutrition in the elderly is necessary and the best approach is by encouraging consumption of vitamin C-rich foods, such as fruits, especially citrus fruits.

In different population groups, several studies in the past showed significant association of sociodemographic factors with the nutritional status and dietary intake[51,131,132]. In the present study, we examined the relationship between various sociodemographic factors and the nutrient intake of urban elderly. Samples were classified into arbitrary groups on the basis of per capita monthly income, participants' education, marital status and health status to assess the role of these variables in determining the nutritional status.

Bivariate analysis revealed that the participants who had some level of formal education had higher BMI. And the participants with low income observed to have low BMI. Relationships were also found between education and per capita income with intake of a number of nutrients.

It is observed from the study that 87% participants had either single or multiple health complains. Anthropometric findings showed that not only chronic energy deficiency but overweight (20%) was also a problem of this elderly group. The findings further indicate that the diets of these elderly were inadequate in energy, zinc, vitamin A and riboflavin. It was not possible for us to determine the intake of vitamin E, B_6 and B_{12} due to lack of information of these vitamin contents in local foods.

The present study was purposive and was not representative from a statistical point of view but for the first time had provided information on the nutritional status and dietary intake of the elderly. This study has identified the nutritional problems and dietary deficiencies prevailing in this group of elderly which could be taken as a mirror image of the urban elderly in Bangladesh. It is our belief that information provided by this study will help nutrition or health policy makers and planners to formulate healthy eating guidelines for the elderly and plan programs for the improvement of their nutritional status.

It is suggested that in near future a representative large-scale nutrition assessment study be conducted that should include biochemical nutrition parameters to provide a more complete assessment of nutritional status of the elderly. Lack of facilities and resources hindered their inclusion in the present study.

Chapter Five

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ANNEXURE-I

Annexure-I

INSTITUTE OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF DHAKA

NUTRITIONAL STATUS AND DIETARY PATTERN OF ELDERLY ATTENDING AN URBAN GERIATRIC CENTRE IN BANGLADESH

Sl.No. :

Date :

Name :

Age (years) :

Sex : Male/Female

Address :

Signature of interviewer :

SOCIODEMOGRAPHIC INFORMATION

1) Education of participant :

2) Number of siblings :

3) Birth order :

4)	Residence			
	a)	Ownership	:	Own/Rented/Others
	b)	Housing characteristics	:	Building/half building/ Kutcha/Others
5)	Total income of the family (Taka)		:	
6)	Participant's own income		:	
7)	Total family members		:	
8)	Number of living children:			
		Son	:	
		Daughter	:	
9)	Number of children currently living with the participant		:	
10)	Out of them, how many are currently living with participant		:	
		Employed sons	:	
		Employed daughters	:	
11)	Occupation			
	a)	Previous	:	
	b)	Present	:	
	If retired, whether does any work to earn money		:	Yes/No
12	Marital status		:	Married/Unmarried/Widow/ Widower/Divorced/ Separated

NUTRITIONAL STATUS

Anthropometry

1) Height (cm) :

2) Weight (kg) :

Clinical

1) Suffering from

   a) Acute :

   b) Chronic

Name	Duration	Treatment
1.		
2.		
3.		

2) Blood pressure (mmHg) :

3) Conjunctiva : Pallor/Normal/Congested

4) Stomatitis : Present/Absent

5) Angular stomatitis : Present/Absent

6) Gum : Spongy/Bleeding/Normal

7) Goitre : Grade 0/Grade 1/Grade 2

Dietary intake in last 24 hours

Meal	Item	Serving size	Cooked weight (g)	Food code	Raw (AP) weight (g)
Breakfast					
Mid-morning					
Lunch					
Afternoon					
Supper					

Oil intake per month:

Dietary habit

Food items	Never	<1/week	1-3/week	6+/week
1. Milk				
2. Egg				
3. Beef				
4. Poultry				
5. Mutton				
6. Large fish				
7. Small fish				
8. Dal				
9. G.L.V.				
10. Fruits				