# RISK FACTORS ASSOCIATED WITH OVERWEIGHT AND OBESITY AMONG ADOLESCENTS STUDYING IN PRIVATE SCHOOLS OF RATNANAGAR MUNICIPALITY, CHITWAN

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# Risk Factors Associated with Overweight and Obesity among Adolescents studying in Private Schools of Ratnanagar Municipality, Chitwan

*A dissertation submitted to Department of B.Sc. Nutrition and Dietetics, Campus of Technology, Tribhuvan University in the partial fulfillment of the requirements for a bachelor degree in Nutrition and Dietetics*

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# Approval Letter

**This *dissertation* entitled the *Risk factors associated with overweight and obesity among adolescents studying in private schools of Ratnanagar presented* by Kiran Tiwari has been accepted as the partial fulfillment of the requirement for the bachelor degree in Nutrition and Dietetics**

## Dissertation Committee

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(Kiran Tiwari)

## Abstract

The study was performed with objective to examine risk factors associated with overweight and obesity on 213 adolescent boys and girls of 10 to 19 years studying in Private School of Ratnanagar Municipality. A cross sectional study was conducted in 10-19 years boys and girls studying in private schools of Ratnanagar Municipality. The sample size taken for the study was 213.Anthropometric measurements were taken to determine the prevalence of overweight and obesity among adolescents. A structured questionnaire was administered to participants for demographic, socio-economic information, physical activity and diet behavior. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20 and Microsoft package 13 (Excel and Word). Chi-square tests were performed to establish the association between different categories, analysis was performed to establish the strength and direction of the relationship between variables. BAZ score was also used.

Mean BMI was found to be 21.92 ± 4.677 kg/m² in Boys and 22.86 ±4.152 kg/m² in Girls, Mean BAZ-score was found to be 0.84±1.707 in Boys and 1.02±1.136 in Girls. BMI was used to determine generalized overweight and obesity using WHO standard classification. Present study revealed that 19.25% and 3.76% were overweight and obese respectively. Likewise based on BMI for Age 31.8% were overweight, 22.5% were obese and 1.4% were severely obese. Factors such as skip breakfast, hours spent on TV, eat in front of TV, Physical activity, were significantly associated ($p<0.05$) with overweight and obesity. The findings are a clear evidence of the rising trends of overweight and obesity in adolescents. So, overweight and obesity must be taken as serious problem. Efforts should be made to address the problem of overweight and obesity, by addressing the factors associated with it to minimize its consequences.



**Keywords:** Obesity, BMI, BAZ, Adolescents.

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## List of abbreviations

| Abbreviation | Full form |
|---|---|
| ADBI | Asian Development Bank Institute |
| BF | Body Fat |
| BMI | Body Mass Index |
| BAZ | Body Mass Index for Age Score |
| CBS | Central Bureau of Statistics |
| CD | Communicable Disease |
| CHD | Coronary Heart Disease |
| CI | Confidence Interval |
| CNS | Central Nervous System |
| CVD | Cardio Vascular Disease |
| FAO | Food and Agriculture Organization |
| FFM | Fat Free Mass |
| FM | Fat Mass |
| FV | Fruits and Vegetables |
| HDI | Human Development Index |
| IPAQ | International Physical Activity Questionnaire |
| MET | Metabolic Equivalents |
| MOH | Ministry of Health |
| MOHP | Ministry of Health and Population |
| NCDs | Non-Communicable Diseases |
| NDHs | Nepal Demographic and Health Survey |
| NPHC | National Population and Housing Census |
| RMR | Resting Metabolic Rate |
| SPSS | Statistical Package for Social Science |
| VDC | Village Development Committee |
| WHO | World Health Organization |

# Part I

# Introduction

## 1.1. General introduction

Adolescence is the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to 19 years. It represents one of the critical transitions in the life span and is characterized by a tremendous pace in growth and change that is second only to that of infancy (WHO, 2015b). Adolescence is one of the most rapid phases of human development. Biological maturity precedes psychosocial maturity. Rapid physical, physiological, psychological and social development takes place during adolescence (Sharma *et al.*, 2016).

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health(WHO, 2016). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered as overweight. A crude population measure of obesity is the body mass index (BMI). Obesity is due to positive energy balance, the intake of calories is more than the expenditure of energy. Over weight is a condition where the body weight is 10-20 percent greater than the mean standard weight for age, height and sex. Obesity invites disability, disease and pre mature death. Obesity is a chronic disease(Srilakshmi, 2014c).

The World Health Organization (WHO, 1998) has declared overweight as one of the top ten health risks in the world and one of the top five in developed nations. It has been estimated that obesity is the fifth major cause for the death worldwide. In 2016, 39% of adults aged 18 years and over (39% of men and 40% of women) were overweight. Overall, about 13% of the world's adult population (11% of men and 15% of women) was obese in 2016. The worldwide prevalence of obesity nearly tripled between 1975 and 2016. Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016. The prevalence of overweight and obesity among children and adolescents aged 5-19 has risen dramatically from just 4% in 1975 to just over 18% in 2016. The rise has occurred similarly among both boys and girls: in 2016 18% of girls and 19% of boys were overweight. While just under 1% of children and adolescents aged 5-19 were obese in 1975, more 124 million children and adolescents (6% of girls and 8% of boys) were obese in 2016(WHO, 16 february 2018). A prospective longitudinal study showed that 56% of male and 42% of female, who were overweight in adolescence remained overweight in adulthood and 47% of male and 55% of female who were obese in adolescence remained obese in adulthood(Laitinen *et al.*, 2001).

