A COMPARATIVE NUTRITIONAL STATUS AND FOOD INTAKE PATTERN OF ADOLESCENT GIRLS WITH EMPHASIS ON FISH INTAKE (MARINE & RIVERINE) BETWEEN SELECTED URBAN & RURAL LOCATIONS

A Dissertation Submitted for the Partial Fulfillment of M. Phil Degree in Nutrition and Food Science, University of Dhaka

Submitted By:

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Dedication

..... To my beloved Daughters

Tahia & Tasmiah

Declaration

This is to certify that the thesis entitled "A comparative nutritional status and food intake pattern of adolescent girls with emphasis on fish intake (marine & riverine) between selected urban & rural locations" by Sonia Zebsyn in partial fulfillment of the requirement for the award of Master of Philosophy in Nutrition and Food Science has been completed under my supervision.

It is certified that Sonia Zebsyn has fulfilled all conditions laid down in the Academic Ordinance with regard to the M. Phil course work and to the best of my knowledge, the thesis contains her original research.

27-5-2012

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Declaration

I, hereby, humbly declare that this thesis entitled "A comparative nutritional status and food intake pattern of adolescent girls with emphasis on fish intake (marine & riverine) between selected urban & rural locations" based on works carried by me. No part of it has been presented for higher degree.

The research work was carried out in-

1) Mission International School and College, Adabar, Dhaka,
2) Mahinanda High School, Amirganj, Kishoreganj,
3) Department of Histopathology, National Institute of Kidney Diseases and Urology, Sher-e Bangla Nagar, Dhaka and
4) Institute of Nutrition and Food Science (INFS), University of Dhaka.

under the guidance of Dr. Md. Aminul Haque Bhuyan, Professor, Institute of Nutrition and Food Science, University of Dhaka.

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Abstract

This study aims to see the difference in lifestyle, food intake and nutritional status of urban and rural adolescent girls. For this purpose, a comparative cross-sectional survey was done in urban and rural area. Appropriate statistically designed and estimated number of adolescent girls between 10 to 19 years of a school and college in Dhaka city and a village school of Kishoreganj district were included in the study and comparison was made between 121 urban and 121 rural adolescent girls. Various variables of socio-economic, food intake and anthropometric information were collected and these findings were compared.

Everyone (100%) in rural group preferred homemade food and most of the urban group (66.1%) preferred snacks. None of the rural areas preferred snacks and continental foods. Some 47.9% and 13.2% respondents in urban area consumed green leafy vegetables 1-3 times per week and daily respectively. On the other hand 52.1% adolescent girls in rural area consumed green leafy vegetables 1-3 times per week and 24.8% daily. About 14.9% respondents in urban area and 9.1% respondents in rural area consumed milk and milk products daily. Urban group consumed big fish more than rural group ($p=0.000$). But in case of small fish, rural group consumed more than urban group ($p=0.028$). Both urban and rural groups consumed less marine fish. Among the various marine fishes 38.7% urban respondents consumed *Pampus chinensis* (Rupchanda). For rural respondents this percentage was 33.1. There was no respondent in rural group, who consumed *Auxis rochei* (Surma) and *Trichiurus haumela* (Tuna), but for urban group those were 19.3% and 5% respectively. In urban area *Tenualosa ilisha* (Illish). consumption was highest (73.9%) among riverine (big) fishes. Next place was occupied by *Labeo rohita* (Rui, 55.5%). On the other hand, in rural area *Pangasius pangasius* (Pungas) and *Katla katla* (Katla) consumptions were high. 76% and 76% respectively. Rural respondents never consumed *Wallago attu* (Boal). *Amblypharyngodon* (Mola 42%) consumption was high in urban group; *Batasio batasio* (Tengra 67.8%) and *Puntius chola* (Puti 62.8%) consumptions were high among riverine (small) fishes in rural group. *Labeo bata* (Bata, 2.5%) and *Neotropius atherinoides* (Batasi, 3.4%) were rarely consumed by urban

adolescent girls. *Ompok pabo* (Pabda) and *Apocryptes bato* (Bele) were never consumed by rural adolescent girls.

The mean weight and height were greater in urban group than rural group. Mean weight in kg among urban group was 44.87 and 41.95 in rural group. The mean height in cm of the respondents was 151.06 and 148.89 in urban and rural group respectively. Moderate and mild chronic energy deficiency were 8.3% and 20.7% among urban group, on the other hand 10.7% and 28.1% respectively among rural group. Severe chronic energy deficiency was 17% in urban group and 9% in rural group. Again overweight and obese was 8.3% in urban group and 0.8% in rural group. The difference of nutritional status was significant (p=0.019). At age group 10-12 and 13-15 years, anemia rate was higher among urban group, but at age group 16-17 years anemia rate was higher among rural group.

Mean energy intake was 1504 kcal among urban group and 1619 kcal among rural group. The difference was significant (p=0.024) Mean protein intake was 50 g among urban group and 48 g among rural group. In total, calcium intake was 394 mg for urban group and 458 mg for rural group. Again mean iron intake was 9 mg for urban and 7 mg for rural group. The difference of iron intake was highly significant (p=0.000).

Though socio-economic status, food security and food intake are better in urban group than rural ones the outcomes of these factors were not significant. Moreover the situation was comparatively better among rural group. So it can be said that there must had been other factors which were affecting both urban and rural adolescent girls in their anthropometric status.

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List of Abbreviations

ANOVA	Analysis of Variance
BDHS	Bangladesh Demographic and Health Survey
BINP	Bangladesh Integrated Nutrition Project
BMI	Body Mass Index
BNNS	Bangladesh Rural Advancement committee
CED	Chronic Energy Deficiency
Cm	Centimeter
Hb	Hemoglobin
HKI	Hellen Killer International
Ht	Height
IDD	Iodine Deficiency Disorder
INFS	Institute of Nutrition and Food Science
IU	International Unit
Kcal	Kilo calorie
Kg	Kilogram
Kg/m^2	Kilogram per meter square
Mg/dl	Milligram per deciliter
µ g	Microgram
Ml	Milliliter
NCHS	National Center for Health Statistics
NGO	Non-governmental Organization
NNP	National Nutrition Programme
NNMB	National Nutrition Monitoring Bureau
No.	Number
RDA	Recommended Dietary Allowance
SPSS	Statistical Package for Social Scientists
TS	Transferrin Saturation
WHO	World Health Organization
Wt	Weight
%	Percent

CHAPTER-1

Introduction

Rationale

Objectives

1.1 Introduction

Adolescent is a period of rapid growth and maturation in human development.[1] During this period an adolescent's body size grows by 15 percent.[2] It is an intense anabolic period when requirements for all nutrients increase.[3] Adolescents are tomorrow's adults and 85% of them live in developing countries.[4] They are relatively healthy compared to other life cycle groups, and they show roughly similar morbidity patterns in developed and developing countries.[5,6] As adolescents have a low prevalence of infection compared with under five children and of chronic disease compared with ageing people, they have generally been given little health and nutrition attention.[7]

World Health Organization defines adolescents as young people aged 10-19 years. Adolescence can be separated into three phases. Early adolescence (aged 11-14 years) is distinguished by the onset of puberty and increased cognitive development. The second decade of life is a period of personal development almost as rapid as the first. Ten year olds are still children, although many are already depicted to confrontation from the adult world. Middle adolescence (aged 15-17 years) is characterized by increased independence and experimentation. Late adolescence (aged 18-21 years) is a time for making important personal and occupational decisions. By the age of twenty one, juvenile people are contributing component of society, acquiring rights at a multiplicity of ages to get married, vote, drive, fight for their country or to go to prison. Adolescence is an expedition from the world of the child to the world of the adult. It is a time of corporeal and emotional transformation as the body matures and the mind becomes more questioning and independent. Inadequate nutrition during any of these stages can have long lasting consequences on an adolescent's cognitive development, resulting in decreased learning capability, poor attentiveness, and impaired school performance.

Adolescents are no longer children, but not yet adults, and this period of change is full of paradox. Adolescents can seem old ahead of their years, but require adult support. They can put themselves at risk without thinking through the cost, exhibit sanguinity and curiosity, quickly followed by dismay and gloominess. They feel a growing sense of autonomy, but depend on adults for their material needs. And as they change, so their needs change with them. Adolescents complete their physical, emotional and psychological journey to adulthood in a changing world that contains both opportunities and dangers. Most adolescents are full of optimism and represent a positive force in society, an asset now and for the future as they grow and develop into adults. When supported, they can be resilient in absorbing setbacks and overcoming problems.

Healthy and unhealthy practices adopted during adolescence may last a lifetime. Today's adolescents are tomorrow's parents, teachers and community leaders. What they learn they will teach to their own children. Adolescence is a period of curiosity. It is the age when young people are receptive to information about themselves and their bodies and when they begin to take an active part in decision making. Younger adolescents often lack the means to start to take responsibility for their own health, because they do not properly understand what is happening to their bodies, and may need reassurance and support.

Adolescence is a period of intense physiological, psychological and social change. The transition from childhood to adulthood may extend over variable period of time depending upon socio-cultural and economic factors. Even in a given culture, adolescents are not a homogeneous group, with wide variations in development, maturity and lifestyle. It is interesting, however, that a study conducted in 1996 on 25,000 middle class high school students aged 15-18 years on five continents found them to be more similar that different in their values and concerns. Boys express more self confidence, more happiness and well-being and less

vulnerability than girls, who tend to be less satisfied with their body, personality and their health. A majority of adolescents think that they are in good health and they show little concern for protecting their health "capital" for the future.[8] Adolescents of both sexes and in all income and ethnic groups are at risk for dietary excesses and deficiencies. Dietary excesses of total fat, saturated fat, cholesterol, sodium, and sugar commonly occur. Most adolescents do not meet dietary recommendations for fruits, vegetables, and calcium-rich foods.[9]

Due to enhanced growth during adolescence, the requirement of some minerals is of paramount importance. A rapid growth rate combined with a marginal nutrient intake increase the risk of nutritional deficiencies in this population. Micronutrients such as iron and zinc are essential trace elements involved in the high growth rates of adolescents.[10] Common nutrition problems for the adolescent with special health care needs may include the following:

- Altered energy and nutrient needs
- Delayed or stunted linear growth
- Underweight
- Overweight or obesity
- Appetite disturbances
- Unusual food habits (e.g., rumination, pica, disordered eating, etc.)
- Dental and gum disease

Adolescents with special needs may experience one or more of these problems and require attention to prevent, treat or correct nutrition related health problems.[11,12,13]

In Bangladesh, a large number of adolescent girls suffer from various degrees of nutritional disorders.[14,15,16,17] The main nutritional problems of adolescents are micronutrients deficiencies, iron deficiency anemia in particular and depending on the context, under nutrition or obesity and co-morbidity, like in any other age group. Poor nutrition is usually the result of dietary inadequacies, often combined with unhealthy lifestyles of infections, which further compromise with nutritional status.[18] Poor nutritional status during adolescent is an important determinant of health outcomes at later stage of life. In girls, poor nutrition can delay puberty and lead to the development of a small pelvis. Malnourished adolescent girls who have babies at a young age are more likely to experience, and will be less able to withstand, complications because the body has not yet reached maturity. Maternal mortality is higher in anemic women. Even when they survive, poorly nourished adolescent mothers are more likely to give birth to low birth-weight babies, perpetuating a cycle of health problems which pass from one generation to the next.

In a growing number of developing countries, obesity and eating disorders exist alongside malnutrition. Obesity itself is a major problem in some societies. A failure to deal with this at a young age, can lead to a lifetime of poor health and unhappiness and an early death. From an early age adolescents are under pressure from mass media to conform to ultra thin body shapes and have a poor self image as a result. In extreme cases, eating disorders such as bulimia and anorexia can permanently damage physical and mental health. Therefore, attention should be given to adolescent health and nutrition.

Addressing the needs of adolescents is a challenge that goes well beyond the role of health services alone. The legal framework, social policy, the safety of communities and opportunities for education and recreation are just some of the factors of civil society those are keys to adolescent development. The present study thus aims at investigating nutritional status and food intake pattern of selected adolescent girls of urban and rural locations and to compare the results

obtained in order to take measures to improve the health and well-being of the country's adolescents as a whole.

1.2 Rationale of the Study

In adolescence, a second period of rapid growth may serve as a window of opportunity for compensating for early childhood growth failure, although the potential for significant catch-up is limited. Adult size, measured by height and weight, also reflects an entire range of physiological measurements that determine work capacity, safety, ease of childbirth and decreased obstetric risk to mother and decreased incidence of low birth weight. Survival itself, for both mother and child, is affected by maternal body size. In Bangladesh, almost one-fourth of the total population consists of adolescents. About 37% of the rural and 20% of urban girls aged 15-19 years are married.[19]

In Bangladesh, a large number of adolescent girls suffer from various degrees of nutritional disorders.[14,15,16,17] The main nutritional problems of adolescents are micronutrients deficiencies, iron deficiency anemia in particular, and depending on the context, under nutrition or obesity and co-morbidity, like in any other age group. Poor nutrition is usually the result of dietary inadequacies, often combined with unhealthy lifestyles of infections, which further compromise nutritional status.[18] In a society such as Bangladesh where the first pregnancy is likely to occur before adolescence is completed, physical growth, mental and sexual development of girls during adolescence may have critical effect on their capacity to carry successful pregnancies.

There is rapid growth during adolescence when skeletal and sexual maturation occurs. Teenagers like to experiment and their experimentation might include risky food behavior leading to poor eating habits or tendencies to consume highly processed foods. Girls often view food as a threat to being thin, while boys may frequently take muscle-building supplements. Poor dietary habits in this period

can be related to obesity, osteoporosis, heart disease and diabetes later in life. Adequate nutrients are required to meet these growth needs and facilitate efficient mental and physical development.

Adolescents' calorie needs vary depending on their growth rate, degree of physical maturation, body composition, and activity level. However, they do need extra nutrients to support the adolescent growth spurt, which, for girls, begins at ages 10 or 11, reaches its peak at age 12, and is completed by about age 15. In boys, it begins at 12 or 13 years of age, peaks at age 14, and ends by about age 19.

In addition to other nutrients, adequate amounts of iron and calcium are particularly important as the adolescent body undergoes this intensive growth period. From ages nine to 18 years, both males and females are encouraged to consume a calcium-rich diet (1,300 milligrams daily) in order to ensure adequate calcium deposits in the bones. This may help reduce the incidence of osteoporosis in later years. The recommended calcium intake can be achieved by getting at least three cups of fat-free or low-fat milk daily or the equivalent amount of low-fat yogurt and/or low-fat cheese. For those who don't wish to consume dairy products, a variety of other calcium sources are available such as green, leafy vegetables, calcium-fortified soy products, and other calcium-fortified foods and beverages.

The phenomenal growth that occurs in adolescence, second only to that in the first year of life, creates increased demands for energy and nutrients. Total nutrient needs are higher during adolescence than any other time in the lifecycle. Nutrition and physical growth are integrally related; optimal nutrition is a requisite for achieving full growth potential. Failure to consume an adequate diet at this time can result in delayed sexual maturation and can arrest or slow linear growth. Nutrition is also important during this time to help prevent adult diet-related chronic diseases, such as cardiovascular disease, cancer, and osteoporosis.

During this time, physical changes affect the body's nutritional needs, while changes in one's lifestyle may affect eating habits and food choices. Despite all

these important considerations, adolescent nutrition did not receive adequate attention in Bangladesh, and only recently few studies have been carried out in this population group. Adolescent nutrition is therefore important for supporting the physical growth of the body and for preventing future health problems.

1.3 Objectives

1.3.1 General objective

To compare nutritional status and food intake pattern of selected adolescent girls between urban and rural locations including marine and riverine fish intake.

1.3.2 Specific objectives

1. To assess anthropometric measurements (Height, Weight and BMI) of selected urban and rural adolescent girls.
2. To measure hemoglobin level of selected urban and rural adolescent girls.
3. To assess food intake pattern with emphasis on fish intake of selected urban and rural adolescent girls.
4. To compare nutritional status of adolescent girls between selected urban and rural locations.
5. To compare food intake pattern of adolescent girls between selected urban and rural locations.
6. To recommend appropriate measures for the improvement of nutritional status of both urban and rural adolescents based on the study findings.

CHAPTER-2

Literature Review

2.1 Literature Review

Adolescence is an important stage of physical growth and development in the lifespan. Unique changes that occur in an individual during this period are accompanied by progressive achievement of biological maturity. Growth occurs in skeleton, in the muscle, and in almost every system and organ of the body in adolescence except the brain and the head.[20]

During adolescence, more than 20% total growth in stature and up to 45% of adult bone mass is achieved, and weight gained during the period contributes about 50% to adult weight.[21] Accelerated growth characteristic of adolescence places increased demand on energy, protein, and other nutrients. Tempo of growth during adolescence is slower in undernourished populations.[22] Protein deficiency reduces growth during adolescence.[23] Iron is also essential for skeletal growth.[24] It is shown to be a limiting factor for growth if intake is deficient.[25] Vitamin A has also been indicated to be important for growth, development, and maturation.[24,25] Increase in skeletal size and its mineral content enhances need for calcium, which is therefore greater during adolescence than in either childhood or young adulthood.[26] Another significance of adolescence in human life cycle lies in its proximity to adulthood. For females, this is the period of preparation for motherhood. Thus, health and nutritional status of today's adolescent girls may have great impact on the quality of the next generations. A stunted adolescent girl is most likely to become a woman of short stature. Short stature is associated with increased risk of adverse reproductive outcomes. Risks for low birth weight,[27] Cephalopelvic disproportion and caesarean section are increased in short mothers. The risks are even higher if pregnancy occurs before physical growth and maturation have completed, which is common in the developing countries.

In Bangladesh, almost one-fourth of the total population consists of adolescents. About 37% of the rural and 20% of urban girls aged 15-19 years are married.[19] Nearly half of the married women in Bangladesh have at least

one child and another 14% have more than one child before the age of 19 years.[28] Further, maternal mortality rates for 15 to 19 year olds in Bangladesh are twice as high as that for 20 to 24 year olds.[29] In a society such as Bangladesh where the first pregnancy is likely to occur before adolescence is completed, physical growth, mental and sexual development of girls during adolescence may have critical effect on their capacity to carry successful pregnancies. Despite all these important considerations, adolescent nutrition did not receive adequate attention in Bangladesh, and only recently few studies have been carried out in this population group. For example, Ahmed and colleagues investigated vitamin A and iron status among urban[30] and rural adolescent school girls, [31] and in adolescent female garment factory workers[32] and reported nutrient intake and growth of adolescent schoolgirls in the Dhaka City.[33]

WHO defines adolescence as the segment of life between the ages of 10-19 years. Adolescents are an in between group, with some nutrition problem commonalities with children and some with adults. Adolescents constitute about 20% of the total population in countries of the South East Asia Region with the exception of Sri Lanka and Thailand where they comprise about 17% of the population. In all countries, male adolescents outnumber female adolescents. The illiteracy rate is high among adolescents in Bangladesh, Bhutan, India and Nepal, especially among girls. A majority of older adolescents are not in school. Rural adolescents are more likely to work and less likely to study than their urban counterparts.[28]

In adolescence, a second period of rapid growth may serve as a window of opportunity for compensating for early childhood growth failure, although the potential for significant catch-up is limited. Adult size, measured by height and weight, also reflects an entire range of physiological measurements that determine work capacity, safety, ease of childbirth and decreased obstetric risk to mother and decreased incidence of low birth weight. Survival itself, for both

mother and child is affected by maternal body size. Research evidence suggests that optimal nutrition during the brief period of pre-pubertal growth spurt, some 18 to 24 months immediately preceding menarche, results in catch- up growth from nutritional deficits suffered earlier in life [34] . Growth is faster than at any other time in the individual's life except the first year[35]. Over 80% of adolescent growth (attained weight and height) is completed in early adolescence (10-15 years), with a marked deceleration in weight and height velocity in the post-pubertal phase[36]. This adolescent growth spurt is also associated with cognitive, emotional and hormonal changes. An important feature is the great variability that exists in the timing and magnitude of the growth spurt both between genders and among individuals[37]. The girl begins her adolescent growth spurt at an average of about 10 years and grows at peak velocity at about 12 years. These ages vary from country to country, being lowest in developed countries and highest in poorest countries. The boy starts his adolescent growth spurt around 12 years of age and in a year or two overtakes the girl. The girl attains her adult height at about 16 years, the boy at 18 years. Adolescents of a given chronological age usually vary widely in physiological development. Because of this variability among individuals, age is a poor indicator of physiological maturity and nutritional needs. The hormones mediating the pubertal growth spurt are sex steroids and growth hormone, which are modulated to a great extent by nutritional factors. All these changes create special nutritional needs. The requirement of some of the nutrients is as high as, or higher in adolescents than in any other age groups and therefore many micronutrients, including vitamin A, thiamine, riboflavin, niacin, folic acid, vitamin B_{12}, vitamin C, and iodine reach the levels required by adults[34].