Nepal is a landlocked country situated in South Asia between India and China (Nepal, 2074 Baisakh). Population of Nepal as of the census day (June 22, 2011) stands at 2,64,94,504 with population of adolescents (10 – 19 year age group) 64,07,404 (CBS, 2012).Ratnanagar is a municipality in Chitwan District of Province No. 3 in Nepal. It is the second biggest municipality after Bharatpur Metropolitian City.Ratnanagar lies on Mahendra Highway, one of the main highways in Nepal. The total population is 46,367. The number of adolescents is 11,212; among which 5720 are Boys and 5492 are Girls.

In Nepal trends of overweight and obesity is found to be increasing with 7.1% overweight and 2.4% obesity in 2007 to 17.3% overweight and 4.8% obesity in 2013. A study done in Kaski district among the adolescents of age 16 to 19 years has shown that prevalence of obesity was 8.1%, of which 5.8% were overweight and 2.3% were obese (Acharya *et al.*,2014).Another study done in Dharan show that the prevalence of overweight and obesity was higher among adolescents from private than government schools (13.7% and 5.8% vs. 3.8% and 0.8%)(Shakya *et al.*). The dietary intake of school children and adolescents in developing countries is limited in diversity, mainly comprising plant-based food sources, but with limited intake of fruits and vegetables. 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 Television and magazines, influenced preferences in 80% of these Nepalese adolescents (Vadlamannati and Khan, 2017). Adolescence is a critical phase for the development of obesity because of various biological, psychological, social and environmental changes(Walton *et al.*, 2018). Adolescence overweight and obesity may persist into adulthood. A prospective longitudinal study showed that the 56% of male subjects and 42% of female subjects who were overweight in adolescence remained overweight in adulthood, and the 47% of male subjects and 55% of female subjects who were obese in adolescence remained obese in adulthood(Laitinen *et al.*, 2001). Adolescence overweight and obesity may increase the risk of developing NCDs at a younger age and consequently a premature death. In addition to future health risks, overweight and obese adolescents also suffer short-term health consequences (WHO, 2019).

### 1.2. Statement of problem and justification

Adolescents considered being healthy but millions of them suffer chronic ill health and disablement that may remain a lifetime(WHO, 1998). The physiological changes and physical activity influence nutrient needs of adolescents (Spear, 2002). Their dietary habits are influenced by peers, mass media, social and cultural norms, and lack of nutrition knowledge,

while the influence of the family tends to decline(Story *et al.*, 2002). This ultimately affects the nutritional status. The foundations of health in adulthood and old age are laid during childhood and adolescence (Rapee *et al.*, 2009) so, the health and nutritional status during adolescence becomes more important.

Overweight and obesity is becoming one of the major public health problems in developing countries(Wang and Lim, 2012). Overweight and obesity is amazingly increasing in Nepal along with other nutritional deficiencies. Overweight and obesity are epidemic and a public health crisis among adolescents worldwide particularly in developing and low income countries like Nepal. Overweight and obesity are major risks factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer and are the fifth leading risk factors for global deaths (WHO, 2013). Nepal is experiencing nutrition transition in recent decades which may be the result of urbanization. It has been found from studies that consumption of high fat, sugary foods have increased in recent decades in Nepal. At least 35 million overweight children are estimated to be living in developing countries and 8 million in developed countries. It was 2.9% among adolescent girls of 15-19 years of age in 2011 in Nepal of which 2.6% were overweight and 0.3% girls were obese. With pace of urbanization and development, overweight and obesity among adolescents is on increasing trend. Overweight and obesity are unrecognized public health problems in Nepal. Adolescent is the most vulnerable group for developing obesity (Acharya *et al.*, 2014).

A number of studies have reported that with each surge in weight, there is an increase in the risks for coronary heart disease, type 2 diabetes, cancers (endometrial, breast, and colon), hypertension, dyslipidemia, stroke, sleep apnea, respiratory problems, osteoarthritis, and gynecological problems menstrual irregularities and infertility (Bhurosy and Jeewon, 2014).

Overweight and obesity leads to loss not only in terms of disease but also productivity of country. Through the development of various diseases caused by obesity, being overweight are known to reduce life expectancy and shortens lifespan by three to seven years for an individual aged 40 and with a BMI of 30 or more (Mbochi, 2011). Obesity in early life is of particular concern due to its associated health consequences and its influence on young people's psychological development. Once people develop obesity, it is difficult and costly to cure and there are tremendous challenges for patient to maintain a healthy body weight. Childhood obesity confers long term effects on mortality and morbidity. Therefore, prevention

of obesity in children and adolescents has been argued as a public health priority to combat the obesity epidemic (Wang and Lobstein, 2006).

## 1.3. Objectives

### 1.3.1. General objective

To assess the risk factors associated with overweight and obesity among adolescents studying in private school of Ratnanagar Municipality, Chitwan.

### 1.3.2. Specific objectives

Specifically, the objectives are to:

1. To assess the prevalence of overweight and obesity in adolescents studying in private school of Ratnanagar Municipality.
2. To identify associated risk factors of prevalent over nutritional status of adolescents in Private School of Ratnanagar municipality.

## 1.4. Research question

a) What is the prevalence of overweight and obesity in adolescents in Ratnanagar Municipality?
b) What are the risk factors associated with overweight and obesity in adolescents?

## 1.5. Significance

The significance of study is to:

- The study will contribute to academic knowledge in the field of foods, nutrition and health.
- The study results may be useful in highlighting the problem of overweight and obesity and the main contributing factors among adolescent in Ratnanagar in the different socioeconomic groups.
- As health problems associated with obesity and overweight are increasing in number, these findings will be useful in informing the health sector and the public health planners in the mobilization and allocation of resources for the control and prevention of NCDs.
- The result of this study could form the basis for the formulation of guidelines and messages which could be used for counseling of adolescent in Ratnanagar and similar circumstances in the country.

- As prevention is best way to achieve economic growth in country like Nepal, these findings will surely be effective in increasing awareness on overweight and obesity as a problem.

## 1.6. Limitation

Obesity was not assessed by body fat percentage due to limited resources.