Adolescence is considered as a nutritionally critical period of life for several reasons.

- Firstly, the dramatic increase in physical growth and development puts greater pressure on the need for nutrients. During this period,

adolescents will experience a weight gain equivalent to 65% of their weight at the beginning of the period or 40% of their final weight, and a height gain equivalent to 15% of their adult height[35].

- Secondly, there may be socio-cultural factors or change of lifestyle and food habits of adolescents that can affect both nutrient intake and needs[34].

- Thirdly, growing adolescents have increased nutrient requirements during pregnancy and illness [38,39].

- Fourthly, adolescence can be the second opportunity to catch up growth if environmental conditions, especially in terms of nutrient intake are favourable[40].

- Finally, psychological changes and development of their own personality can impact on their dietary habits during a phase when they are very influential.

Adolescence can be the second opportunity to catch up growth if environmental conditions, especially in terms of nutrient intake, are favorable[40].

Adolescence is an important time for gains in height as well as weight. While both muscle and fat increase, girls gain relatively more fat, and boys gain relatively more muscle. Thus, the requirement of energy as well as proteins increases considerably during this period. Energy and protein needs correlate more closely with the growth pattern than with the chronological age[34]. The peak in energy and protein requirements coincides with the peak in growth of adolescents. Actual needs also vary with physical activity. Therefore, monitoring weight and height and body mass index [BMI (weight/height^2)] is

essential to determine the adequacy of energy intake for individual adolescents. Generally, the requirement of protein is met even in economically disadvantaged populations if calorie intake is sufficient. However, if energy intake is limited, dietary protein may be used to meet energy needs and be unavailable for synthesis of new tissues or for tissue repair. This may result in reduction of growth rate and muscle mass despite an apparent adequate protein intake[34].

Minerals play a crucial role in adolescent nutrition. Adolescents, at the peak of their growth velocity, require large quantities of nutrients. The increment in skeletal mass, body size and body density, associated with pubescence, highlights the role of minerals in the growth process [41].

Iron requirements peak during adolescence due to rapid growth with sharp increase in lean body mass, blood volume and red cell mass which increases iron needs for myoglobin in muscles and haemoglobin in blood[42]. In boys, there is a sharp increase in the iron requirements from approximately 10 to 15 mg/day. After the growth spurt and sexual maturation, there is a rapid decrease in growth spurt and need for iron[43]. As a result, there is an opportunity to recover from an iron deficiency that might have developed during this peak growth. In girls, however, the growth spurt is not as great, but menstruation typically starts about one year after peak growth and some iron is lost during menstruation. The mean requirement for iron reaches a maximum of approximately 15 mg/day at peak growth but settles to approximately 13 to 15 mg/day because of the need to replace menstrual iron losses[44].

Iron requirements in adolescence are greater in developing countries because of infectious diseases and parasitic infections that can cause iron loss, and because of low bio-availability of iron from diets[24]. Other benefits of iron for adolescents: Iron helps in improving cognition which leads to better academic performance that may be an incentive for girls to remain in school [45].

Dietary calcium has been identified as a nutrient of great potential concern for adolescents[46]. The adolescent years are a window of opportunity to influence lifelong bone health. Because of the accelerated muscular, skeletal and endocrine development, calcium needs are greater during puberty and adolescence than in any other population age group except pregnant women[34]. At the peak of the growth spurt, the daily deposition of calcium can be twice that of the average between 10 to 20 years. In fact, 45% of the skeletal mass is added during adolescence[34, 47]. By the end of the second decade of life, 90-95% of the total body peak bone mass is attained[48]. Bone mineral content must be maximized during puberty to prevent osteoporosis (risk of fracture in later life)[49].

Low calcium intake in early life may account for as much as 50% of the difference in hip fracture rates in postmenopausal years[26]. Consumption of calcium rich products with every meal goes a long way towards ensuring that requirements are met for calcium and many other nutrients e.g., phosphorus, magnesium and vitamin D needed for bone health[50].

Zinc is known to be essential for growth and sexual maturation during puberty. It enhances bone formation and inhibits bone loss. Limited intake of zinc-containing foods may affect physical growth as well as development of secondary sex characteristics[51].

Iodine is important during adolescence for two reasons. These are the high growth velocity of adolescents and the increased iodine requirements during pregnancy. As large percentage of adolescent girls get married early and bear children during adolescence, their requirements for iodine increase to provide for their own growth as well as for the needs of the fetus. Severe iodine deficiency in children results in learning disability and lowered achievement[52]. In fact, even moderate iodine deficiency can lead to loss of 10-13 IQ points. Iodine deficiency during pregnancy has been associated with increased

incidence of miscarriages, still births, birth defects and mental retardation, and if severe, may result in cretinism in the offspring[51].

Although, the roles of other minerals in the nutrition of adolescents have not been studied extensively, the importance of magnesium, phosphorus, copper, chromium, cobalt and fluoride is well recognized. The possibility of interactions among these nutrients cannot be overlooked[34].

The requirements for vitamins are also increased during adolescence. Because of higher energy demands, more thiamine, riboflavin and niacin are necessary for the release of energy from carbohydrates. The increased rate of growth and sexual maturation increases the demand for folic acid and vitamin B_{12} [34,53]. With increasing evidence of the role of folic acid in the prevention of birth defects, all adolescent girls of childbearing age should be encouraged to consume the recommended amount of folic acid from supplements in addition to intake of food folate from varied diet . The Center for Disease Control and Prevention recommend 400 mg of folate for all females of childbearing age. The rapid rate of skeletal growth demands more vitamin D. Further Vitamins A, C, and E are needed in increased amount for new cell growth. Adolescents' vitamin needs are also associated with the degree of maturity rather than chronological age because of demands of growth.

Early pregnancy not only focuses major health risks for the adolescent girl and her child, but also disrupts the physiological, social and intellectual development of young girls. When the adolescent becomes pregnant, her needs for energy and nutrients may be in direct competition with those of her foetus[53]. The risk of anaemia is greater for girls during pregnancy[54]. Recent research has shown that growth during pregnancy does occur in adolescent females and that it can have negative effects on pregnancy outcome if additional dietary and weight gain allowances are not made. The risk of LBW and preterm delivery increases among iron-deficient anaemic adolescents [38, 39].

As pregnant adolescents often receive inadequate antenatal care, their anaemia during labour and the postpartum period may be worse than in older women. Severe anaemia is an important cause of maternal mortality among adolescents[24].

Inappropriate dietary intakes during adolescence can have several consequences. For example, it can:

- Potentially retard physical growth, reduce intellectual capacity and delay sexual maturation, as rapid physical growth creates an increased demand for energy and nutrients [39].

- Affect young people's risk for a number of immediate health problems such as iron deficiency, under nutrition, stunting, bone health, eating disorders and obesity[55]. It may also affect concentration, learning and school performance in school going adolescents.

- Also have long-term implications. For example, low calcium intake during adolescence is associated with low bone density and an increased risk for osteoporosis later in life; being overweight as an adolescent is associated higher risk for diabetes as an adult; and high fat intake during adolescence and into adulthood is associated with an increased risk of heart disease[55]. Further, stunting and underweight among girls during adolescence, continuing into adulthood, and early pregnancies, increases the obstetric risk for women. Thus, the compromised nutritional status and poor growth in adolescent years affects the reproductive role [40].

Adolescent growth and development is closely linked to the diet they receive during childhood and adolescence. Adequate nutrition of any individual is determined by two factors[39]. The first is the adequate availability of food in terms of quantity as well as quality, which depends on socio-economic status,

food practices, cultural traditions, and allocation of the food. The second factor is the ability to digest, absorb and utilize the food. This ability can be hampered by infection and by metabolic disorders. Poverty is considered the prime factor determining food consumption; however, some researchers suggest that cultural factors play a stronger role than socioeconomic conditions in determining allocation of food and nutritional adequacy[47]. Even where food resources are adequate, the mean calorie intake of individual family members can fall below requirements. The most vulnerable are children under two, and adolescents [56]. In some countries of the South-East Asia Region, gender discrimination plays an important role in intra household food allocation. Because of the preference for sons, girls may receive less food and/or food inferior in quality [33]. In some parts of India, girls' food consumption is limited for the fear that they will grow too rapidly and will have to be given marriage soon [57]. An adolescent girl in India may need to observe a series of fasts once or twice a week for getting a good husband, [57]. Therefore, girls are probably more exposed than boys to inadequate intakes because of social discrimination, dieting or lower energy intake and pregnancy.

An assessment of the current diet and nutritional status of 12,124 adolescents was carried out in villages of 10 states of India in 1996 by the National Nutrition Monitoring Bureau (NNMB), India, and compared with the data of an earlier survey conducted in 1975-79 in the same villages. The average daily food and nutrient intake of different groups were studied and compared with the recommended dietary intake for Indians [58], whereas the average intake of nutrients was compared with the Recommended Dietary Allowances (RDA) for Indians (1990). The results revealed that intake of most foods, except cereals, millets, roots and tubers, were below the RDI in all ages of adolescence. Consumption of green leafy vegetables, fruits, pulses and milk was grossly inadequate. The mean nutrient intakes were below the RDA in all adolescent age groups irrespective of sex. In both the sexes, the proportion of adolescents consuming inadequate amounts was higher in case of micronutrients i.e., iron

and vitamin A than that of protein, energy and total fat. Almost half of the adolescents of both sexes were not getting even 70% of their daily requirements of energy and a quarter of them were getting less than 70% of RDA of proteins. However, the extent of severe deficit with respect to energy intake (<50%) decreased from 21% to 9% in boys and 14% to 5% in girls during 1996-97 as compared to 1975-79. Similarly, the deficit in protein intake also decreased. Low energy and protein intake by adolescents in India can explain to some extent the high proportion of undernourished and stunted adolescents and adults.

In 2000-2001 another survey was conducted by National Nutrition Monitoring Bureau (NNMB), India in the rural populations of nine states of India. In general, the median intake of all the nutrients was less than the RDA for all age groups and in both the sexes. The diets were grossly deficient in micronutrients such as iron and vitamin A. More than 80% of adolescents are getting less than 50% of their daily dietary requirements of vitamin A. Similarly, more than 70% had their iron-deficient diet by more than 50% of RDA and more than 50% of boys and girls get less than 50% of required calcium[58].

The National Family Health Survey 1998-99 (NFHS-2), India also showed that 50% of households were not consuming adequately iodized salt; this means that adolescents living in 50% of households too are not consuming adequately iodized salt, hence are at risk of learning disability[59].

The search for identity, the struggle for independence and acceptance, and concern about appearance, tend to have a great impact on lifestyle, eating patterns and food intake among adolescents. The meal pattern of adolescents becomes more disorganized, and they tend to miss their meals at home as they get older, often skipping breakfast. Some dietary patterns like snacking, usually on energy dense foods, wide use of fast foods that are low in iron, calcium, riboflavin, vitamin A, folic acid and fibers, low consumption of fruits and

vegetables and faulty dieting are more common among the adolescents of industrialized countries [34]. In developing countries also, particularly in cities, some of these patterns are also common, and yet very little has been documented. A study in Nepalese school children showed that fast foods (ready to eat snacks, chips etc) were preferred by more than two-third of adolescents. Advertising, probably TV and magazines, influenced preferences in 80% of these Nepalese adolescents [30].

A food study carried out in schools of Myanmar showed that approximately half of the students buy snacks as they consider them good for health and 30-50% of students consume snacks that are advertised. They were curious to try the new products or liked the taste. It can also be inferred that preferences can be guided by peer influence, which is very strong in this age group. However the encouraging finding was that, preference for Myanmar snacks was more than for western snacks (74.5% vs 25.5%)[58].

Intra-household distribution of food is another reason for girls not getting adequate food in terms of both quality and quantity. Culturally, it is expected that the girls should eat after serving all family members [60]. They eat with their mothers after the family has eaten. Families are generally less aware of high adolescent requirements for food and often believe that boys should get a bigger share. From intra-household food distribution data in two poor communities of Vadodara, India, it was observed that compared to other family members, both adolescent boys and girls met relatively less of their nutrient requirements (calorie, proteins, iron and beta-carotene). Adolescent girls showed the greatest deficit in terms of percent RDA met for iron [61].

In another study in Bangladesh, intake of fish, meat, eggs, milk, legumes and fruits and vegetables were highest in case of boys and main earning members as compared to female adolescents. Although foods like fish, meat, eggs, milk

and some fruits and vegetables were said to be restricted for girls, it was reported by only 5% of the girls[60].

A cross-sectional survey was conducted to investigate the dietary pattern and nutritional status of adolescent girls attending schools in Dhaka city [62]. The intake of nutrients was much below the RDA. Animal sources supplied 50% of dietary protein. Milk was the major contributor for riboflavin and preformed vitamin A (retinol). Leafy vegetables and fruits were the main sources of carotene.

The pubertal growth spurt involves gain in weight as well as height. A prepregnancy weight of about 45 kg and height of 145 cm has been agreed upon as the minimum standard. Research has shown that better-nourished girls have higher pre-menarcheal growth velocities and reach menarche earlier than undernourished girls, who grow more slowly but for a longer, as menarche is delayed. Because underweight girls are growing for longer duration, they may not finish growing before their first pregnancy. In India, for example, up to 67% of girls were classified to be at obstetric risk (by weight and height criteria) in their 15th year as compared with about 20% in their 19th year [40].

The rate of weight gain during adolescence corresponds to the height spurt. In boys, the peak height velocity coincides with the peak weight velocity. In contrast, peak weight velocity occurs 6 to 9 months before height rate changes in girls [63]. Weight gain during this period accounts for approximately 50% of the ideal adult weight. Because peak weight occurs before the peak height in girls, many parents and teens become concerned about teenage girl's weight. Some girls may try losing weight. Any weight loss during this period may affect ultimate adult height [34].

There is little evidence to suggest that growth retardation suffered in early childhood can be significantly compensated for in adolescence. Some

spontaneous catch-up growth in adolescence may be possible in chronically malnourished children since the growing period is thereby extended [41]. Studies on effects of adoption show that some catch-up growth may be possible, but is not complete for those who remain in the same adverse environment [56].

In adolescents, chronic undernutrition also delays normal maturation and is an important and widespread problem with multiple adverse health outcomes. Stunting among adolescents is of interest for several reasons. First, a short woman tends to have a small pelvis and, therefore, is more likely to have obstructed labour during childbirth. Second, 25% of an individual's attained height is achieved during adolescence, which marks the end of growth in height and the attainment of adult height [64].

Thinness is of particular interest because it results in poor pregnancy outcomes, in particular low birth weight [64]. Thinness may also limit school achievement and work productivity. Thinness is defined as Body Mass Index (BMI) less than 5th percentile of the NCHS and World Health Organization (1995) reference data. BMI (weight/height^2) for age was recommended as the best indicator for use in adolescence. It has been validated as an indicator of total body fat at the upper percentiles. However, BMI has not been fully validated as an indicator of thinness or undernutrition in adolescents. Nonetheless, it provides a single index of body mass, applicable at both extremes [65]. The relationship between BMI and body fatness is dependent on maturation state, race and gender in children and adolescents [41]. Among four countries of the South-East Asia Region, rural Bangladesh has the highest prevalence of thinness and stunting (67% and 48% respectively) among adolescents. At the same time, the lowest prevalence was observed in school-going girls of urban Bangladesh (16% and 10%). Although stunting was similar in boys and girls, the prevalence of thin boys was more than the girls (75% vs 59%) in rural Bangladesh.

Another recent study by the National Nutrition Monitoring Bureau, India, compared the BMI values of adolescents with those reported for NHANES of USA. The proportion of adolescents below the 5th percentile of NHANES ranged from 77.6% at 11 years compared to 44% at 17 years age among boys, and from 62.7% at 10 years to 16.4 % at 17 years among girls [60].

The overall prevalence of stunting was similar in both the sexes (boys- 39.5% and girls-39.1%). However, it increased in boys as age advanced from 34.7% at 10 years to 59.7% at 17 years, but in girls, stunting increased with age up to 13 years (37.4% to 46.7%) after which it decreased to 37.2% at the age of 17 years[66].

India is a large country and there are wide disparities with respect to socio-economic status, living conditions, and diets between different sections of the country's population, with the urban rich and rural poor representing two ends of the socio-economic spectrum. The growth performance of the two groups is, in a broad sense, an indication of prevailing socio-economic disparities in the country [34]. While the BMI of affluent adolescent girls is comparable (after 13 years of age) with adolescent girls of USA, the margin of difference between rich and poor girls within the country is apparently high. The growth of these rich girls, who are not subject to dietary and environmental constraints fully reflects their genetic potential [34, 60].

Adolescents with a BMI above the 85th percentile are at risk for overweight. Weight gain is the result of a positive energy balance (consuming more energy than is expended). Energy expenditure, as assessed through levels of physical activity, declines in children as they reach adolescence, particularly in adolescent girls. There is evidence [63] that children and adolescents of urban families are more overweight than in the past, possibly because of decreased physical activities, sedentary lifestyle, altered eating patterns and increased fat content of the diet. Increase in sedentary activities, such as television viewing

and computer games, is suspected to be responsible for the decline in physical activity levels. Overweight and obesity during adolescence has some immediate consequences, particularly as they relate to body image and self-esteem, and becomes a risk factor for overweight and obesity as an adult. One quarter to one-half of the individuals who are obese in adolescence remain obese in adulthood [67].

However, many factors come into play while predicting adult obesity from adolescent obesity, which includes age of onset, degree of overweight and how long overweight persists in adolescence.

Longitudinal tracking studies show that adolescent weight-related risk carries into adult cardiovascular risk [49]. Data from Bogalusa (USA) show that adolescents with a BMI >75th percentile were more than eight times as likely to have hypertension in adulthood as compared with leaner adolescents [61]. Similarly, overweight adolescents, particularly boys, are more likely to have high serum cholesterol and abnormal lipoproteins levels in adulthood [41]. In the Bogalusa Heart Study, 2.4% of the overweight adolescents developed type 2 diabetes by the age of 30 years, whereas none of the normal weight adolescents developed the disease.