### 1.7. Conceptual framework

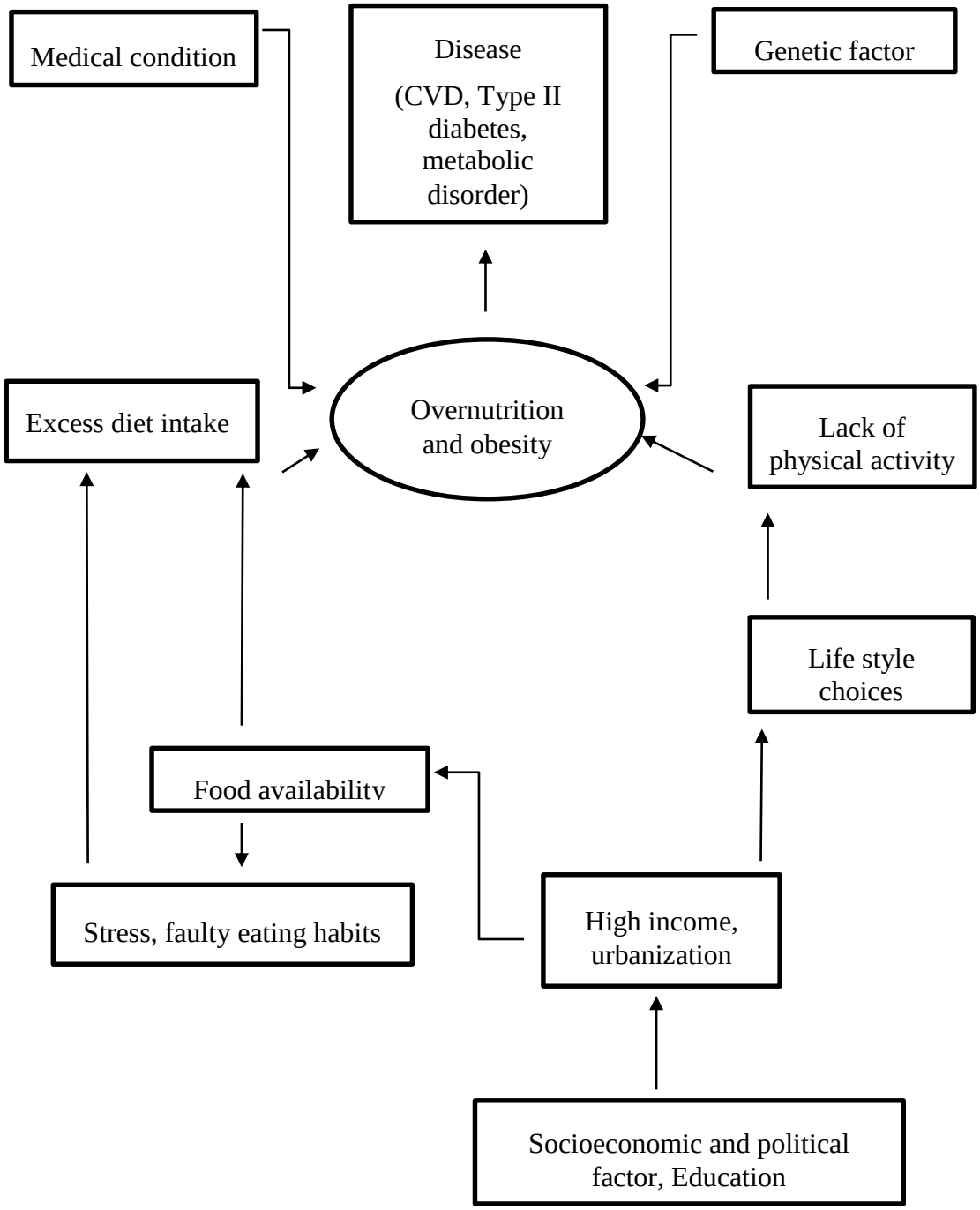


**Figure 1.1** Conceptual framework for over nutrition.(Jiménez, 2013).

# PART II

# Literature Review

## 2.1 Adolescence

According to WHO, individuals between 10 and 19 years are considered adolescents. The period of transition from childhood to adulthood is called adolescence with accelerated physical, biochemical and emotional development(Srilakshmi, 2007). Biological process drives many aspects of the adolescent growth and development, with the onset of puberty making the passage from childhood to adolescence. The process of adolescence is a period of preparation for adulthood during which time several key developmental experiences occur. While adolescence is a time of tremendous growth and potential, it is also a time of considerable risk during which social contexts exert powerful influences(WHO, 2015a). (UNICEF, 2011) divides the second decade of life as below:

### i) Early adolescence (10–14 years)

The age of 10 to 14 years can be considered as early adolescence. It is at this stage that physical changes generally commence, usually beginning with a growth spurt and soon followed by the development of the sex organs and secondary sexual characteristics. These external changes are often very obvious and can be a source of anxiety as well as excitement or pride for the individual whose body is undergoing the transformation. The internal changes in the individual, although less evident, are equally profound. The brain also undergoes a spectacular burst of electrical and physiological development. The number of brain cells can almost double in the course of a year, while neural networks are radically recognized, with a consequent impact on emotional, physical and mental ability (UNICEF, 2011).

### ii) Late adolescence (15-19 years)

Late adolescence encompasses the ages of 15 and 19 years. The major physical changes have usually occurred by now, although the body is still developing. The brain continues to develop and recognize itself, and the capacity for analytical and reflective thought is greatly enhanced. Peer- group opinions still tend to be important at the outset, but their hold diminishes as adolescents gain more clarity and confidence in their own identity and opinions(UNICEF, 2011).

## 2.2. Changes during adolescence

### A) Physical changes

Growth in physical size during adolescence is second to the growth that occurs in infancy(St-Onge and Keller, 2012). Generally, growth spurt begins at the age of ten or eleven for girls and twelve or thirteen for boys. It lasts for about two and a half years(Wilkinson, 2015). More than 20% of total growth in stature and up to 50% in adult bone mass occurs during adolescence(WHO, 2015b). Some physical changes during teenage are as below:

#### i) Body composition

During adolescence, boys muscle mass increases and shoulders broaden, whereas girls increase their body fat and develop rounder hips and smaller waists. The pattern and rate of development in body composition differ in boys and girls. Girls attain peak height growth velocity 13.5 years of age, which is higher than that for girls and height increase for a longer period of time (St-Onge and Keller, 2012). Before puberty, Boys and Girls have similar proportions of fat (15% and 19%), muscle and lean body mass. During puberty, the rate of linear growth increases to reach that of 2 year-old children. In girls, fat increases to 23% at age 20, while it decreases to 12% in boys (Srof and Velsor-Friedrich, 2006). Girls gain fat mass (FM) steadily through age 16. Boys have an initial increase in FM between age 8 and 14 years, then a decline between ages 14 and 16 years. The distribution of FM also changes as: in boys, increased deposition of subcutaneous adipose tissue (SAT) occurs in the trunk area, whereas in girls, SAT is deposited in the gluteal-femoral region. Patterns of change in fat-free mass (FFM) also differ: Girls increase in FFM until age 15 years, and boys increase in FFM through age 18 years, with the most rapid increase occurring between 12 and 15 years. The composition of FFM also changes during this time, from 80% water in young childhood to approximately 73% water by ages 10 to 15 years. The rise in density of FFM compartment during growth(St-Onge and Keller, 2012).

#### ii) Sexual maturity

The growth spurt is an accompanied by sexual maturity. In girls there is development of breasts, auxiliary and pubic hair and menarche. In boys the pubertal changes include depending of voice, broadening of shoulders, development of auxiliary and pubic hair, growth of penis and testicles(Kumar, 2020). Sexual maturation can be determined by evaluating pubertal development based on secondary sex characteristics: testicular and penile development and appearance of pubic hair in boys; breast development and appearance of pubic hair in girls which is known as tanner stage rating(St-Onge and Keller, 2012).

**B) Psycho-social changes**

Besides physical and sexual maturation, changes include movement toward social and economic independence, and development of identity, the acquisition of skills needed to carry out adult relationships and roles, and the capacity for abstract reasoning (Das *et al.*, 2017). As adolescence is a transition to adulthood, they try to develop self-identity. The desire to be accepted in their peer group changes their food habits, dressing and group conduct. This in turn brings psychological, emotional and social stress (Becker, 2004). There is occurrence of transition towards greater autonomy from parents and their values, and a progressively more central role of peers as role models, advisors, friends, and determinants of interests and values (Kossek *et al.*, 1999).

## 2.3 Nutrition Requirement of Adolescents

Nutrition requirement can be defined as the minimum amount of the absorbed nutrient that is necessary for maintaining the normal physiological functions of the body(Srilakshmi, 2014b). It is in adolescence that the second growth spurt occurs, the first spurt being in infancy. Caloric needs are increased, as well as protein, vitamins, minerals salts (calcium and iron mostly). A normal diet will deliver all nutrients needed for growth. However, if some discrepancy occurs, either qualitative or quantitative, there will be some effect on nutrition(Gong and Spear, 1988).

Adolescence is the period of increased nutritional requirement due to the rapid formation of new tissues and other changes (Cadogan *et al.*, 1997). After puberty, there is difference in nutritional requirement of girls and boys. The reason for it includes earlier maturation of Girls and variations in physiological needs for some nutrients by sex e.g. difference in the requirement of iron. Besides differences in height and weight, boys gain proportionately more muscle mass than fat as compared to girls. They experience increased linear growth to produce a heavier skeleton and develop greater red blood cell mass than girls. Girls on the other hand have more fat than muscle tissues. These difference in body composition have important implications for nutritional needs of male and female adolescents(WHO, 2006).

Recommended Dietary Allowance (RDA) is the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly 97 to 98% healthy individuals in a particular life stage and gender group (ICMR, 2010). ICMR has calculated the nutrient requirements considering all adolescents as moderately active. The recommended Daily allowance as provided by ICMR in 2010 is given as below:

**Table 2.1** Energy and nutrient requirements of boys

| Nutrients | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|
| Energy (kcal) | 2030 | 2180 | 2370 | 2580 | 2760 | 2890 | 2980 | 3060 | 2730 |
| Protein (gm) | 36.3 | 39.6 | 43.7 | 49.8 | 54.7 | 58.2 | 60.8 | 62.2 | 60 |
| Visible fat (gm) | 35 | 35 | 35 | 45 | 45 | 45 | 50 | 50 | 50 |
| Calcium (mg) | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 600 |
| Iron (mg) | 21 | 21 | 21 | 32 | 32 | 32 | 28 | 28 | 17 |
| Vitamin A | | | | | | | | | |
| Retinol (µg) | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 |
| ß-carotene (µg) | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 |
| Thiamine (mg) | 1.1 | 1.1 | 1.1 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.4 |
| Riboflavin | | | | | | | | | |
| (mg) | 1.3 | 1.3 | 1.3 | 1.6 | 1.6 | 1.6 | 1.8 | 1.8 | 1.6 |
| Niacine (mg) | 15 | 15 | 15 | 16 | 16 | 16 | 17 | 17 | 18 |
| Pyriodxine | | | | | | | | | |
| (mg) | 1.6 | 1.6 | 1.6 | 2 | 2 | 2 | 2 | 2 | 2 |
| VitC (mg) | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Folic acid (µg) | 140 | 140 | 140 | 150 | 150 | 150 | 200 | 200 | 200 |
| VitB12 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 |
| Magnesium(µg) | 120 | 120 | 120 | 165 | 165 | 165 | 195 | 195 | 340 |
| Zinc (mg) | 9 | 9 | 9 | 11 | 11 | 11 | 12 | 12 | 12 |

**Table 2.2** Energy and nutrient requirements of girls

| Nutrients | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|
| Energy (kcal) | 1880 | 2010 | 2140 | 2260 | 2340 | 2390 | 2430 | 2450 | 2230 |
| Protein (gm) | 36.8 | 40 | 44.5 | 49 | 52.8 | 53.8 | 54.9 | 56 | 55 |
| Visible fat (gm) | 35 | 35 | 35 | 40 | 40 | 40 | 35 | 35 | 25 |
| Calcium (mg) | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 600 |
| Iron (mg) | 27 | 27 | 27 | 27 | 27 | 27 | 26 | 26 | 21 |
| Vitamin A | | | | | | | | | |
| Retinol (µg) | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 |
| ß-carotene (µg) | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 |
| Thiamine (mg) | 1 | 1 | 1 | 1.2 | 1.2 | 1.2 | 1 | 1 | 1 |
| Riboflavin | | | | | | | | | |
| (mg) | 1.2 | 1.2 | 1.2 | 1.4 | 1.4 | 1.4 | 1.2 | 1.2 | 1.3 |
| Niacine (mg) | 13 | 13 | 13 | 14 | 14 | 14 | 14 | 14 | 14 |
| Pyriodxine | | | | | | | | | |
| (mg) | 1.6 | 1.6 | 1.6 | 2 | 2 | 2 | 2 | 2 | 2 |
| VitC (mg) | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| Folic acid (µg) | 140 | 140 | 140 | 150 | 150 | 150 | 200 | 200 | 200 |
| VitB12 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 | 0.2-1 |
| Magnesium(µg) | 160 | 160 | 160 | 210 | 210 | 210 | 235 | 235 | 310 |
| Zinc (mg) | 9 | 9 | 9 | 11 | 11 | 11 | 12 | 12 | 10 |

Source: (ALLOWANCES, 2009)

**Note:** These tables reflect the energy requirement of adolescents who have a moderate activity level. Requirements of age group 18-19 is as that of moderately active adult.