A study conducted in India showed the prevalence of obesity in affluent adolescent schoolchildren was 7.4%, and higher in males than in females. The maximum prevalence of obesity was found during the pubertal period (between 10 to 12 years).

Overweight tended to increase in the higher grades. Females were more prone to this problem as compared to males. Overconsumption of calories, especially fast food, snacks and soft drinks, were common among these adolescents.[64]

Adolescents, particularly girls, are especially vulnerable to iron deficiency due to low intake and absorption of iron, and increased iron requirements for growth and replacement of menstrual blood losses [24]. Anemia can be associated with other nutrient deficiencies (folic acid, vitamin A, B_{12}), as well as with infectious diseases like malaria, intestinal parasitic infestations, and chronic infections such as HIV [43].

Mild to moderate iron deficiency, even without anaemia, has adverse functional consequences, although the effects are less obvious. Anaemia has a serious negative impact on growth and development during adolescence, and decreases the ability to concentrate and learn. Iron deficiency was shown to be associated with impaired cognitive processes in adolescents, as suggested by improved performance following supplementation in South-East Asia [65]. Similarly, anaemia was independently associated with lower school achievements in adolescent girls [26]. Iron deficiency decreases energy and physical strength resulting in reduced physical capacity and work performance, both in men and women [50]. Physical performance may be compromised even at mild levels of anaemia [51]. In addition, anaemia in adolescence may also impair the immune response thus making them more prone to infections. A study of Indian children aged 1-14 years indicated that the immune response was significantly depressed in those with haemoglobin concentrations below 10g/dl [43]. As physical growth slows down in late adolescence, the iron status of boys improves [43]. Adult men are therefore less at risk of anaemia than women, who lose blood (and as a result, iron) through menstruation.

During adolescence, women's bodies develop and prepare for future childbearing. Low iron stores in young women of reproductive age makes them susceptible to iron deficiency anaemia because dietary intake alone is insufficient in most cases to meet the iron requirements of pregnancy [42]. Anaemia in adolescence puts a young woman and her future child at risk of premature birth, low birth weight, and increased peri-natal mortality [38]. Infants

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born to iron-deficient mothers also have higher prevalence of anaemia in the first six months of life [26]. Maternal mortality is increased in women whose haemoglobin levels fall below 6-7 g/dl [48].

Iron deficiency anaemia is a public health nutrition problem. A national household health survey in 1995 found that the prevalence of anaemia among schoolboys and girls was 46.4% and 48.0% respectively. Among 10-14 year age-group the prevalence was 45.8% in boys and 57.1% in girls. A baseline study among adolescent girls in 10 districts in East and Central Java provinces showed the prevalence to be 80.2% and 57.4% respectively. The study also showed a limited awareness of anaemia due to scanty information provided in the school curriculum by family and mass media [60].

The Nutrition Section, Ministry of Health, Nepal measured haemoglobin levels of 410 school-going adolescent girls in Kathmandu valley. The result showed that 72.5% of these girls had mild, moderate or severe anaemia. The study looked at parents' education, girls' menstruation pattern, distance from home, helminthiasis and malaria and showed that there were not significant statistical differences in these areas between the normal and anaemic group. However, a significant difference was found in relation to food consumption in these two groups. Approximately 16% of non-anaemic girls took soybean in comparison to 6% of anaemic group. Similarly, 36% of non-anaemic girls took daytime snack in comparison to 24% of anaemic girls[30].

Vitamin A deficiency affects millions of children in developing countries around the world. The major cause of this deficiency is inadequate dietary intake of vitamin A. Though the risk of severe deficiency declines with age, vitamin A deficiency frequently extends into adolescence and further into early adulthood. Reports have shown that vitamin A deficiency is also prevalent among adults, especially in women of reproductive age[34].

Studies conducted in different settings in Bangladesh showed that there is a high prevalence of sub-clinical vitamin A deficiency among adolescents [62].

Teenage mothers bear a double (physiological) burden: one involving their own growth and development, and another involving the intra-uterine growth and development of their offspring. Teenage mothers in India, on the other hand, carry a triple burden – the added (pathological) burden of their under-nutrition and underdevelopment with its inevitable mutually aggravating effect on the other two burdens [40]. This is probably true in many countries in the Region. Adolescent females who are considered biologically immature (less than 2 years past menarche) or who are less than 16 years old, may continue to experience linear growth and changes in weight and body composition [39]. They show gains in linear height during pregnancy and additional body fat, almost exclusively during the third trimester, which is the period of most rapid growth by the foetus [38]. These pregnant adolescents deliver infants of lower birth weight than the comparable non-growing adolescents, suggesting that the mother and foetus may compete for energy and nutrients [38].

Calcium status is a particular concern, as the bones of adolescents still require calcium for growth at a time when foetal needs for bone growth are also high[27]. The overlap of the increase in iron requirement due to growth, onset of menses and costs of pregnancy suggests that there is a limited opportunity to acquire sufficient iron before pregnancy to acquire a storage iron pool of sufficient size to meet the demands of pregnancy [42]. Controlled studies in several sites have shown that adolescent mothers have higher incidence of prematurity, low birth weight and complicated labour [38]. Poor pregnancy outcomes are more often observed in pregnant adolescents who have poor nutritional and low socio-economic status.

Maternal mortality ratios for 15-19 years olds in Bangladesh are twice as high as those for 20 to 24 years olds . These grave risks are further heightened by

the fact that pregnant adolescents are less likely to use antenatal and obstetric services [38]. Pregnant adolescents from poor families are at exceptionally higher risk. The growth pattern of rural and poor girls continues for a longer time than in the well-to- do, and it is the poor rural girls who are married at a much younger age and have to start their reproductive role much earlier than the well-to- do ones. Furthermore, since menarche is delayed in the poor girls and they grow for a longer time, it is more important that conception is delayed till about the 18th year [40].

Good nutrition during adolescence is critical to cover the deficits suffered during childhood and should include nutrients required to meet the demands of physical and cognitive growth and development, provide adequate stores of energy for illnesses and pregnancy as well as prevent adult onset of nutrition-related diseases.

Poor nutrition starts before birth, and generally continues into adolescence & adult life and can span generations. Chronically malnourished girls are more likely to remain undernourished during adolescence and adulthood, and when pregnant, are more likely to deliver low birth-weight babies. Epidemiological evidence from both developing and industrialized countries now suggests a link between foetal under-nutrition and increased risk of various adult chronic diseases[27].

A large percentage of adolescents in the South-East Asia region suffer from nutritional deficiencies. Dietary intake with respect to adequate availability of food in terms of quantity and quality (particularly, the mean calorie intake), ability to digest, absorb and utilize food and the social discriminations against girls can greatly affect the adequate nutrition of adolescents. Studies in India and Bangladesh have shown deficiencies in the intake of all nutrients, particularly iron, calcium, vitamin A and vitamin C. The reported reasons are mainly the low educational level of parents and low family income. Studies

conducted in different countries in the South-East Asia Region, reveal that nutritional deprivation affects almost all growth parameters and final adult body size resulting in thinness and stunting. However, nutritional status of both boys and girls improved with age, showing that the effect of malnutrition is more pronounced at the time of peak growth. Obesity amongst adolescents is responsible for carrying weight-related risks like cardiovascular diseases into adulthood. An Indian study has shown that obese adolescents are more likely to develop hypertension later in life as compared to their leaner counterparts. According to a Thai study, over-consumption of calories, especially fast food, snacks and soft drinks were contributing factors resulting in obesity and female adolescents were more prone to this as compared to males. Anaemia has a serious negative impact on growth and development during adolescence. A high rate of iron deficiency anaemia is reported among adolescents in the South-East Asia Region. There is, however, a great disparity within the South-East Asia Region. There are disparities between rural and urban areas as well as in school going and non-school going adolescents. It was also observed that socio-economic status determined the occurrence of anaemia among adolescents. Boys are as much prove to anaemia as girls in some countries. Irrespective of the severity, the prevalence of anaemia ranges between 12-100% in the South-East Asia Region. There is clear evidence of an association between plasma-serum levels of vitamin A and haemoglobin levels. Studies conducted in different settings in Bangladesh showed a high prevalence of sub-clinical vitamin A deficiency among adolescents.

Early pregnancy among adolescents poses major risks, not only for the girl but for the child too. Adolescent mothers bear a double burden: one involving their own growth and development, and another involving the intra-uterine growth and development of their offspring. Greater risk of anaemia and other nutritional deficiencies can have negative effects on the outcome of the pregnancy as well as on the growth and development of adolescents themselves. Poor pregnancy outcomes are more often observed in pregnant

adolescents who have poor nutritional and low socio-economic status. Due to the high rate of adolescent marriage in some countries of the Region, pregnancy during adolescence is still common. Adolescent fertility rates were high in Bangladesh, Bhutan, India and Nepal. Not many studies have been done on the nutritional status of pregnant adolescents and its effect on pregnancy outcome. The limited studies carried out in Nepal and India showed a high prevalence of malnutrition among pregnant adolescents.

A study conducted on urban adolescent college girls of Bangladesh indicated poor consumption of milk, liver and leafy vegetables. Food intake data revealed a deficit of 473 kcal/day in energy. Mean intake of carbohydrate and fat were lower than RDA; while protein, iron, vitamin A and vitamin C intakes were much higher. Anthropometric data indicated that 63% of the girls were stunted (height-for-age <95% of NCHS reference values) and 45% were underweight (weight-for-age <75% of NCHS reference values). The prevalence of anaemia (Hb<12 g/dl) among the participants was 23%. About 17% had low serum iron (<40 =g/dl), 23% showed evidence of iron-deficient erythropoiesis (Transferrin Saturation <15%) and only 8% had vitamin C deficiency (<0.29 mg/dl). About 65% of the participants had correct knowledge about the causes of anaemia; while 72.3% and 80% respectively, knew about the prevention and treatment of anaemia. Surprisingly, 73.8% of the participants were not aware about the sources of iron-rich foods.[68]

Malnutrition was calculated by using BMI, a measure of nutrition in a study and through which it was observed that 19% of the girls were under nourished, 74% were having normal BMI which revealed that they were well nourished and only 7% were obese.[69] Although in some other studies reported prevalence rate of undernourishment among adolescent is higher than the current study but even this prevalence rate (19%) also need intervention because 20-30% underweight is high prevalence rate and is indicated as a serious situation and

needs immediate intervention.[70] Obesity or overweight in the adolescent girls was only 7.0%, which is less than that in developed countries.

Evidence suggests that adolescent girls in Bangladesh are of poor nutritional status. One survey reported that 27% of female students aged 11-16 years in peri-urban Bangladesh had anaemia (Hb<12g/l), and 17% had depleted iron stores (SF<12 microg/l) .[71]

Data from the 2004 baseline survey of the National Nutrition Programme (NNP) of the government of Bangladesh [72] were analyzed to describe the nutrition knowledge and practices of adolescent girls. The baseline survey included a random sample of 5,106 never married adolescent girls aged 13-19 from 708 clusters in 113 upazilas (about one quarter of the sub-districts of Bangladesh) for interview. Upazilas were grouped into NNP (where nutrition intervention activities were yet to start) and Bangladesh Integrated Nutrition Project (BINP) areas (where a community-based nutrition intervention had been functioning from 1995 up to 2002). The BINP imparted health and nutrition education and supplied iron and folic acid supplements to adolescent girls.[73] Trained female interviewers visited adolescents at their homes to obtain data on nutrition knowledge and practices. Seven-day food-frequency was recorded to capture eating patterns. Adolescents were mostly young: 43% aged 13-14, 37% aged 15-16 and 19% aged 17-19. The study population included fewer older adolescents because many of them were married and so no longer fit the inclusion criteria. Education levels varied; 69% had completed grade 6 or above, but only 6% had passed grade 10. Very few (4%) had never attended school. By occupation, 66% were students and the rest were doing household chores (29%) and earning some income (4%). Adolescent girls were of poor nutritional status; 9% were severely thin (BMI-for-age below the 5th percentile), another 16% were moderately thin (below the 15th percentile) and none were obese (above the 95th percentile). Prevalence of severe and

moderate thinness did not vary by education or household asset quintile (a proxy for household economic condition).

Adolescent knowledge regarding the nutritional value of different types of food items was limited. When asked to name major energy-dense foods, 31% mentioned rice and 12% mentioned wheat and these are correct responses. Less than half correctly identified high protein foods: dal (20%), meat (32%) and fish (42%). Their knowledge about vitamin- and mineral-rich foods was better; 75% mentioned vegetables and 51% mentioned fruits as vitamin and mineral-rich foods. Most of the adolescent girls (65%) reported understanding the need to take extra nutrients during adolescence to attain potential growth and this was positively associated with both education and household asset quintile.[74]

Stunting in adolescence is 32% in India, 36% in Bangladesh, and 47% in Nepal, and low body mass index (BMI) is 53% in India, 50% in Bangladesh, and 36% in Nepal.[75] In Bangladesh, 25-27% of adolescent girls are anaemic (haemoglobin <12 g/dL) [62, 76], and 30% in the age-group of 14-18 years are iron deficient (serum transferrin saturation [TS] <15%).[77,78] Half (47-54%) of schoolgoing children are vitamin A-deficient.[77,78] The level of zinc deficiency in adolescence is unknown. The average per-capita energy intake by rural adolescent girls is 81% of the recommended dietary allowance (RDA) for age.[79,80] Protein, iron, and calcium are important for growth spurt and skeletal development in adolescence. More than 60% of schoolgirls aged 10-16 years in Dhaka city consume protein, iron, and calcium less than 75% of the RDA for age.[78]

The nutritional status of adolescents in Bangladesh is deplorable. A large number of adolescent girls suffer from malnutrition. The prevalence of malnutrition is found to be markedly higher among female children compared with male children. Short maternal height has been found to account for a sizeable number of low birth weight babies (2.5 kilograms) who are

subsequently more susceptible to infections and death in infancy. Those who survive grow up as undernourished adults, giving rise to an intergenerational cycle of undernourishment. Additionally, small pelvis size may cause obstructed labor due to cephalo-pelvic disproportion. The consequences for women range from ill health (from chronic morbidity due to infections of the reproductive system and conditions such as vesico-vaginal fistulae) to death during and after child birth.[61] Over one-half of adolescent girls are stunted and more than one-third of adolescent girls in rural areas are wasted. Adolescent girls suffer from iron, iodine, and vitamin A deficiencies. Forty three percent of adolescent girls suffer from iron-deficiency anemia.

One study in Bangladesh sought to evaluate adolescents' understanding about food required for pregnant and lactating mothers: 40 percent mentioned fish, 27.5 percent mentioned meat, 38 percent mentioned eggs, and 34.7 percent mentioned milk. Similar proportions of adolescents mentioned food requirements like meat, fish, eggs, and milk for themselves.[60]

The findings of the Bangladesh National Nutrition Survey, 1998 (relating to adolescents ages 10–17) reveal high levels of both stunting and thinness among adolescent girls. Over one-half of girls ages 10– 12 (54 percent) and 13–17 (56 percent) were found to be stunted, with generally higher rates in rural areas compared with urban areas. A slightly lower proportion of adolescent boys were stunted: 47 and 50 percent for the two age groups, respectively.[69]

The Bangladesh National Nutrition Survey, 1998 showed comparative data on energy intake of male and female adolescents. Girls consume fewer calories than boys. They consume 8 percent fewer at ages 10– 12, 18 percent fewer at ages 13–15, and 28 percent fewer at ages 16–19. In terms of meeting energy requirements, boys aged 13–17 consumed just enough calories to meet their needs but girls in the same age group have a 4 percent calorie consumption shortage. In the 10–12 year-old age group there is a shortage among both boys

and girls. Deficiencies in calorie intake are greater among urban girls compared with rural girls.[81]

An anemia survey conducted by Helen Keller International (HKI), Bangladesh in rural areas reported that 43 percent of the 200 adolescent girls ages 11–16 who were studied were anemic.[82] An indication of the prevalence of iodine deficiency disorders (IDD) among male and female adolescents was obtained from a cross-sectional survey in Upazilla of Bangladesh. The survey reported that 3 percent of adolescents had a visible goiter (i.e., an enlarged thyroid). A visible goiter is nearly twice as common among adolescent girls compared with adolescent boys.[83]

A study of approximately 1,000 male and female adolescents (ages 10–17) in a rural area of Bangladesh found that 1.6 percent were suffering from night blindness and 2.1 percent were suffering from physical signs of vitamin A deficiency. A sub-sample of 189 adolescent girls from a large-scale vitamin A survey reported that sub-clinical vitamin A deficiency was found among 12 percent of the adolescent girls ages 12–16.[84]

In Bangladesh, a large number of adolescent and young women migrate from rural areas to participate in wage labor. Most of them live in city slum areas and work in the garment industry. Most of the garment industry is in Dhaka. Nearly 2 million people work in the garment sector. An estimated 80 percent of all total garment workers are female, of whom 50 percent are adolescent girls. No serious studies have been conducted so far on the situation of garment workers. However, a nutritional study of adolescent working girls in a city garment factory revealed low energy and nutrient intake. Another health-affecting factor is that they work for 12 hours, on average. Their reproductive health is at risk due to poor dietary intake, among other reasons.[85]

All the BDHSs, with exception of 1993/94 collected information on the height and weight of the sample women. The data were used to obtain two measures of nutritional status; height; and body mass index (BMI).

The information demonstrates that has been an improvement in the nutritional status of the adolescents aged 15-19 years old. In the 1996 BDHS over 48 % were underweight (BMI less than 18.5) and in the 2007 BDHS it declined to 32.1 %. The amount of adolescents with a BMI greater than 18.5 increased from about 52% to about 68% between 1996 and 2007. Nutritional status of urban adolescents aged 15-19 and youths aged 20-24 are better than the rural adolescents and youths.

A higher level of education is correlated with a higher BMI value. Adolescents from the poorest group are more likely to suffer from malnutrition than the adolescents from the richest group .A decrease in proportion of adolescents with a BMI lower than 18.5 has been documented since 1996 in all age and wealth groups. Improvement is most evident among 20-24 year olds where a decrease of 23 % has taken place, irrespective of economic status. The slowest improvement in BMI value is found among the richest 15-19 year olds.

Stunting in adolescence is 32% in India, 36% in Bangladesh, and 47% in Nepal, and low body mass index (BMI) is 53% in India, 50% in Bangladesh, and 36% in Nepal.[75] In Bangladesh, 25-27% of adolescent girls are anaemic (haemoglobin <12 g/dL) [62,76] and 30% in the age-group of 14-18 years are iron deficient (serum transferrin saturation [TS] <15%).[77,78] Half (47-54%) of schoolgoing children are vitamin A-deficient.[77,78] The average per-capita energy intake by rural adolescent girls is 81% of the recommended dietary allowance (RDA) for age.[79,80] Protein, iron, and calcium are important for growth spurt and skeletal development in adolescence. More than 60% of schoolgirls aged 10-16 years in Dhaka city consume protein, iron, and calcium less than 75% of the RDA for age .[78]

In Bangladesh, low family income, education, and periodic food-shortage were associated with inadequate dietary intake, which might have led to undernutrition. The prevalence of undernutition in the sampled adolescent girls was high; 9% were severely thin (below the 5th percentile value of BMI-for-age for girls), 16% moderately thin (in between the 5th and the 15th percentile value of BMI-for-age), and 0.3% obese (above the 95th percentile value)[79].