### 2.4. Overweight and obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters ($kg/m^2$)(WHO, 16 february 2018).

When energy intake equals energy expenditure, the body is in energy balance and body energy is stable. When energy intake exceeds energy expenditure, a state of positive energy balance occurs and the consequence is an increase in body mass, of which 60 to 80 percent is usually body fat. Conversely, when energy expenditure exceeds energy intake, a state of

negative energy balance ensues and the consequence is a loss of body mass (again with 60 to 80 percent from body fat)(Srilakshmi, 2014b).

Any genetic or environmental factor that impacts body weight must act through one or more component of energy balance. Insulin and leptin affects the regulation of body weight. Obesity gene is expressed in the fat cells and codes for the protein leptin. This hormone promotes negative energy balance by suppressing appetite and increasing the energy expenditure. People having genetic defects in leptin show signs of poor appetite control and eats more and may gain weight. In obesity there is sufficient leptin production but there is insensitivity of the adipose tissues to leptin. Leptin plays an important role in the long term regulation of energy balance. On another hand insulin also inhibits food intake. Likewise insulin provides an indirect role in body weight regulation through the stimulation of leptin. Both insulin and leptin are transferred into the CNS, where they may interact with a number of hypothalamic neuropeptides known to affect food intake and body weight (Srilakshmi, 2014a).

## 2.5. Theories of obesity

### 2.5.1. Fat cell theory

Number of fat cells is determined early in life to provide space to store fat. Once they have been formed, fat cells have tendency to remain full of fat. Total number of fat cells was set early in life, supporting the notion that juvenile onset obesity was caused by increase in the number of aft cells while adult-onset was caused by an increase in the size of fat cells. The number of fat cells can increase in adult life and that the number of fat cells can also actually diminish as a result of sustained weight loss. People with large number of aft cells have more difficulty in maintaining body weight than those with fewer fat cells. Research has shown that risk for medical problems is related to the size of fat cells present more than the number of fat cells or the person's weight (Srilakshmi, 2014a).

### 2.5.2. Set point theory

Each person has an ideal biological weight or set point. Once body weight reaches this point, a whole set of signals is produced that influences the person's food intake to maintain this weight (Srilakshmi, 2014a).

## 2.6. Types of Obesity

### 2.6.1. Based on BMI

a) Grade I obesity: These people have body mass index more than 25 but less than 29.9. Overweight does not affect their health, they lead normal health and life expectancy is above normal. They may reduce on their own.

b) Grade II obesity: The body mass index is between 30-39.9. These patients should be treated by doctors and dieticians. Although they appear to be in good health, they have reduced tolerance to exercise with shortness of breath on exertion and they are unduly fatigued. This is due to burden of increased weight they carry always and reduced capacity of the circulatory and respiratory systems that are handicapped by masses of internal fat and fatty infiltration of muscle. For mechanical and metabolic reasons those patients are at increased risk of diabetes, atherosclerosis, hypertension, fatty liver, gall bladder diseases, osteoarthritis, hernias and varicose veins. Mortality rate also increases(Srilakshmi, 2014a).

c) Grade III obesity: The body mass index is above 40 and these patients are in pathetic condition. Their day to day activities are restricted due to their enormous mass and more susceptible to diseases mentioned in Grade II. They are susceptible to atherosclerosis, prone to accidents and have serious psychological disturbances (Srilakshmi, 2014a).

### 2.6.2. Based on onset of obesity

a) Juvenile onset obesity: Juvenile obesity occurs due to hyperplasia and most rapidly in the first few years of life. There is a marked increase in the adipose tissue cells. Too many calories injected in the infancy and early childhood leads to an over production of fat cells followed by hypertrophy. Fat cells once developed do not disappear nor differentiate. For this reason, fat children are inclined to be fat adults. As many as 80 per cent of obese children will become obese adults (Srilakshmi, 2014a).

b) Adult onset obesity: In the adult onset obesity the size of individual cell is greatly enlarged. A distended adipose cell leads to further physiological, biochemical, anatomic aberrations in individual's organs and organ systems. Hypertrophic obese patients have been reported to maintain weight loss better than hyperplasic ones (Srilakshmi, 2014a).

### 2.6.3. Based on fat storage

Body fat distribution can be used to establish overweight and obesity. Body fat is distributed differently in men and women. The quantity and location of fat in the body can predict health risks. Based on the fat storage in the body, there are 2 types of obesity:-

a) Android obesity

The obesity in which the fat is accumulated in upper part of body is known as android obesity, sometimes it is referred as apple obesity or upper body obesity. This type is frequently observed in most male and few Girls (Sheth and Shah, 2006).

b) Gynacoid obesity:

This is the typical female pattern where excess fat stores accumulate in the periphery, specifically hips, thigh and bottom. Individuals with a gynacoid fat distribution are at a greater risk of mechanical problems (Sheth and Shah, 2006).