Available evidence suggests that adolescent girls in Bangladesh are of poor nutritional status. One survey reported that 27% of female students aged 11-16 years in peri-urban Bangladesh had anaemia (Hb<12g/l), and 17% had depleted iron stores (SF<12 microg/l).[71]

CHAPTER-3

Research Methodology

3.1 Research Methodology

3.1.1 Type of Study

The study was comparative type of cross sectional study.

3.1.2 Subjects

Appropriate statistically designed and estimated number of adolescent girls between 10 to 19 years of a school and college in Dhaka city and a village school of Kishoreganj district were included in the study.

3.1.3 Study Period

The study was conducted from March 2011 to March 2012. The time preceding and following this period was utilized for questionnaire development, data entry and analysis as well as final presentation of the study.

3.1.4 Data Collection Period

Data collection was carried out from July, 2011 to September, 2011.

3.1.5 Sample Size Calculation

There were two separate groups of adolescent girls, one from urban and another from rural location. Each group was consisted of the following sample size which is calculated below:

Sample size of adolescent girls from urban/rural location = n

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

$$= \frac{385}{1 + \frac{(385 - 1)}{175}}$$

$$= 121$$

Here,

$$n_0 = \frac{Z^2 pq}{e^2}$$

$$= \frac{(1.96)^2 (0.5) (0.5)}{(0.05)^2}$$

= 385

N= Sample population size after screening = 175

p = 0.5 (maximum variability)

q = (1-p) = (1-0.5) = 0.5

Z = the value associated with 95% confidence interval = 1.96

E = level of precision (±5%) =0.05

Therefore, the two comparative groups were matched in terms of family size, number of adolescent girls and living parents. However, these two comparable groups differed in terms of education and economic status in urban and rural location. The total numbers of respondents were 242.

3.1.6 Criteria of Marine and Riverine Fish

Marine Fish: Marine fish means fishes found in sea.

Riverine Fish: Riverine fish means fishes found in river, cannel, beel and other land water sources.

3.1.7 Development of Questionnaire

A questionnaire was developed containing both closed and open ended questions to obtain relevant information on socio-economic, nutrition education, anthropometric, dietary and health condition. All questions were designed, pretested, modified and resettled to obtain and record information easily. The purpose of the pre-test was to test the content, wording and expression, the topical

sequence of questions and duration of the interview and the reliability of some items. After pre-test the individual questionnaire which were related for quantitative data collection were improved and reformed to ensure content coverage, the reliability and validity of the study.

3.1.8 Consent of School and College Authority

The purpose and nature of the study was explained to the authority of the school and permission was taken to carry out the work with students. Each participant after getting the verbal consent was included in the study.

3.1.9 Overview of Data Collection Method

Collection of Socio-economic Information

The part of the questionnaire that was designed to obtain socioeconomic information was collected by interviewing the respondents. All the respondents were interviewed about personal characteristics and their family size, family income, educational information, housing conditions and living conditions. All of the information was recorded in the respective places of the questionnaire.

Collection of Anthropometric Information

The anthropometric data was collected based on standard methods. The following anthropometric data was collected -

Age of the subjects under study was determined by interrogation and confirmed through probing. The age of the children were collected from the school record as well as respondents itself. If it was not possible then approximate age was determined by asking some local and national incidence which occurred at that period.

The anthropometrical data was taken individually by the following standard procedure:

Measuring Body Weight

Weight was recorded in kilograms by using standard weighing machine. During measuring the weight, each subject was asked to be bare footed and to remove heavy cloths if any[86].

Measuring Height

Subjects were positioned to stand on the platform, bare footed with their head upright, looking straight forward for measuring height by using standard height measurement scale. Height was measured to the nearest 0.1 cm[86].

Assessment of Nutritional Status

The nutritional status of adolescent girls was assessed by Body Mass Index (BMI), which is weight in kg divided by height in meter square. The cut-off points* of nutritional status according to BMI are given below-

Nutritional Status	BMI (kg/m^2)
Severe CED	<16.00
Moderate CED	16.00-<17.00
Mild CED	17.00 - <18.50
Normal	18.50 - 24.99
Overweight & Obese	≥ 25.00

*WHO (1995), Physical Status: the Use and Interpretation of Anthropometry. WHO Technical Report Series 854. WHO, Geneva.

Collection of Biochemical Information

Two ml blood was collected from each respondent's vein and concentration of hemoglobin was determined by using cyanmethemoglobin method[87].

Determination of Anemia

The cut-off point for hemoglobin concentration to determine anemia was considered based on the suggested criteria for minimum necessary hemoglobin level*.

Age and sex	**Minimum acceptable Hemoglobin (gm/100 ml of blood)**
Children both sex (6-14 years)	12
Adult females (15 years and above)	12

*WHO Technical Report Series No. 405 (1968). Nutritional Anemias Report of a WHO Scientific Group.

Collection of Dietary Information

Assessment of food habit was the central focus of the study as the relation between diet and health is very important. The dietary assessment covered dietary intake including food preferences. Dietary intake was determined by twenty four hour recall method and information about their habitual dietary pattern was obtained using a food frequency questionnaire with emphasis on fish intake (marine and riverine).

3.1.10 Data Verification

Questionnaires were checked each day after interviewing and again these were carefully checked after completion of all data collection and coded before entering into the computer to minimize the errors. After entering the data, it was checked and resolved once again.

3.1.11 Data Analysis

The data was first checked, cleaned, and entered using SPSS program from the numerical codes on the form. The data was then edited if there were any discrepancy found.

All the statistical analysis and all other data processing were done by using SPSS 16.0 windows program. Descriptive statistics was mainly done. Data were analyzed in terms of frequency distribution, percentage, mean and standard deviation. Normally distributed variables were initially analyzed by bivariate analysis and Pearson's correlation. Categorical variables were analyzed by using Chi-square test. ANOVA test was done to see the significance level of nutrient intake by urban and rural groups. For tabular, pictorial and graphical representation Microsoft word and Microsoft excel were used.

CHAPTER-4

Results

Figure-1: Distribution of the respondents according to age and area

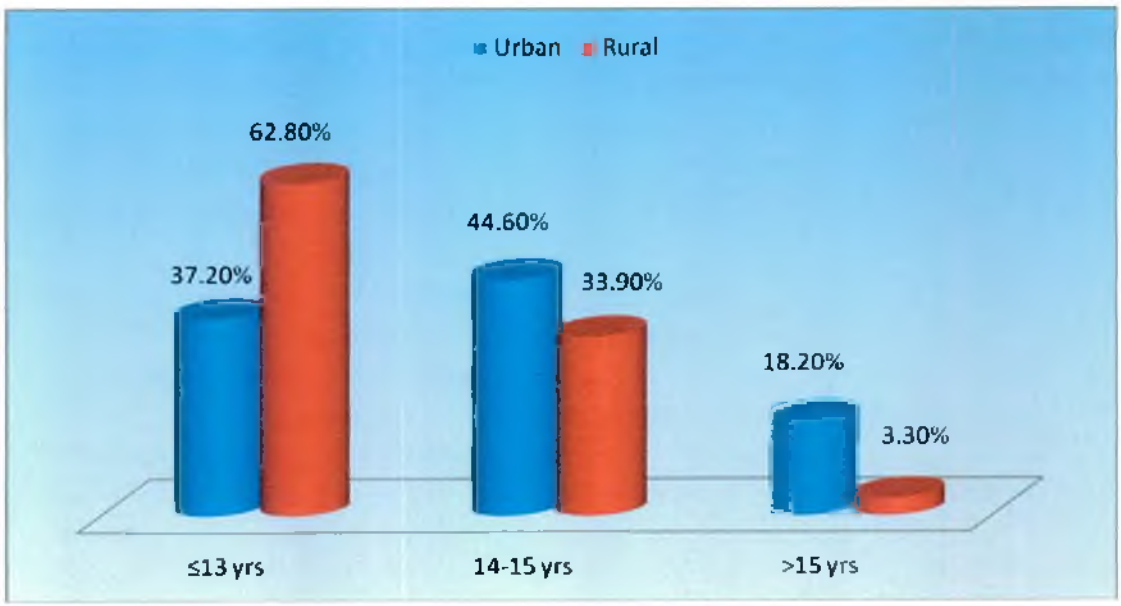


Figure-1 shows that 62.80% respondents in rural area and 37.20% in urban area belonged to ≤ 13 years age group. Again 44.60% of urban area and 33.90% of rural area belonged to 14-15 years age group. About 18.20% of urban and 3.30% of rural respondents belonged to >15 years age group.

Figure-2: Distribution of the respondents according to class

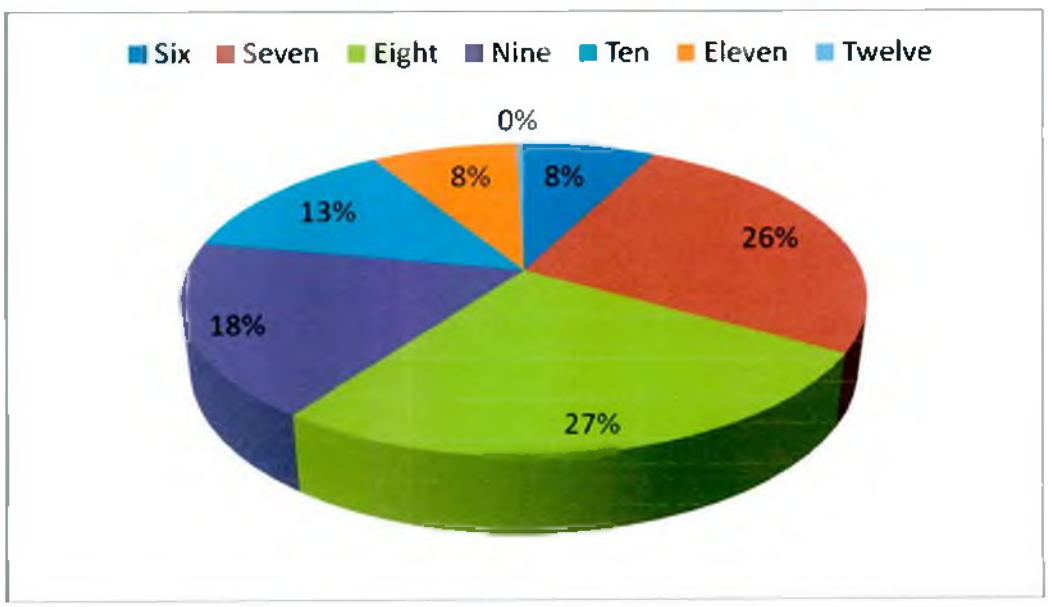


Figure-2 shows that most of the respondents belonged to class eight.

Table-1: Distribution of respondents according to occupation of father

Occupation of father	Area		p value
	Urban	Rural	
Rickshaw puller	2.6%	1.7%	0.000
Small business	9.4%	12.8%	
Daily labor	3.4%	3.4%	
Motor car driver	3.4%	0%	
Service	37.6%	13.7%	
Business	40.2%	28.2%	
Farmer	0%	40.2%	
Others	3.4%	0%	

Table-1 shows that, main occupations of respondents' father in urban area were business and service. On the other hand main occupations of respondents' father in rural area were farming. About 40.2% fathers in urban group were businessman, 37.6% were service holder and 9.4% fathers were doing small business. Again in rural area 40.2% fathers were farmer and 28.2% fathers were businessman. The differences of occupation of fathers in urban and rural group were significant (p=0.000).

Figure-3: Distribution of respondents according to occupation of mother

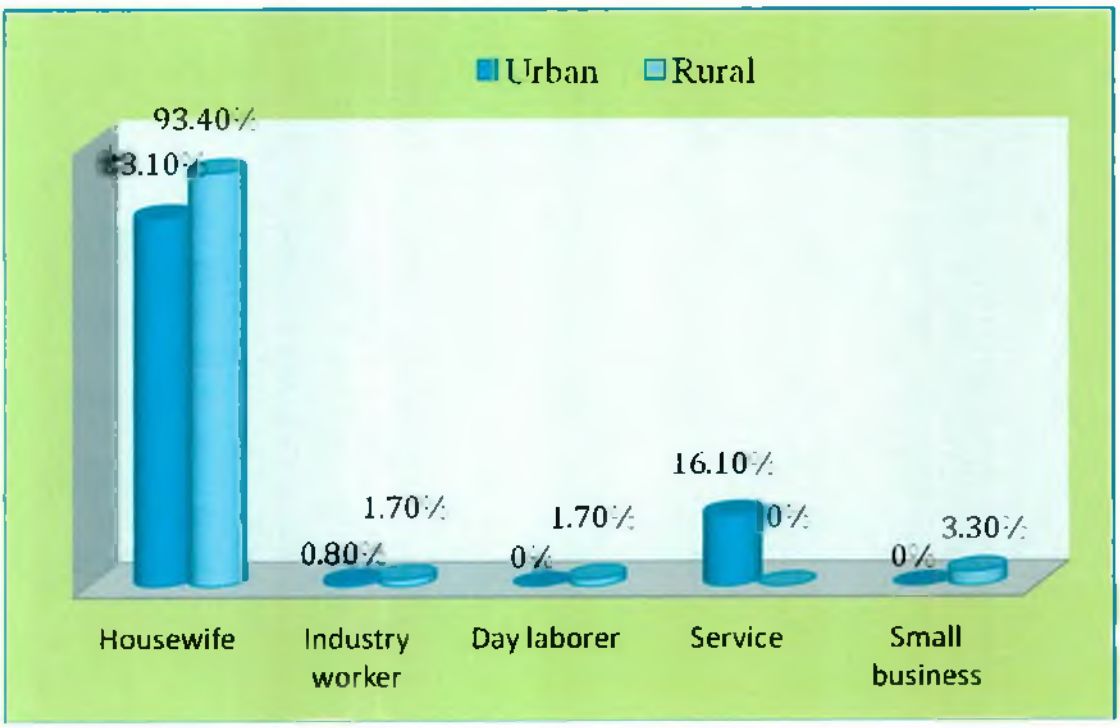


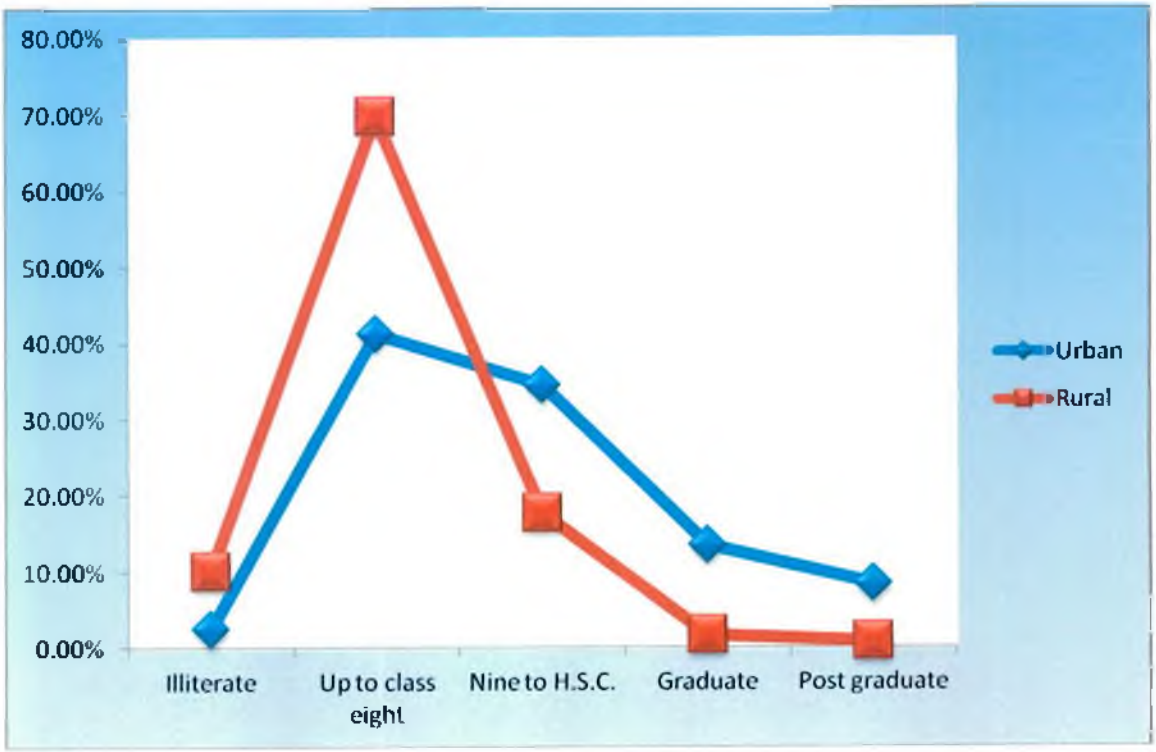
Figure-3 shows that, main occupations of respondents' mother in urban and rural area were service and small business respectively. More than 80% of mothers in urban and rural area were involved in non-payment activities (housewife). Mothers involved in service were 16.1% in urban respondents and 0% in rural respondents. It is evident that mothers involved in income activities were higher in urban group than rural group and this difference is significant.

Table-2: Distribution of respondents according to education level of father

Education level of father	Area		p value
	Urban	Rural	
Illiterate	5.1%	10.9%	0.000
Up to class 8	29.1%	64.7%	
Nine to HSC	30.8%	18.5%	
Graduate	18.8%	5.9%	
Post-graduate	15.4%	0.0%	
Others	0.9%	0.0%	

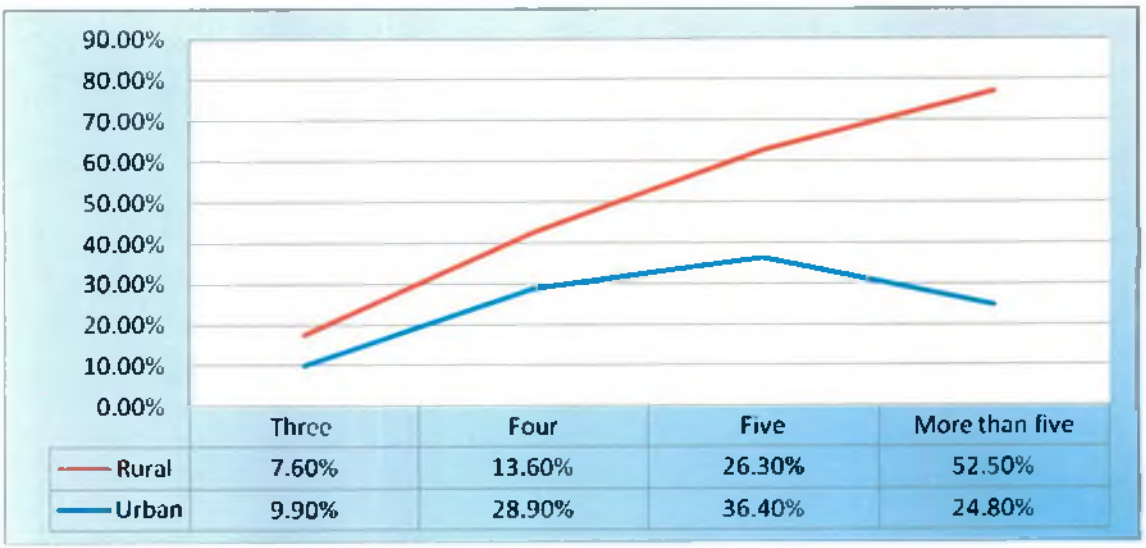
As revealed in Table-2, 5.1% fathers of urban respondents were illiterate and 10.9% fathers of rural respondents were illiterate. Again 29.1% fathers of urban group and 64.7% fathers of rural group had education level up to class eight. Further 18.8% fathers in urban group were graduates but only 5.9% fathers were graduates in rural area.

Figure-4: Percent distribution of respondents according to education level of mother



According to Figure-4, some 2.5% mothers of urban respondents were illiterate and 10.1% mothers of rural respondents were illiterate. Again 41.2% mothers of urban group and 69.7% mothers of rural group had education level up to class eight. Further 13.4% mothers in urban group were graduates but only 1.7% mothers were graduate in rural area. Education level of mothers in urban and rural group was significantly different.

Figure-5: Percent distribution of respondents according to family member



From Figure-5 it is found that in urban group, 9.9% had total family members of three, 28.9% had four members, 36.4% had five members and 24.8% had six or more total family members. In rural group, 7.6% had total family members of three, 13.6% had four members, 26.3% had five members and 52.5% six or more total family members. The difference is statistically significant.

Table-3: Percent distribution of respondents according to number of under five children

Number of under five children	Area		p value
	Urban	Rural	
One	19.8%	38.3%	0.011
Two	3.6%	6.7%	
Three	0.9%	1.7%	
More than three	2.7%	3.3%	
None	73.0%	50.0%	

From Table-3 it is found that in urban group, 19.8% had one under five children, 3.6% had two under five children, 0.9% had three under five children and 2.7% had more than three under five children. In rural group, 38.3% had one under five children, 6.7% had two under five children, 1.7% had three under five children and 3.3% had more than three under five children. Again 73.0% and 50% in urban and rural group had no under five children respectively. The difference is statistically significant.

Figure-6: Percent distribution of respondents according to type of family

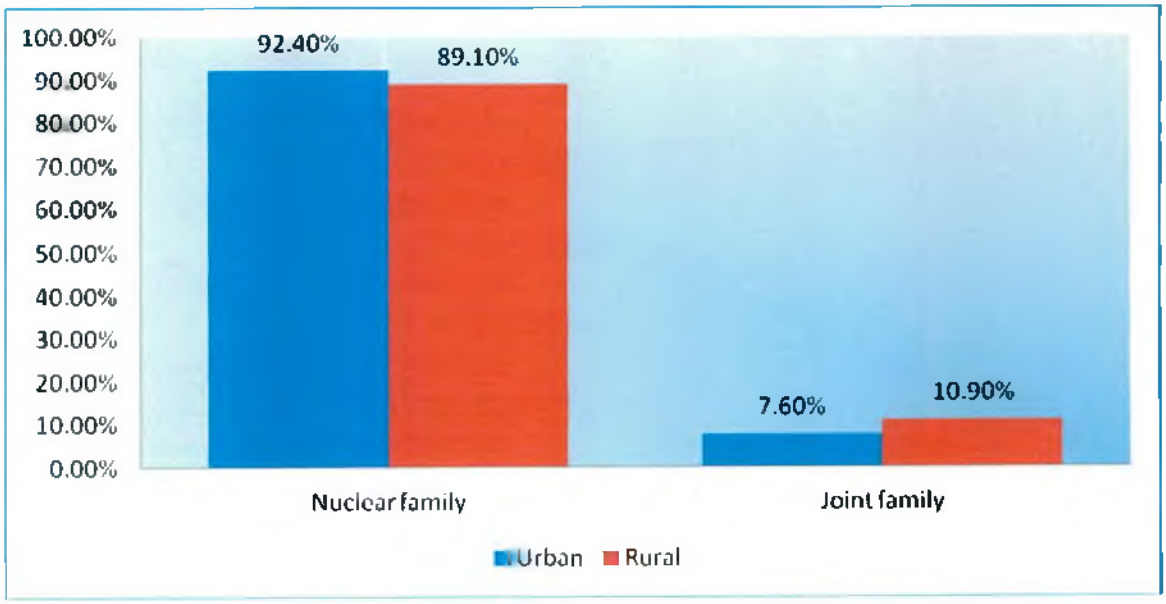


Figure-6 shows the percent distribution of the respondents according to type of family. Almost 90% family in both group were nuclear family.

Figure-7: Percent distribution of respondents according to housing status

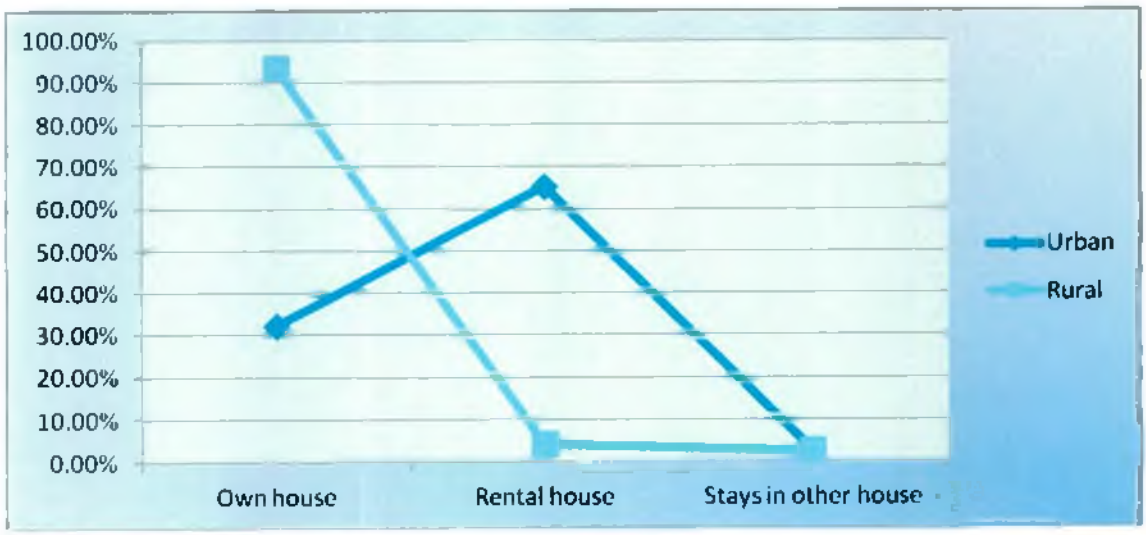
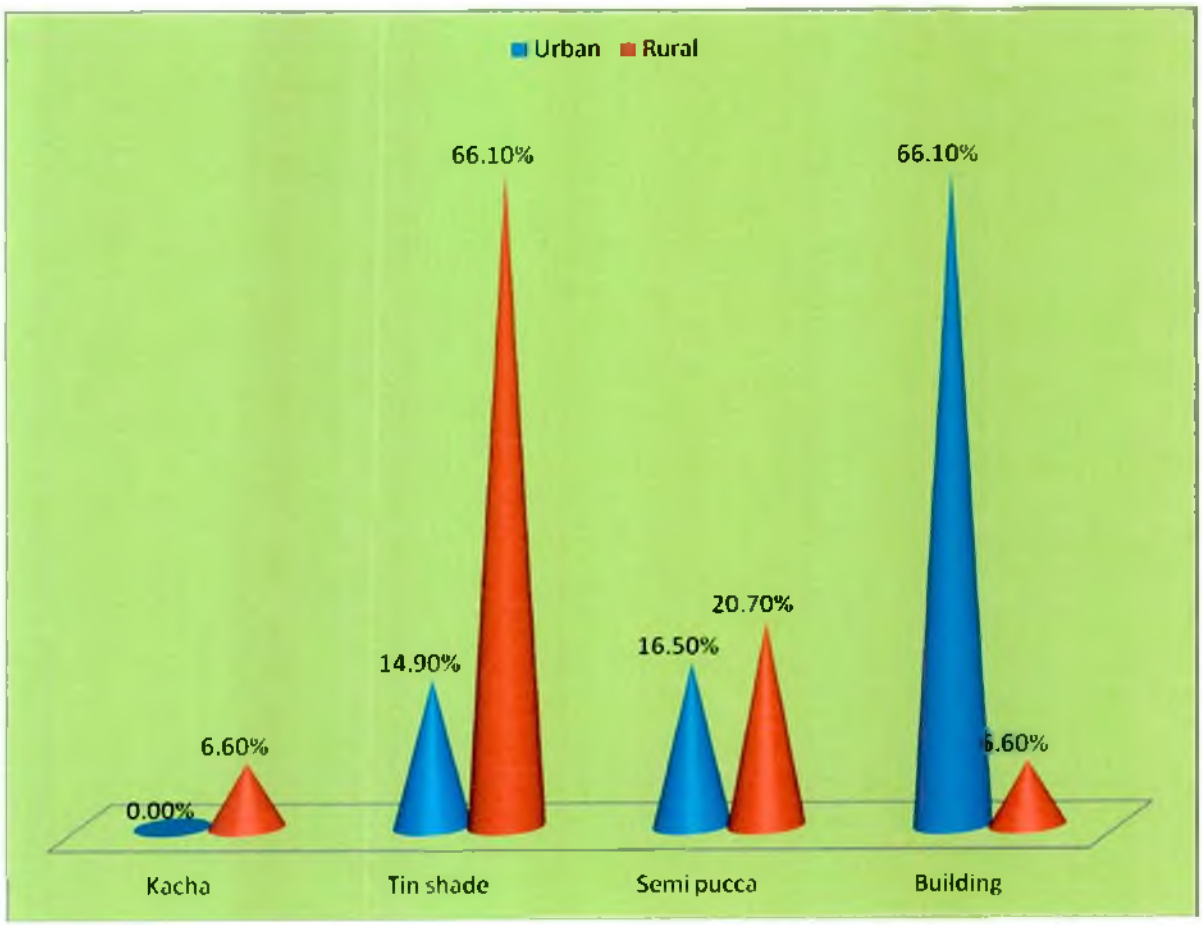


Figure-7 shows the percent distribution of the respondents according to housing status. In urban group, 65.3% respondents lived in rental house. On the other hand in

rural group 93.3% respondents lived in own house. About 32.2% respondents lived in own house in urban group.

Figure-8: Percent distribution of respondents according to type of house



From Figure-8, it is found that 66.1% respondents used to live in building in urban area and 66.1% respondents used to live in tin shade in rural area.

Figure-9: Percent distribution of respondents according to source of drinking water

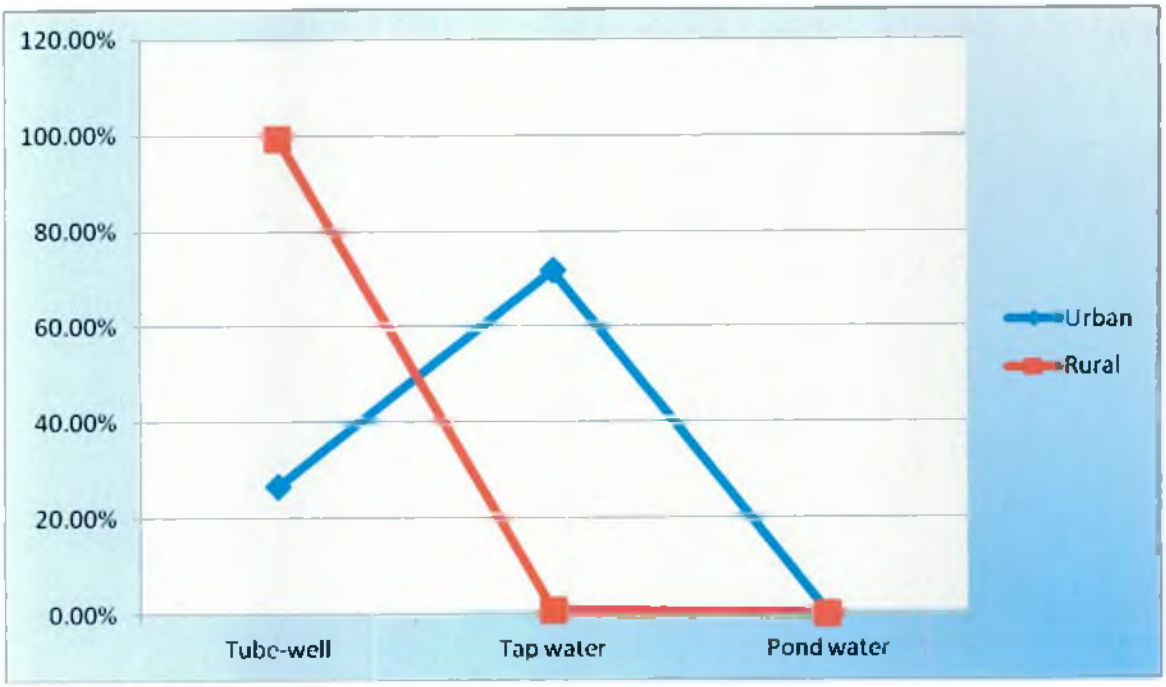


Figure-9 shows the percent distribution of respondents according to source of drinking water. About 26.7% and 99.2% respondent's source of drinking water was Tube-well in urban and rural group respectively. Again 71.7% and 0.8% respondents' source of drinking water was Tap water in urban and rural group respectively. The difference is statistically significant.

Table-4: Percent distribution of respondents according to major source of income of their family

Major source of income	Area	
	Urban	Rural
Business	43.8%	45.0%
Service	52.1%	18.3%
House rent	2.5%	1.7%
Agriculture	1.7%	35%

Table-4 shows the percent distribution of respondents according to major source of income of their family. Major source of income of 43.8%, 52.1%, 2.5% and 1.7% in urban group were Business, Service, House rent and Agriculture respectively. On the other hand major source of income of 45.0%, 18.3%, 1.7% and 35% in rural group were Business, Service, House rent and Agriculture respectively.

Table-5: Percent distribution of respondents according to monthly family food expenditure

Monthly family food expenditure	Area		Pearson Chi-Square
	Urban	Rural	
40 %	16.7%	38.7%	0.002
50 %	46.7%	29.4%	
60 %	17.5%	18.5%	
Above 60 %	18.3%	13.4%	

As revealed in Table-5, for almost half (46.7%) of the family in urban group, the average monthly family food expenditure was 50% of total family income while for 29.4% of the family in rural group the average monthly family food expenditure was 50% of total family income.

Table-6: Percent distribution of respondents according to number of school going children

Number of school going children	**Area**	
	Urban	**Rural**
One	26.0%	16.7%
Two	37.5%	35.0%
Three	24.2%	27.5%
More than three	11.7%	20.8%

Table-6 shows the percent distribution of respondents according to number of school going children. Some 26.0%, 37.5%, 24.2% and 11.7% had one, two, three and more than three school going children respectively in urban group. On the other hand 16.7%, 35.0%, 27.5% and 20.8% had one, two, three and more than three school going children respectively in rural group.

Table-7: Percent distribution of respondents according to food preference

Food preference	Area	
	Urban	Rural
Continental	6.6%	0%
Snacks	66.1%	0%
Home-made	26.4%	100%

Table-7 shows the percent distribution of respondents according to food preference. Almost everyone in rural group and 26.1% in urban group preferred homemade food. Again 66.1% in urban group preferred snacks.

Table-8: Percent distribution of respondents according to factor considered important while preferring the food

Cause of food preference	Respondents (%)	
	Urban	Rural
Food availability	2.5	12.4
Price	0.8	9.9
Nutritional value	7.5	38.8
Taste	89.2	38.8

As presented in Table-8, it is evident that 89.2% in urban group and 38.8% in rural group considered taste while preferring food.

Table-9: Percent distribution of respondents according to nutritional knowledge question

Questions	Response	Respondents (%)		P value
		Urban	Rural	
How can you make a balances diet?	Correct	53.9	60.6	0.331
	Wrong	46.1	39.4	
Fast food & snacks are beneficial for health?	Correct	85.0	32.2	0.122
	Wrong	15.0	67.8	
Most common nutritional deficiency disease	Correct	96.7	100	0.314
	Wrong	3.3	0	

Table-9 shows the percent distribution of respondents according to nutritional knowledge question. Situation is almost same in urban and rural group except for response to the question- "Fast food and snacks are beneficial for health?", to which 15% in urban group and 67.8% in rural group gave wrong answer.

Table-10: Percent distribution of respondents according to the source of nutritional knowledge

Source of nutritional knowledge	Respondents (%)	
	Urban	Rural
TV, radio & news paper	15.1	0
N.G.O. workers	3.8	0
Own study	79.2	95.9
All	1.9	4.1

Table-10 shows the percent distribution of respondents according to the source of nutritional knowledge. The main source of nutritional knowledge was own study in both urban and rural groups.

Table-11: Percent distribution of respondents according to hygiene related question

Questions	Response	Respondents (%)	
		Urban	Rural
Ideal source of defecation	Correct	98.3	90.9
	Wrong	1.7	9.1
Ideal place to dispose garbage	Correct	100	36.4
	Wrong	0	63.6
Ideal way to wash hands	Correct	99.2	100
	Wrong	0.8	0

Table-11 shows the percent distribution of respondents according to hygiene related question. Almost everyone gave the correct answer in both urban and rural groups.

Figure-10: Distribution of the respondents according to consumption of green leafy vegetables

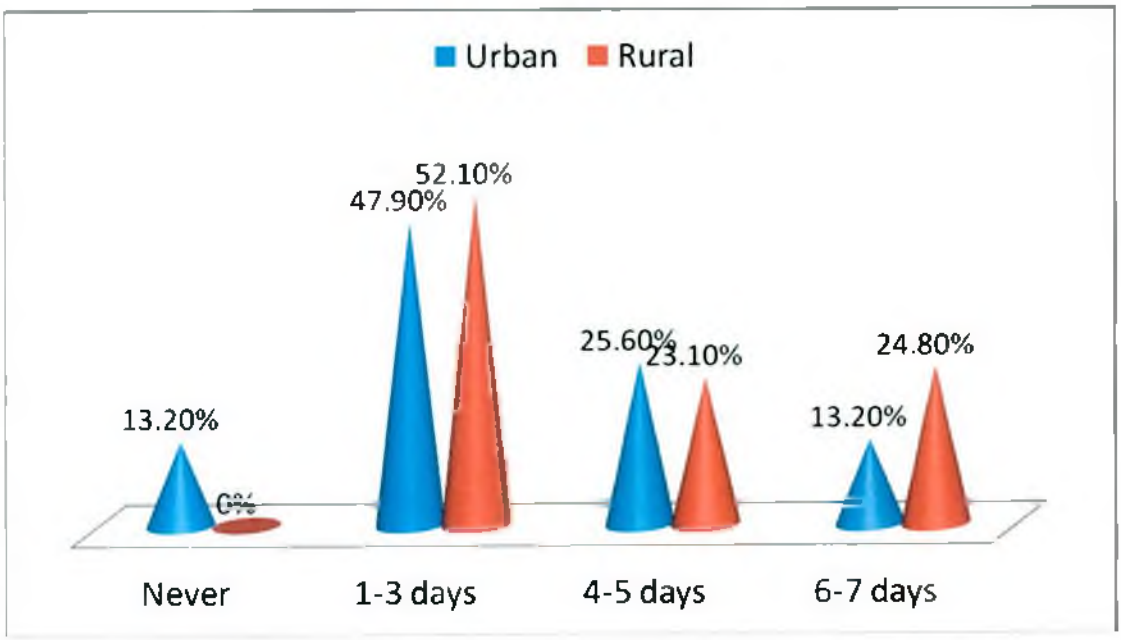


Figure-10, presents consumption pattern of green leafy vegetables. Some 47.9% and 13.2% respondents in urban area consumed green leafy vegetables 1-3 days weekly and daily respectively. On the other hand 52.1% and 24.8% respondents in rural area consumed green leafy vegetables 1-3 days weekly and daily respectively.