## 2.7. Risk factors associated with adolescent obesity

Many factors can contribute to obesity and overweight including genetic factors, socioeconomic factors, medical conditions, physical activity, psychological factors, lifestyle choices, age and sex, sleep.

### 2.7.1. Genetic factors

Genetic inheritance probably influences 50-70 per cent a person's chance of becoming fat more than any other factor. A genetic base regulates species differences in body fat and sexual differences within a species. Within families the chance is 80 per cent if both parents are obese and 50 per cent if one parent is obese. A mutation in human gene for the B3 receptor in adipose tissue, involved in lipolysis and thermogenesis markedly increase the risk of obesity. Many genes play roles in energy homeostasis (UCP1, UCP2, UCP3), food intake regulation (MC3R, MC4R; CCKAR), appetite (NPYRS), and ultimately obesity (ASIP, CPE, LEP, LEPR, TUB, POMC), in mammals (Srilakshmi, 2014a).

### 2.7.2. Physical activity

Obesity is found in persons who lead sedentary lives and pay less importance to physical activity. Though obesity can occur at any age, this is more common during middle age when physical activity decreases without corresponding decrease in food consumption. Obesity can also be seen in school children who spend too much time on studies, who do not have physical exercise, who do not participate in school games and who use vehicle for commuting to schools (Srilakshmi, 2014a). A multivariate analysis of covariance (MANCOVA) indicated the group of respondents classified as active had higher VO2max and lower percentage of body fat than the group of respondents classifies as insufficiently active. An analysis of covariance (ANCOVA) indicated the group of respondents classified as active had higher electronic records of fitness center attendance than the group of respondents classified as insufficiently

active. Therefore, these pieces of validity evidence support the use of the questionnaires classification system among healthy adults(Sikes *et al.*, 2019).

Adolescence is a vulnerable phase in human development as it represents a transition from childhood to physical, psychological and social maturity. During this period, adolescents learn and develop knowledge and skills to deal with critical aspects of their health and development while their bodies mature. WHO recommends at least 60 minutes of moderate-to vigorous-intensity Physical activity accumulated every day (WHO, 2020).

### 2.7.3. Psychological factors

Psychological stressors which can result in emotional eating include bullying, experiencing neglect/ maltreatment, or living in environment where there is a lack of consistency, food limiting or general adult supervision. When young people become stressed, they are more likely to overeat or comfort eats. Other example of stressors can be parents divorcing/ separating patterns, tiredness and a lack of motivation to participate in regular physical activity. This creates a viscous cycle as insufficient sleep is associated with the development of obesity (Adams *et al.*).

### 2.7.4. Medical conditions

A variety of medical conditions are associated with being overweight and obese. The medical conditions associated to obesity and overweight are Cushing syndrome (a rare syndrome that results from excess production of cortisol by the adrenal glands), Eating disorder, especially binge eating disorder, bulimia nervosa, and night eating disorder, Growth hormone deficiency, Hypogonadisim (low testosterone), Hypothyroidism (underactive thyroid), Insulinoma (a tumor of the pancreas that secrets insulin), Polycystic ovarian syndrome(Strauch ingrid, 2015).

### 2.7.5. Lifestyle choices and habits

Overeating, along with a sedentary lifestyle, contributes to obesity. These are lifestyle choices that can be affected by behavior change. Eating a diet in which a high percentage of calories come from sugary, high-fat, refined foods promotes weight gain. Lack of regular exercise contributes to obesity in adults and makes it difficult to maintain weight loss. In children, inactivity, such as watching television or sitting at a computer, contributes to obesity(Health, 2019).

Lifestyle often affects calorie consumption and exercise. People drive instead of walk. Neighborhoods can be unsuitable for significant outdoor activity. Workplaces might have

vending machines that offer only high calorie snacks rather than healthy alternatives. People may not have time to cook low calories meals at home(Larson Karen, 2015).

### 2.7.6. Social and cultural factors

Social factors also may be linked to obesity. Poverty, for example, may cause some people to buy high-calorie processed foods because they typically cost less than healthier foods. Opportunities for exercise may be limited if there are no recreation areas in the neighborhood, if the area is considered unsafe or not conducive to activities like walking or jogging, and/or if gym memberships are too expensive. Many people gain weight when they quit smoking. Food often tastes better and nicotine no longer speeds up the calorie-burning process. Alcohol adds calories to the diet, increases appetite, and may interfere with a person's ability to make good choices about healthy meals and portion sizes (Larson, 2015).

People in the upper socioeconomic strata tend to be more obese mainly due to their rich food intake and luxurious lifestyle which involves minimum physical activity. Cultural habits which influence our food habits and thus predispose us towards obesity (Joshi, 2016)

### 2.7.7. Age and sex

Obesity can occur at any age in either sex as long as the person is under positive energy balance. Studies conducted at Nutrition Foundation of India have shown more Girls than Boys are found to be overweight among all age groups. Hormonal predisposition put women at higher risk of obesity when compared to men (Srilakshmi, 2014a).