Figure-11: Percent distribution of the respondents according to consumption of yellow vegetables

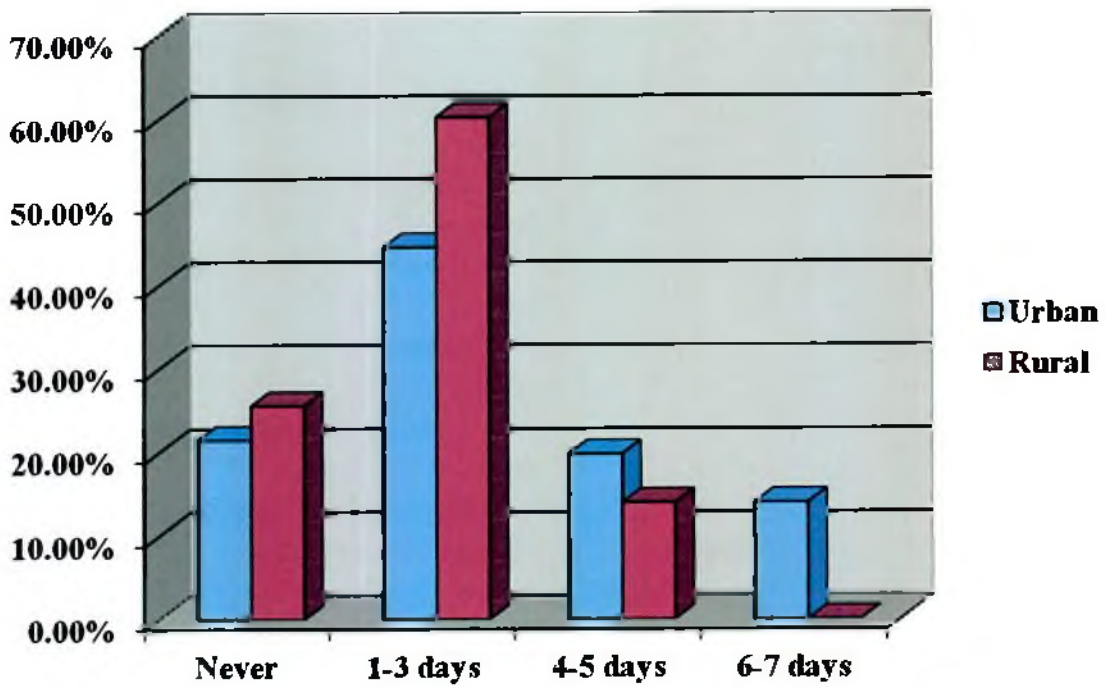
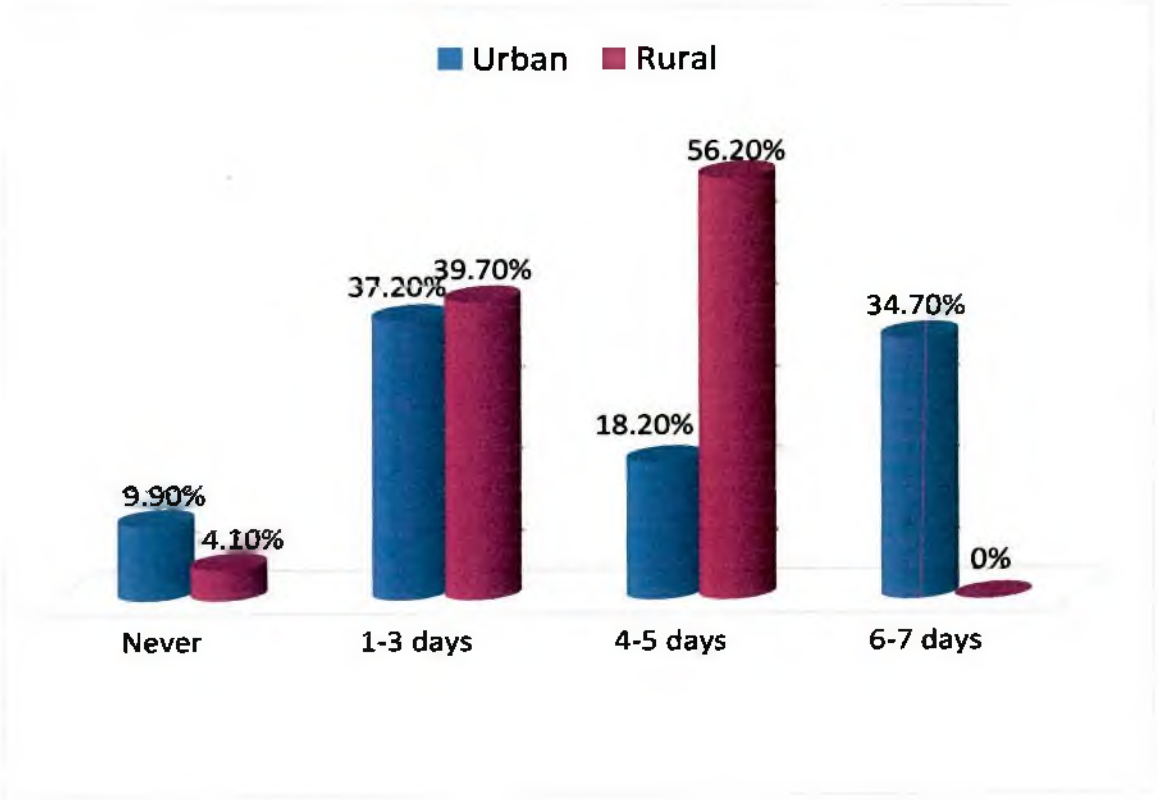


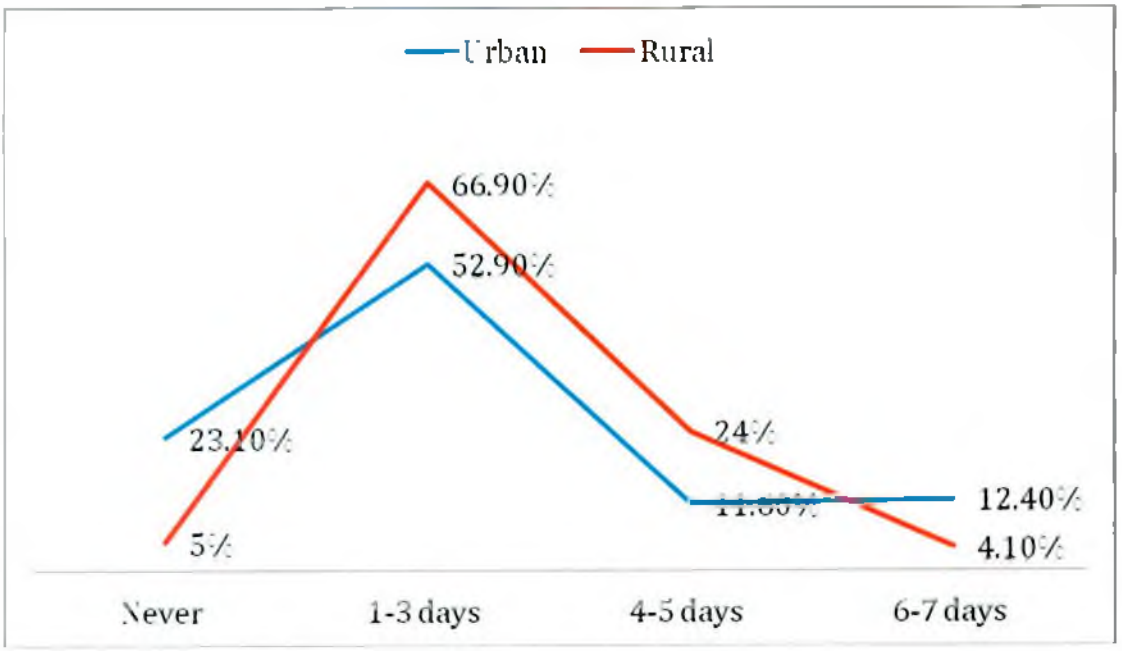
Figure-11 presents consumption pattern of yellow vegetables. Some 44.6% and 14.0% respondents in urban area consumed yellow vegetables 1-3 days weekly and daily respectively. On the other hand, 60.3% and 0% respondents in rural area consumed yellow vegetables 1-3 days weekly and daily respectively.

Figure-12: Percent distribution of the respondents according to consumption of non leafy vegetables



Figurer-12 presents consumption pattern of non leafy vegetables. Some 37.2% urban and 39.7% rural respondents consumed non leafy vegetables 1-3 days weekly.

Figure-13: Distribution of the respondents according to consumption of citrus fruits



The consumption pattern of citrus fruits is presented in Figure-13. It has been found that 52.9% respondents ate citrus fruits 1-3 days in a week and 23.1% respondents never ate citrus fruits in urban area. On the other hand, 66.9%respondents ate citrus fruits 1-3 days in a week and only 5% respondents never ate citrus fruits in rural area.

Figure-14: Distribution of the respondents according to consumption of milk

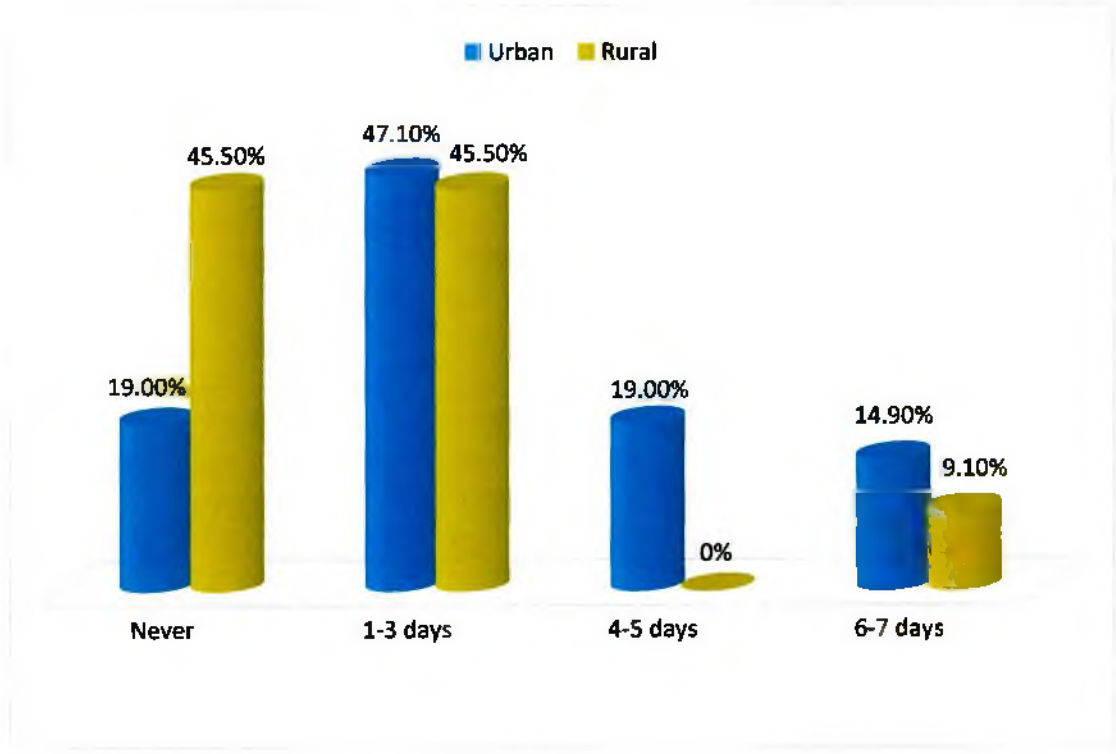


Figure-14 shows the consumption pattern of milk and milk products. About 14.9% respondents in urban area and 9.1% respondents in rural area consumed milk and milk products daily.

Table-12: Mean and standard deviation of the respondents weight and height

Area	Age		Weight (kg)	Height (cm)
Urban	≤13 yrs	Mean	41.85	148.11
		Std. Deviation	10.44	6.41
	14-15 yrs	Mean	45.44	152.53
		Std. Deviation	7.63	5.10
	>15 yrs	Mean	49.64	153.46
		Std. Deviation	11.11	5.61
Rural	≤13 yrs	Mean	40.38	148.11
		Std. Deviation	5.14	5.79
	14-15 yrs	Mean	44.33	150.92
		Std. Deviation	5.56	5.10
	>15 yrs	Mean	47.50	142.85
		Std. Deviation	15.11	6.88

Table-12 shows the mean and standard deviations of the height and weight of the respondents. The mean weight in kg of the respondents was 41.85, 45.44 and 49.64 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively in urban area. On the other hand, the mean weight in kg of the respondents in rural area was 40.38, 44.33 and 47.50 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively. In total, the mean weight in kg of the respondents was 44.87 and 41.95 in urban and rural group respectively. The mean height in cm of the respondents was 148.11, 152.53 and 153.46 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively in urban area. On the other hand, the mean height in cm of the respondents in rural area was 148.11, 150.92 and 142.85 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively. In total, the mean height in cm of the respondents was 151.06 and 148.89 in urban and rural group respectively. The mean weight and height were greater in urban group.

Table-13: Distribution of respondents according to nutritional status by BMI

Respondent	Age	Nutritional status by BMI (kg/m^2)					p value
		Severe CED <16	Moderate CED 16-<17	Mild CED 17-<18.5	Normal 18.5-24.99	Overweight & obese ≥25	
Urban	≤13 yrs (n=45)	22.2% (10)	8.9% (4)	22.2% (10)	42.2% (19)	4.4% (2)	0.019
	14-15 yrs (n=54)	11.1% (6)	7.4% (4)	24.1% (13)	50.0% (27)	7.4% (4)	
	>15 yrs (n=22)	4.5% (1)	9.1% (2)	9.1% (2)	59.1% (13)	18.2% (4)	
Rural	≤13 yrs (n=76)	10.5% (8)	14.5% (11)	30.3% (23)	44.7% (34)	0% (0)	
	14-15 yrs (n=41)	2.4% (1)	4.9% (2)	26.8% (11)	65.9% (27)	0% (0)	
	>15 yrs (n=4)	0% (0)	0% (0)	0% (0)	75.0% (3)	25.0% (1)	

Table-13 shows nutritional status of urban and rural respondents by BMI in different age groups. It presents that moderate and mild chronic energy deficiency were 8.3% and 20.7% respectively among total respondents of urban group; on the other hand, the values were 10.7% and 28.1% respectively among total respondents of rural group. Severe chronic energy deficiency was 17% in total respondent of urban group and 9% in total respondent of rural group. Again overweight and obese was 8.3% in total respondent of urban group and 0.8% in total respondent of rural group. The difference was significant (p = 0.019).

Figure-15: Distribution of the respondents according to nutritional status by BMI

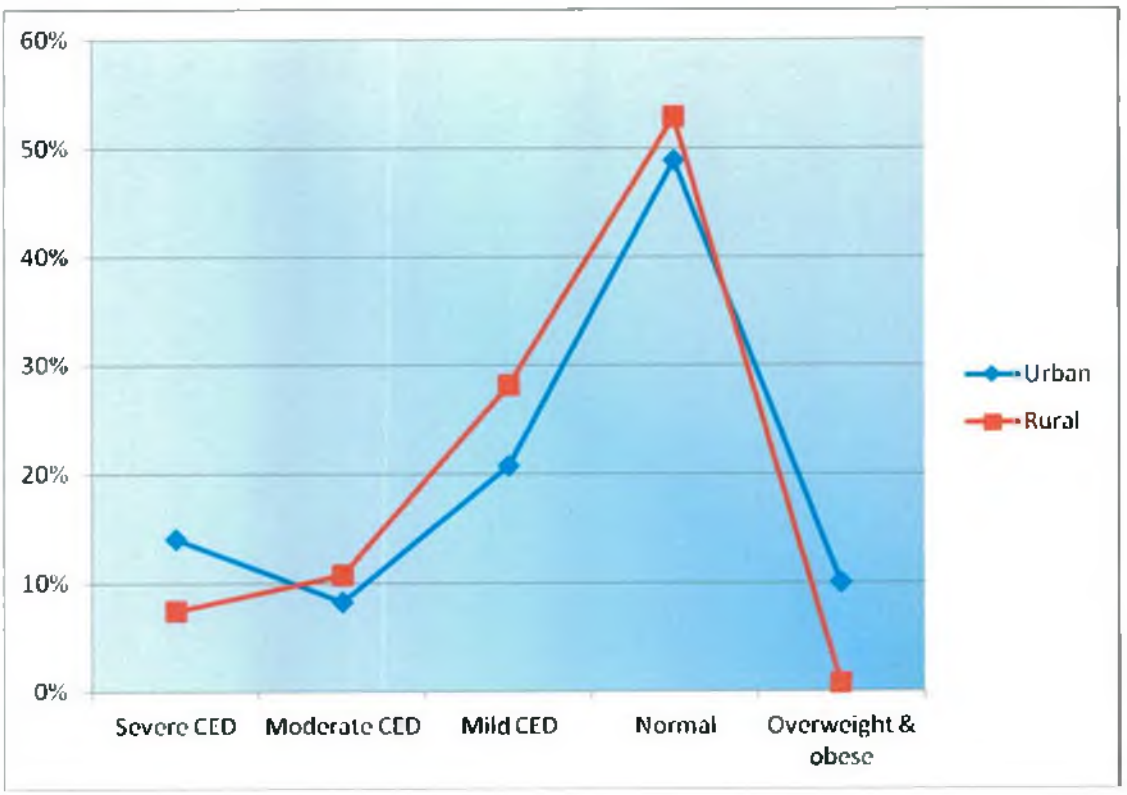


Figure-15 shows nutritional status of urban and rural respondents by BMI. It presents that moderate and mild chronic energy deficiency was higher among rural group but severe chronic energy deficiency was higher among urban group. Overweight and obese was higher among urban group.

Table-14: Mean hemoglobin level of the respondent according to age and area

Age (years)	Type of Respondent	Hemoglobin level	
		Mean	Std. Deviation
10-12	Urban	11.6	0.5
	Rural	11.4	0.3
13-15	Urban	12.0	0.6
	Rural	11.6	0.4
16-17	Urban	11.9	0.5
	Rural	11.1	0.1

Table-14 shows the mean hemoglobin level according to age and area. It is evident that for age group 10-12 years mean hemoglobin level was 11.6 g/dl and 11.4 g/dl in urban and rural area respectively, while for age group 13-15 years mean hemoglobin level was 12.0 g/dl and 11.6 g/dl in urban and rural area respectively. Again for age group 16-17 years hemoglobin level was 11.9 g/dl and 11.1 g/dl in urban and rural area respectively.

Table-15: Prevalence of anemia according to age and area

Age (years)	Hemoglobin status (g/dl)		Area	
			Urban	Rural
10-12	Anemic (<12)	Count	14	12
		Percent	63.6%	40.0%
	Normal (≥12)	Count	8	18
		Percent	36.4%	60.0%
13-15	Anemic (<12)	Count	41	31
		Percent	52.6%	35.6%
	Normal (≥12)	Count	37	56
		Percent	47.4%	64.4%
16-17	Anemic (<12)	Count	10	3
		Percent	47.6%	75.0%
	Normal (≥12)	Count	11	1
		Percent	52.4%	25.0%

As revealed in Table-15, among age group 10-12 and 13-15 years, prevalence of anemia was higher is urban areas, while among age group 16-17 years the prevalence was higher in rural areas.

Table-16: Mean and standard deviation of the respondents food groups intake by area

Food Groups (gm)	Area				p value
	Urban		Rural		
	Mean	Std.	Mean	Std.	
Cereal	208	52	241	43	**0.000**
Roots & Tubers	100	51	58	29	**0.000**
Sugar	3	6	0	2	**0.000**
Pulse & nut	6	7	3	3	**0.000**
Vegetables	15	23	27	32	**0.001**
Fruits	32	71	41	68	0.281
Meats	50	50	24	62	**0.000**
Eggs	32	41	38	47	0.268
Fish	50	60	98	61	**0.000**
Milk product	25	37	41	53	**0.007**
Fats & oils	39	11	42	10	**0.024**

Table-16 presents that there was a significant difference in intake of different food groups between urban and rural groups. There was no significant difference in their fruits and egg intake.

Table-17: Mean and standard deviation of the respondents macro nutrient intake by age and area

Age (year)	Area		Energy (k cal)	Requirement*	Protein (g)	Requirement*	Fat (g)	Requirement*
10-12	Urban	Mean	1567	1775	57	42.7	14	22
		Std.	436		14		7	
	Rural	Mean	1705		46		19	
		Std.	371		28		8	
13-15	Urban	Mean	1457	1848	47	42.7	15	22
		Std.	422		15		10	
	Rural	Mean	1585		46		16	
		Std.	386		21		9	
16-17	Urban	Mean	1614	1855	59	46.1	15	22
		Std.	310		18		4	
	Rural	Mean	1731		58		21	
		Std.	179		13		7	

*Jahan K and Hossain M: Bangladesh National Nutrition Survey, 1995-96, P. 55-59.

Table-17 shows the respondents' mean macro nutrient intake by age and area. It presents that energy and fat intake was below than requirement for both urban and rural groups, but in case of protein both groups fulfilled their requirement. Energy intake was higher among rural group but protein intake was higher among urban group. Mean energy intake was 1504 k cal among urban group and 1619 k cal among rural group. In total, mean energy intake was 1562 k cal. Mean protein intake was 50g among urban group and 48g among rural group. In total mean protein intake was 49g.

Table-18: Mean and standard deviation of the respondents vitamin intake by age and area

Age	Area		Vit.A (IU)	Requirement*	Niacin (mg)	Requirement*	Vit.C (mg)	Requirement*
10-12	Urban	Mean	1918	2000	14	12.0	54	50
		Std.	1667		4		44	
	Rural	Mean	3192		13		43	
		Std.	866		6		30	
13-15	Urban	Mean	1944	2000	12	12.3	47	50
		Std.	1444		4		39	
	Rural	Mean	1115		12		40	
		Std.	1001		5		31	
16-17	Urban	Mean	1899	2000	17	12.2	50	50
		Std.	1638		5		41	
	Rural	Mean	1693		13		24	
		Std.	1469		7		8	

*Jahan K and Hossain M: Bangladesh National Nutrition Survey, 1995-96, P. 55-59.

Table-180 shows the mean intake of vitamins by the respondents. It is evident that Vit-C intake was comparatively lower among rural group. In case of niacin, both group fulfilled their requirement. Vitamin-A intake was slightly lower than requirement for both urban and rural groups.

Table-19: Mean and standard deviation of the respondents Calcium and Iron intake by age and area

Age (year)	Area		Ca (mg)	Requirement*	Iron (mg)	Requirement*
10-12	Urban	Mean	343	650	9	32
		Std.	266		4	
	Rural	Mean	620		8	
		Std.	400		3	
13-15	Urban	Mean	391	650	9	32
		Std.	320		4	
	Rural	Mean	396		6	
		Std.	279		3	
16-17	Urban	Mean	463	550	8	25
		Std.	187		4	
	Rural	Mean	590		6	
		Std.	243		1	

*Jahan K and Hossain M: Bangladesh National Nutrition Survey, 1995-96, P. 55-59.

Table-19 presents the respondents' mean intake of calcium and iron by age and area. For both groups, calcium and iron intake was lower than requirement. In total calcium intake was 394 mg for urban group and 458 mg for rural group. Again mean iron intake was 9 mg for urban and 7 mg for rural group.

Table-20: Mean and standard deviation of the respondents nutrient intake from fish by age and area

Intake	Urban		Rural	
	Mean	Std. Deviation	Mean	Std. Deviation
Fish (g)	49.6	61.3	93.1	60.0
Energy (Kcal)	77.3	99.0	126.3	67.7
Protein (g)	9.1	10.4	17.7	11.5
Fat (g)	3.8	6.0	5.0	4.1
Carbohydrate (g)	1.6	2.6	2.5	1.9
Calcium (mg)	264.2	278.4	394.5	370.5
Iron(mg)	0.7	0.8	1.0	0.5
Vit-A (IU)	9.1	16.3	9.0	15.1
Niacine (mg)	0.6	0.7	0.9	0.6
Vit-C (mg)	10.5	18.0	9.4	8.3
Zinc(mg)	1.0	1.1	1.6	0.7

Table-20 shows the respondents nutrient intake from fish by age and area. Mean fish protein intake was 9.1 g in urban area and 17.7 g in rural area. Again fat intake from fish was 3.8 g in urban area and 5.0 g in rural area. Mean calcium intake from fish was 264.2 mg in urban and 394.5 mg in rural area.

Table-21: Percent distribution of the respondents according to frequency of marine fish consumption

Frequency of consumption	Area		p value
	Urban	Rural	
Never	28.1%	54.5%	
1-3 days	62.0%	29.8%	0.000
4-5 days	5.8%	14.0%	
6-7days	4.1%	1.7%	

Table-21 shows that 4.1% of urban and 1.7% of rural adolescent girls consumed marine fish daily. Again 28.1% among urban and 54.5% among rural adolescent girls never consumed marine fish. It is to be noted that the consumption of marine fish was low for both urban and rural subjects.

Table-22: Percent distribution of the respondents according to frequency of riverine (big) fish consumption

Frequency of consumption	Area		p value
	Urban	Rural	
Never	8.3%	19.0%	0.000
1-3 days	58.7%	37.2%	
4-5 days	14.9%	32.2%	
6-7 days	18.2%	11.6%	

As is revealed in Table-22, the frequency of big fish consumption was higher among the urban respondents. The difference was highly significant (p=0.000).

Table-23: Percent distribution of the respondents according to frequency of riverine (small) fish consumption

Frequency of consumption	Area		p value
	Urban	Rural	
Never	14.9%	14.0%	0.028
1-3 days	58.7%	47.9%	
4-5 days	20.7%	19.8%	
6-7 days	5.8%	18.2%	

Table-23 shows that 5.8% of urban and 18.2% of rural respondents consumed small fish daily. Again 14.9% among urban and 14.0% among rural respondents never consumed small fish. But the rural respondents consumed more small fish than urban ones. The difference was significant (p=0.028).

Table-24: Percent distribution of respondents according to the kind of fish consumed

	Name of Fish	Urban	Rural
Marine fish	Pampus chinensis (Rupchanda)	38.7%	33.1%
	Auxis rochei (Surma)	19.3%	0%
	Harpodon nehereus (Loitta)	15.1%	5.8%
	Trichiurus haumela (Churi)	7.6%	9.1%
	Euthynnus affinis (Tuna)	5.0%	0%
	Otolithoides pama (MarinePoa)	10.1%	5.8%
Riverine Fish	Labeo rohita (Rui)	55.5%	45%
	Tenualosa ilisha (Illish)	73.9%	13.2%
	Pangasius pangasius (Pungas)	40.3%	76.0%
	Wallago attu (Boal)	19.3%	0%
	Katla katla (Katla)	28.6%	76.0%
	Cirrhinus cirrhosus (Mrigel)	6.7%	24.0%
	Sperata aor (Ayre)	12.6%	4.1%
	Chitala chitala (Chitol)	14.3%	8.3%
	Hypophthalmichthys molitrix (Silvercarp)	15.1%	52.9%
	Labeo calbasu (KaliBaus)	5.9%	18.2%
	Corica soborna (Kachki)	41.2%	8.3%
	Amblypharyngodon (Mola)	42.0%	32.2%
	Batasio batasio (Tengra)	27.7%	67.8%
	Labeo bata (Bata)	2.5%	14.9%
	Mastacembelus armatus (Bain)	5.0%	28.9%
	Oreochromis mosasambicus (Tilapia)	30.3%	20.7%
	Neotropius atherinoides (Batasi)	3.4%	5.8%
	Gonialosa manmina (Chapila)	9.2%	5.8%
	Ompok pabo (Pabda)	4.2%	0%
	Ailia coila (Kajoli)	5.9%	0%
	Puntius chola (Puti)	33.6%	62.8%
	Chanda nama (Chanda)	7.6%	38.0%
	Channa punctata (Taki)	22.7%	5.8%

Table-24 shows the percent distribution of respondents according to the kind of fish consumed. Among the various marine fishes 38.7% urban respondents consumed *Pampus chinensis* (Rupchanda). For rural respondents this percentage was 33.1. There was no

respondent in rural group, who consumed *Auxis rochei* (Surma) and *Trichiurus haumela* (Tuna), but for urban group those were 19.3% and 5% respectively. In urban area *Tenualosa ilisha* (Illish). consumption was highest (73.9%) among riverine (big) fishes. Next place was occupied by *Labeo rohita* (Rui, 55.5%). On the other hand, in rural area *Pangasius pangasius* (Pungas) and *Katla katla* (Katla) consumptions were high. 76% and 76% respectively. Rural respondents never consumed *Wallago attu* (Boal). *Amblypharyngodon* (Mola 42%) consumption was high in urban group; *Batasio batasio* (Tengra 67.8%) and *Puntius chola* (Puti 62.8%) consumptions were high among riverine (small) fishes in rural group. *Labeo bata* (Bata, 2.5%) and *Neotropius atherinoides* (Batasi, 3.4%) were rarely consumed by urban adolescent girls. *Ompok pabo* (Pabda) and *Apocryptes bato* (Bele) were never consumed by rural adolescent girls.

Table-25: Comparison of nutrient intake between urban and rural respondents

Nutrients	Area				p value
	Urban		Rural		
	Mean	Std	Mean	Std	
Energy (kcal)	1504	410	1619	379	**0.024**
Protein (g)	50	16	48	23	0.481
Ca(mg)	394	292	458	326	0.112
Iron (mg)	9	4	7	3	**0.000**
Vit-A (IU)	1920	1583	2000	1112	0.118

As presented in Table-25, there was found a significant difference in energy intake between urban and rural respondents, the intake being higher for rural ones. There was no significant difference in their intakes of protein, calcium and vitamin A. On the other hand, iron intake was significantly higher for urban respondents as compared to rural ones.

CHAPTER-5

Discussion

Conclusion

Recommendations

5.1 Discussion

Nutrition is a basic need that can be met minimally to prevent death and help optimally achieve maximum genetic potential. The proper nutrition of adolescent girl is also very important because she plays great role in the intergeneration cycle. Different variables influence the nutritional status of adolescent girl which are socioeconomic, dietary and anthropometric variables. The present study has sought to focus on the lifestyle, food intake and nutritional status of urban and rural adolescent girls because in case of third world country like Bangladesh is also yet to go more way to move the intergenerational process in a better position.

In rural area 62.80% respondents and in urban area 37.20% respondents belonged to the age group $\leq$ 13 years. Again 44.60% of urban respondents and 33.90% of rural respondents belong to the age group 14-15 years. Again 18.20% of urban and 3.30% of rural respondents belonged to the age group >15 years. Most of the respondents belonged to class eight.

Main occupations of respondents' father in urban area were business and service. On the other hand main occupation of respondents' father in rural area was farming. About 40.2% fathers in urban group were businessman, 37.6% were service holder and 9.4% fathers were doing small business. Again in rural area 39.3% fathers were farmer, 28.2% fathers were businessman and 3.4% were day labour. The differences of occupations of fathers in urban and rural group were significant. According to the study main occupations of respondents' mother in urban and rural area were service and small business respectively. More than 80% of mothers in urban and rural area were involved in non-payment activities (housewife). Mothers involved in service were 16.1% in urban area and 0% in rural area. About 5.1% fathers of urban and 10.9% fathers of rural respondents were illiterate. Again 29.1% fathers of urban and 64.7% fathers of rural respondents had education level up to class eight. Moreover 18.8% fathers of urban respondents were graduates, while only 5.9% fathers of rural respondents were graduates.

Education level of mothers between urban and rural respondents was significantly different. About 2.5% mothers of urban respondents were illiterate and 10.1% mothers of rural respondents were illiterate. Again 41.2% mothers of urban and 69.7% mothers of rural respondents had education level up to class eight. Furthermore 13.4% mothers of urban respondents were graduate, but only 1.7% mothers were graduate in case of rural ones.

It was found that among urban subjects, 9.9% had total family members of three, 28.9% had four members, 36.4% had five members and 24.8% had six or more total family members. Among rural subjects, 7.6% had total family members of three, 13.6% had four members, 26.3% had five members and 52.5% six or more total family members. The difference was statistically significant.

Again in urban group, 19.8% parents had one under five children, 3.6% had two under five children, 0.9% had three under five children and 2.7% had more than three under five children. In rural group, 38.3% parents had one under five children , 6.7% had two under five children, 1.7% had three under five children and 3.3% had more than three under five children. Again 73.0% and 50% of parents in urban and rural group respectively had no under five children. The difference was statistically significant. Almost 90% family in both group were nuclear family.

In urban group 65.3% respondents lived in rental house. On the other hand in rural group 93.3% respondents lived in own house. About 32.2% respondents lived in own house in urban group. It was found that 66.1% respondents lived in building in urban area and 66.1% respondents lived in tin shade in rural area. About 26.7% and 99.2% respondents' source of drinking water was Tube-well in urban and rural area respectively. Again 71.7% and 0.8% respondents' source of drinking water was Tap water in urban and rural area respectively. The difference was statistically significant.

Major source of income for 43.8%, 52.1%, 2.5% and 1.7% urban respondents were Business, Service, House rent and Agriculture respectively. On the other hand major source of income for 45.0%, 18.3%, 1.7% and 35% rural respondents were Business, Service, House rent and Agriculture respectively. For almost half of the family in urban area the average monthly family food expenditure was 50% of total family income, while for 29.4% of the family in rural area the average monthly family food expenditure was 50% of total family income.

There may be socio-cultural factors or change of lifestyle and food habits of adolescents that can affect both nutrient intake and needs[34]. Almost everyone in rural group and 26.1% in urban group preferred homemade food. Again 66.1% in urban group preferred snacks. It was found that 89.2% in urban group and 38.8% in rural group considered taste while preferring food. Situation is almost same in urban and rural group except for response to the question- "Fast food & snacks are beneficial for health?", to which 15% and 67.8% of respondents gave wrong answer in urban and rural area respectively. The main source of nutritional knowledge was own study in both group. As regards hygiene related question, almost everyone gave the correct answer in both urban and rural areas.

About 47.9% and 13.2% of respondents in urban area consumed green leafy vegetables 1-3 days in a week and daily respectively. On the other hand, 52.1% and 24.8% of respondents in rural area consumed green leafy vegetables 1-3 days in a week and daily respectively. About 44.6% and 14.0% of respondents in urban area consumed yellow vegetables 1-3 days in a week and daily respectively. On the other hand, 60.3% and 0% respondents in rural area consumed yellow vegetables 1-3 days in a week and daily respectively. About 37.2% urban and 39.7% rural respondents consumed non leafy vegetables 1-3 days weekly. In another study in Bangladesh, intake of fish, meat, eggs, milk, legumes and fruits and vegetables were highest in case of boys and main

earning members as compared to female adolescents. Although foods like fish, meat, eggs, milk and some fruits and vegetables were said to be restricted for girls, it was reported by only 5% of the girls[60].

The mean weight in kg of the respondents was 41.85, 45.44 and 49.64 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively in urban area. On the other hand, the mean weight in kg of the respondents in rural area was 40.38, 44.33 and 47.50 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively. In total, the mean weight in kg of the respondents was 44.87 and 41.95 in urban and rural area respectively. The mean height in cm of the respondents was 148.11, 152.53 and 153.46 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively in urban area. On the other hand, the mean height in cm of the respondents in rural area was 148.11, 150.92 and 142.85 among age groups- ≤13 yrs, 14-15 yrs and >15 yrs respectively. In total, the mean height in cm of the respondents was 151.06 and 148.89 for urban and rural group respectively. The mean weight and height is greater for urban respondents as compared to that for rural ones.

Moderate and mild chronic energy deficiency were 8.3% and 20.7% respectively among urban respondents, on the other hand, the values were 10.7% and 28.1% respectively among rural ones. Severe chronic energy deficiency was 17% in urban and 9% in rural subjects. Again overweight and obese was 8.3% in urban and 0.8% in rural group. The difference was significant ($p = .019$). According to various study among four countries of the South-East Asia Region, rural Bangladesh had the highest prevalence of thinness and stunting (67% and 48% respectively) among adolescents. At the same time, the lowest prevalence was observed in school-going girls of urban Bangladesh (16% and 10%). Although stunting was similar in boys and girls, the prevalence of thin boys was more than the girls (75% vs 59%) in rural Bangladesh.[88]

Adolescents, particularly girls, are especially vulnerable to iron deficiency due to low intake and absorption of iron and increased iron requirements for growth and replacement of menstrual blood losses[24]. Anemia can be associated with other nutrient deficiencies (folic acid, vitamin A, B_{12}), as well as with infectious diseases like malaria and intestinal parasitic infestations. For age group 10-12 years, mean hemoglobin level was 11.6 g/dl and 11.4 g/dl respectively in urban and rural area, while for age group 13-15 years, mean hemoglobin level was 12.0 g/dl and 11.6 g/dl respectively in urban and rural area. Again for age group 16-17 years, hemoglobin level was 11.9 g/dl and 11.1 g/dl in urban and rural area respectively. Again among age group 10-12 and 13-15 years, anemia prevalence was higher for urban subject, while among age group 16-17 years, anemia prevalence was higher for rural ones. Iron deficiency anemia is a public health nutrition problem. A national household health survey in 1995 found that the prevalence of anemia among schoolboys and girls was 46.4% and 48.0% respectively. Among 10-14 year age-group the prevalence was 45.8% in boys and 57.1% in girls. A baseline study among adolescent girls in 10 districts in East and Central Java provinces showed the prevalence to be 80.2% and 57.4% respectively. The study also showed a limited awareness of anemia due to scanty information provided in the school curriculum by family and mass media[60].

There was significant differences in intake of different food groups between urban and rural groups. Energy and fat intake was below the requirement for both urban and rural adolescent girls but in case of protein both group fulfilled their requirement. Energy intake was higher among rural subjects while protein intake was higher among urban ones. Mean energy intake was 1504 kcal among urban subjects and 1619 kcal among rural ones. Mean protein intake was 50 g among urban respondents and 48 g among rural ones. But the growing adolescents have increased nutrient requirements during pregnancy and illness [38, 39]. According to a study conducted among adolescent girls in Dhaka city [62], intake of nutrients was found to be much below the RDA.

Animal sources supplied 50% of dietary protein. Milk was the major contributor for riboflavin and preformed vitamin A (retinol). Leafy vegetables and fruits were the main sources of carotene.

The requirement of some of the nutrients is as high as, or higher in adolescents than in any other age groups (WHO, 2000), and therefore many micronutrients, including vitamin A, thiamine, riboflavin, niacin, folic acid, vitamin B_{12}, vitamin C, and iodine, reach levels required by adults. Vit-C intake was comparatively lower among rural subjects. In case of niacin both urban and rural subjects fulfilled their requirement. Vitamin-A intake was slightly lower than requirement for both groups. Calcium and iron intake was lower than requirement. In total, calcium intake was 394 mg for urban and 458 mg for rural subjects. Again mean iron intake was 9 mg for urban and 7 mg for rural subjects. Frequency of big fish consumption was higher among urban group. But as regards small fish, the consumption was higher for rural respondents as compared to that for urban ones. The difference was highly significant. About 5.8% among urban subjects and 18.2% of rural subjects consumed small fish daily. Again 14.9% among urban and 14.0% among rural subjects never consumed small fish. About 4.1% of urban and 1.7% of rural subjects consumed marine fish daily. Again 28.1% among urban and 54.5% among rural subjects never consumed marine fish. It is to be noted that consumption of marine fish was low for both urban and rural respondents. Among the various marine fishes 38.7% urban respondents consumed *Pampus chinensis* (Rupchanda). For rural respondents this percentage was 33.1. There was no respondent in rural group, who consumed *Auxis rochei* (Surma) and *Trichiurus haumela* (Tuna), but for urban group those were 19.3% and 5% respectively. In urban area *Tenualosa ilisha* (Illish). consumption was highest (73.9%) among riverine (big) fishes. Next place was occupied by *Labeo rohita* (Rui, 55.5%). On the other hand, in rural area *Pangasius pangasius* (Pungas) and *Katla katla* (Katla) consumptions were high. 76% and 76% respectively. Rural respondents never consumed *Wallago attu* (Boal). *Amblypharyngodon* (Mola 42%)

consumption was high in urban group; *Batasio batasio* (Tengra 67.8%) and *Puntius chola* (Puti 62.8%) consumptions were high among riverine (small) fishes in rural group. *Labeo bata* (Bata, 2.5%) and *Neotropius atherinoides* (Batasi, 3.4%) were rarely consumed by urban adolescent girls. *Ompok pabo* (Pabda) and *Apocryptes bato* (Bele) were never consumed by rural adolescent girls. There was found no significant difference in protein, calcium and vitamin A intake between urban and rural subjects. Iron intake was significantly higher for urban subjects as compared to rural ones.

5.2 Conclusion

The group of adolescent girls is the significant portion of whole population. But the lack of expected nutritional status of adolescent girls has been identified as one of the major health problem throughout the world specially in third world country like Bangladesh. Malnutrition exacerbates individuals by causing or aggravating illness, lowering educational attainment, and diminishing livelihood skills and options. It is related to adequate food intake and supply, proper care and health practice, hygiene and sanitation and anthropometric status. Adolescent girls of Bangladesh are influenced by these variables and still need to go more way to solve the lack of nutrition and nutrition related problems. Out of this concern and to see the situation of adolescent girls in Bangladesh, a study was conducted in urban and rural area to determine the situation of adolescent girls and compared urban and rural group to establish whether there is any significant differences between two groups.

The study shows that, mothers involved in income activities were higher in urban group than rural group and this difference was significant. Education level of father and mothers significantly different in urban and rural group also. It was found that most of the respondents lived in building in urban area and in tin shade in rural area. According to the study, response to the nutritional knowledge and hygiene related question was almost same among urban and rural group.

Nutritional status of rural group was better than urban group. The mean weight and height was greater in urban group. Nutritional status of the adolescent girls by BMI showed significant difference between urban and rural group. Moderate and mild chronic energy deficiency was higher among rural group but severe chronic energy deficiency was higher among urban group. Overweight and obese was higher among urban group. Anemia percentage was higher among urban group. At age group 10-12 and 13-15 anemia rate was

higher among urban group but at age group 16-17 anemia rate was higher among rural group. Most of the urban respondents preferred snacks and rural respondents preferred homemade food.

Energy and fat intake was below the requirement for both group but in case of protein both group fulfilled their requirement. Energy intake was higher among rural group but protein intake was higher among urban group. Vitamin-C intake was comparatively lower among rural group. In case of niacin both group fulfilled their requirement. Vitamin-A intake was slightly lower than requirement for both group. Iron intake was very low compared to the requirement. For both group calcium intake was lower than requirement. Marine fish intake was relatively lower among both groups. Frequency of big fish consumption was higher among urban group and small fish consumption was higher among rural group. Among the various marine fishes urban respondents mainly consumed Rupchanda, Surma and Tuna fishes. There was no respondent in rural area who consumed Surma and Tuna fishes. In urban area Illish and Rui consumptions were high among riverine (big) fishes. But rural ones, these places were occupied by Pungas and Katla. Rural adolescent girls never consumed Boal, Pabda and Bele fishes. Urban respondents consumed Mola while rural respondents consumed Tengra and Puti mainly among riverine (small) fishes. Bata and Batasi were rarely consumed by urban adolescent girls.

Though socio-economic status, food security and food intake were better in urban group than rural ones, the outcomes of these factors were not significant. So it can be said that there must had been other factors which were affecting both urban and rural adolescent girls in their anthropometric status.

5.3 Recommendations

Adolescents are an in between group, with some nutrition problem commonalities with children and some with adults. In Bangladesh, almost one-fourth of the total population consists of adolescents. Some achievement occurred in the group of adolescent girls as a result of National Nutrition Programme. But this achievement is not up to the satisfactory level. After observing, assessing and comparing the situation of the adolescent girls of urban and rural area, the following recommendations and suggestions may be considered from the priority basis-

- Nutrition education should be disseminated among adolescent girls. Behavior change communication in terms of nutritional awareness, food consumption, hygiene and sanitation need to strengthen to improve the nutritional status of adolescents.
- Balanced food should be taken. Protective food items must be eaten every day in proper amount. Emphasis should be given on fresh foods and vegetables intake.
- Some adolescents were seen not to take iron tablet. This habit should be changed by increasing their knowledge. The should eat more iron rich foods and consult with the physician if needed.
- Severely malnourished adolescent girls should be identified as early as possible and they should be brought under supplementary feeding programme.
- Overweight and obesity should be given attention specially in urban area.
- Marine fish intake should be increased. As marine fish is not available in the rural area, so attempt should be taken to make marine fishes available to them by government and private efforts.

CHAPTER-6

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CHAPTER-7

Annexure

7.1 Annexure

7.1.1 Operational Definitions

Anemia : The condition of having less than the normal number of red blood cells or less than the normal quantity of hemoglobin in the blood. The oxygen-carrying capacity of the blood is, therefore, decreased.

ANOVA : Analysis of variance is the separation of the variance ascribable to one group of causes from the variance ascribable to other groups.

Anthoropometry : This is the technique that deals with the measurement of the size, weight and proportions of the human body. The anthropometric measurements taken in this study are height or length and weight.

Biochemical Assessment : It refers to measurement of a nutrient in biological fluids or tissues, measurement of the urinary excretion rate of the mutrient and measuring the production of an abnormal metabolite or changes in the activities of certain enzymes or blood components dependent on a nutrient. In the study, hemoglobin level was measured from blood collected from study population.

Bivariate analysis : It refers to testing hypothesis of "association" and causality. In its simplest form, association simply refers to the extent to which it become easier to know or predict a value for the Dependent variable if we know a case's value on the independent variable. A measure of association helps us to understand this relationship. these measures of association relate to how well an independent variable relates to the dependent variable.

BMI : It is used to measure thinness or obesity. It is defined as weight in Kilograms divided by height in meters square (kg/m^2)

Chi-square test (x^2 test) : It is any statistical hypothesis test in which the sampling distribution of the test statistic is a chi-square distribution when the null hypothesis is true, or any in which this is asymptotically true, meaning that the sampling distribution (if the null hypothesis is true) can be made to

approximate a chi-square distribution as closely as desired by making the sample size large enough.

Food Frequency : This is a special method to determine the evaluation of the diet and is conducted by a written food check-list to know the daily, weekly or monthly usual food intake pattern of an individual.

Frequency Distribution : The most important form of tabulation from a statistical point of view is what is called a frequency distribution. In this process raw data are grouped into classes or groups of appropriate sizes and the number of observations belonging to each class are recorded. The width of a class is called the class interval and the number of observations in a particular class is called class frequency or simply frequency. When a set of data is arranged in this way it is called a frequency distribution.

Height-for-age : It measures linear growth. A child who is below two standard deviations (-2SD) from the median of the WHO reference population in terms of height-for-age is considered short for his/her age, or stunted. This condition reflects the cumulative effect of chronic malnutrition. If a child is below minus three standard deviations (- SD) from the reference median, then he/she is considered to be severely stunted. Stunting reflects a failure to receive adequate nutrition over a long period of time and is worsened by recurrent and chronic illness. Height-for-age, therefore, reflects the long-term effects of malnutrition in a population and does not vary appreciably according to recent dietary intake.

Mild CED : It refers to BMI seventeen to less than eighteen point five.

Moderate CED : It refers to BMI sixteen to less than seventeen.

Nutrition : It is a dynamic process concerning with ingestion, digestion, absorption and assimilation (metabolism) of food substances by which growth, repair and maintenance of activities in the body as well as a whole or in any of its parts are accomplished.

Nutritional Status : The condition of the body resulting from the utilization of the essential nutrients available to the body is termed as nutritional status.

Obese : It refers to BMI greater or equal to twenty five.

Overweight : It refers to BMI greater or equal to twenty five.

Pearson's chi-square test : It is also known as the chi-square goodness-of-fit test or chi-square test for independence. When mentioned without any modifiers or without other precluding context, this test is usually understood (for an exact test used in place of x^2.

Severe CED : It refers to BMI less than sixteen.

Standard Deviation : The variance of a set of data is defined as the square of the standard deviation.

Stunting : It is defined as Height-for-age below minus two standard deviations from the median Height-for-age of the standard reference population. Linear growth is a more stable indicator of nutritional status and stunting indicates reduced linear growth compared to the expected growth in a child of same age. Stunting is usually the end result of chronic and less severe inadequate nutrition.

Twenty-four Hour Recall Method : This is a method to recall the subject's exact food intake during the previous twenty-four hour period or preceding day. Detailed descriptions of all foods and beverages consumed, including cooking methods. Vitamin and mineral supplement use is also noted. Quantities of foods consumed are usually estimated in household measures.

Underweight: It means a deficit in body weight compared to the expected weight for the same age, which may result either from a failure in growth or loss of body weight due to infections. It is a composite form of under nutrition that includes elements of stunting and wasting and is defined as weight-for-age

below minus two standard deviations from the median weight-for-age of the standard reference population.

Weight-for-age : A child can be underweight for his age because he/she is stunted, because he/she is wasted, or both. Children whose weight-for-age is below two standard deviations (-2SD) from the median of the reference population are classfied as underweight. Children whose weight-for-age is below three standard deviations (-3 SD) from the median of the reference population are considered severely underweight.

7.1.2 Questionnaire

Institute of Nutrition and Food Science
University of Dhaka

A comparative nutritional status and food intake pattern of adolescent girls with emphasis on fish intake (marine & riverine) between selected urban & rural locations

Serial No. [ ][ ][ ]

Date of interview [ ][ ][ ]

Type of respondent	Urban 1	Rural 2

A) General Information :

1. Name.....
2. Age.....
3. Name of school/ College .....
4. Class.....
5. Father's Name.....
6. Father's Occupation

   1. Rickshaw puller / Van driver [ ]
   2. Small business [ ] 3. Daily labour [ ]
   4. Motor car driver [ ] 5. Service [ ]

6. Business ☐ 7. Others (specify.....)

7. Father's education

1. Illiterate ☐ 2. Can sign only name ☐
3. Can read and write ☐ 4. Class I-V ☐
5. Class VI-VIII ☐ 6. Class IX-SSC ☐
7. HSC ☐ 8. Graduate ☐
9. Post graduate ☐ 10. Others (Specify.....)

8. Mother's name.....

9. Mother's Occupation

1. Housewife ☐ 2. Industry worker ☐
3. Day labour ☐ 4. Service ☐
5. Business ☐ 6. Others (Specify.....)

10. Mother's Education

1. Illiterate ☐ 2. Can sign only name ☐
3. Can read and write ☐ 4. Class I-V ☐
5. Class VI-VIII ☐ 6. Class IX-SSC ☐
7. HSC ☐ 8. Graduate ☐
9. Post graduate ☐ 10. Others (Specify.....)

11. Religion

1. Muslim ☐ 2. Hindu ☐
3. Christian ☐ 4. Buddhist ☐

B) Socio-economic Information :

1. How many members are there in your family?

1. 3 ☐ 2. 4 ☐
3. 5 ☐ 4. More than 5 ☐

2. How many members are below 5 years?

1. 1 ☐ 2. 2 ☐

3. 3 ☐ 4. More than 3 ☐

3. What type of your family is?

1. Nuclear family ☐ 2. Joint family ☐

4. How many earning members are there in your family?

1. 1 ☐ 2. 2 ☐

3. 3 ☐ 4. More than 3 ☐

5. a. What is your monthly family income?

1. Upto Tk. 10000 ☐ 2. Tk. 10001- Tk. 15000 ☐

3. Tk. 15001-Tk. 20000 ☐

4. Tk. > 20000 ☐ 5. .....

(Applicable for urban respondent)

5. b. What is your monthly family income?

1. Upto Tk. 3000 ☐ 2. Tk. 3001- Tk. 6000 ☐

3. Tk. 6001-Tk. 9000 ☐

4. Tk. > 9000 ☐ 5. .....

(Applicable for rural respondent)

6. Where do you live in?

1. Own house ☐ 2. Rental house ☐

3. Stays in other's land / house ☐

7. Type of house :

1. Kacha ☐ 2. Tin shade ☐

3. Semi Pucca ☐ 4. Building ☐

8. Source of drinking water:

1. Tube-well ☐ 2. Tap water ☐

3. Pond water ☐ 4. Others (Specify.....)

9. What is the major source of income of your family?

1. Business ☐ 2. Service ☐

3. House rent ☐ 4. Others (Specify.....)

10. What is the percentage of monthly family food expenditure out of your monthly income?

1. 40% ☐ 2. 50% ☐

3. 60% ☐ 4. Above 60% ☐

5. .....

11. How many school going children are there in your family?

1. 1 ☐ 2. 2 ☐

3. 3 ☐ 4. More than 3 ☐

12. a. What is your educational expenditure in a month?

1. Upto Tk. 2000 ☐ 2. Tk. 2001- Tk. 3000 ☐

3. Tk. 3001-Tk. 4000 ☐ 4. Above Tk. 4000 ☐

(Applicable for urban respondent)

12. b. What is your educational expenditure in a month?

1. Upto Tk. 500 ☐ 2. Tk. 501- Tk. 1000 ☐

3. Tk. 1001-Tk. 1500 ☐ 4. Above Tk. 1500 ☐

(Applicable for rural respondent)

13. a. What is your monthly medical expenditure?

1. Upto Tk. 1000 ☐ 2. Tk. 1001- Tk. 1500 ☐

3. Tk. 1501-Tk. 2000 ☐ 4. Above Tk. 2000 ☐

(Applicable for urban respondent)

13. b. What is your monthly medical expenditure?

1. Upto Tk. 300 ☐ 2. Tk. 301- Tk. 600 ☐

3. Tk. 601-Tk. 900 ☐ 4. Above Tk. 900 ☐

(Applicable for rural respondent)

C) Anthropometric Measurement:

1. Body mass index (BMI) :

Weight (Kg)	Height (m)	BMI (kg/m^2)

D) Biochemical Indicator:

1. Level of Haemoglobin.....g/dl

E) Food intake pattern and nutritional aspects of the adolescents:

1. What type of food do you prefer most?

   1. Continental ☐ 2. Snacks ☐

   3. Homemade ☐ 4. Others (Specify.....)

2. What factor do you consider important while preferring the food?

   1. Food availability ☐ 2. Price ☐

   3. Nutritional value ☐ 4. Taste ☐

   5. Others (Specify.....)

3. Do you know, what is nutrition?

   1. Yes ☐ 2. No ☐

   3. A little bit ☐

   If yes, or a little bit, then tell me how can you make a balanced diet?

   a. Cereal, vegetables, fish / meat and fruit

   b. Cereal, vegetables and fruit

   c. Cereal, dal and meat / fish

   d. Cereal, egg and meat / fish

4. What is the source of your nutritional knowledge?

   1. Television, radio and news paper ☐

   2. N.G.O. workers ☐ 3. Own study ☐

   4. Others (Specify.....)

5. Do you think that your food is enough nutritious?

   1. Yes ☐ 2. No ☐

   3. Don't know ☐

6. When do you feel that you have taken sufficient food?

   1. Self-satisfaction ☐

   2. When I loose my appetite ☐

7. Do you think fast food and snacks are beneficial for health?

   1. Yes ☐ 2. No ☐

8. Do you know about nutritional deficiency diseases?

   1. Yes ☐ 2. No ☐

9. If yes, then what are the most common nutritional deficiency diseases?

   1. Night blindness, Anemia, Marasmus &

      Kwashiorkor, Goiter ☐

   2. Diarrhoea, Jaundice, TB, Malaria ☐

   3. Beriberi, Scurvy, Osteoporosis, Osteomalacia ☐

   4. Others (Specify.....)

10. Do you know about personal hygiene and cleanliness?

    1. Yes ☐ 2. No ☐

11. What is the ideal source of drinking water?

    1. River / Pond / Ditch / Well ☐

    2. Tube well / Tap ☐

    3. Don't know ☐ 4. Others (Specify.....)

12. What is the ideal source of defecation?

    1. In a latrine ☐
    2. In water sealed sanitary latrine ☐
    3. Don't know ☐
    4. Others (Specify.....)

13. What is the ideal place to dispose household garbage?

    1. Anywhere ☐
    2. In a fixed common place / garbage bin ☐
    3. Don't know ☐
    4. Others (Specify.....)

14. What is the ideal way to wash hands after touching feces?

    1. With soap and water ☐
    2. With mud / ash and water ☐
    3. With plain water ☐
    4. Don't know ☐

Dietary Assessment:

A) Food intake of adolescent girls by 24 hour recall method:

How was yesterday in respect of food intake?

1. As usual normal day ☐
2. Festival ☐
3. Sick ☐

Time of Eating	Menu	Cooked / Raw food				Code of the Food	Total Weight (gm)
		Family measurement	Ingre-dients	Cooked wt (gm)	Cooking Method		
Breakfast							
Mid morning snacks							
Lunch							
Mid Afternoon Snacks							
Dinner							

B) Food intake of adolescent girls by food frequency questionnaire:

Food items	No of days in a week			
	Never	1-3 days	4-5 days	6-7 days
Rice				
Bread				
Wheat / Ruti/ Parota				
Pulses (All kinds)				
Green leafy vegetables				
Yellow vegetables				
Non-leafy vegetables				
Citrus fruits				
Beef				
Mutton				
Poultry				
Marine fish				
Riverine big fish				
Riverine small fish				
Others (dryfish, shrimp etc)				
Egg				
Milk and milk products				
Fats and oils				
Others				

C) Detailed food frequency in terms of type of fish consumed :

Marine fish:
Rupchanda
Surma
Loitta
Churi
Tuna
Marine Poa
Marine Cheua
Riverine big fish:
Rui
Ilish
Pungas
Boal
Katla
Mrigel
Ayre
Chitol
Silver carp / Ghass carp
Kali Baus

Riverine small fish:
Kechki
Mola
Dhela
Vetki
Tengra
Bata
Meni
Bain
Telapia
Batasi
Chapila
Pabda
Kajoli
Puti
Chanda
Taki
Bele