### 2.7.8. Sleep

Sleep plays a crucial role in human endocrine, metabolic and neurological functions. Among various sleep measures such as duration, quality, timing and regularity, duration is most frequent parameter related to health. Long sleep duration (>9 hours) is predicted risk of higher mortality, multiple cardiovascular diseases and obesity than short sleep duration (<6 hours)(Liu Wenjia, 2018).

Short sleep duration, poor sleep quality, and late bed times are all associated with excess food intake, poor diet quality, and obesity with adolescents. Sleep, sedentary behavior, physical activity and diet all interact and influence each other to ultimately impact health(Dutil Caroline, 2016).

### 2.7.9. Physiological factors

There are certain critical periods during the growth and development of the person that demands increased energy intake e.g. third trimester pregnancy and lactation, during childhood, and adolescence. A person consumes more energy during such critical periods. However, after this critical period passes the energy intake should actually come back to normal. If this does not happen and the diet pattern (increased calorie intake) continues over a long period of time the person gradually gains more weight and becomes obese(Sheth and Shah, 2006).

### 2.7.10 Dietary Intake and overweight and obesity:

Adolescent growth and development is closely linked to the diet they receive during childhood adolescence. Adequate nutrition of individual is determined by two factors. The first is the adequate availability of food in terms of quantity as well as quality, which depends on socioeconomic 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 (Organization, 2006). Dietary inadequacy might be caused by an inadequate supply of diet or by mothers having too little time to prepare food. According to (Van Dam and Seidell, 2007) carbohydrates are the macronutrients that provide energy and can thus contribute to excess intake and subsequent weight gain. Protein is also essential for weight loss, especially in the obese, as it helps to stabilize blood sugar, curb hunger and potentially increase the number of calories you burn through digestion. Protein takes longer to digest as compared to carbohydrates and thus can play a role in making us feel more satisfied when trying to cut calories(Stokes *et al.*, 2018). Calcium and salt intake were also significant with overweight and obesity(Lederer Goldberg *et al.*, 2009).

**Energy Balance:** Energy balance is the level of energy intake of an individual from food that will balance energy expenditure and maintain body weight, when he/she is healthy and maintains body weight and has a body size, body composition and level of activity consistent with good health. In growth stages, such as childhood, pregnancy and lactation, the energy requirement includes energy needed for growth or the formation of tissue or the secretion of milk at rates consistent with good health (Mudambi,2014).

**Energy Intake:** It is the energy needed to fuel the body that comes from the carbohydrates, fat, protein and alcohol in food. The amount of energy taken in depends on the total amount in depends on the total amount of food consumed and the nutrient composition of these foods.

**Energy output:** It is the amount of energy used to maintain basic body functions, to fuel physical activity and to process the nutrients consumed in food. When energy intake is more than energy output (i.e. greater than RDA) called Positive energy balance. Positive energy balance often cause overweight and obesity in long term. On contrary, when energy intake is less than energy output (i.e. less than RDA) called Negative energy balance. Negative energy balance often causes underweight on long term.

**Energy dense foods:** Large shifts of diet and physical activity have occurred in the last two or three decades of twentieth century. Modern societies seem to be converging on a diet high in saturated fats, sugar, refined foods, and low in fibre referred to as western diet and on lifestyles characterised by lower levels of activity. The diets of developing world are rapidly shifting particularly with respect to fat, calorie sweeteners and animal source foods. In 2000, 306 kilocalories were consumed per person per day, about a third more than the calorie consumed in 1962 countries (Gordon-Larsen, 2003). Nepal's increasing trend towards urbanization presents large health challenges, whose consequences are at an early stage (Oli, 2014).

In Nepal, the average proportion of energy from fat has significantly increased from 13% in 1970 to 17% in 2010. Plant fat and sugar are the main contributors to the increased energy intake trends over the 40 years, followed by meat, fish, milk and eggs. Nepalese dietary patterns have changed over the past forty years, especially with increased energy from plant fat, sugar and animal products coinciding with increased levels of obesity and overweight, especially in urban areas (McGuire, 2012). Changing dietary habits can shift a society's disease pattern from infectious, communicable diseases" dominance towards a status of double-disease burden with increasing prevalence of obesity and non-communicable diseases (NCDs) (Vaidya, 2014).

**Milk and Milk Products:** Calcium is one of the most abundant mineral present in milk (Harinarayan, 2004). Many studies have shown that calcium-rich diet could help to control body weight. Dietary calcium is known to increase lipolysis and persevere thermogenesis, thereby accelerating weight loss (Martini, 2013). Maximum bone mass is acquired during adolescence, but the deficient intake of calcium among study subjects might apparently increase bone fracture, lead them to risk of osteoporosis during adulthood (Straub, 2007). Also it had been found that proper calcium intakes helps in maintain healthy weight and prevention of hypertension (Rolfes *et al.*, 2020) so mean intake of his nutrient among the studied subjects must be increased.

**Salt intake:** It has been recommended that adults should consume less than 5 gram of salt per day (WHO, 2013b). A study conducted in Andhra pradesh in India showed a positive association between salt intake and BMI (Petersen, 2017). High salt intake leads to water retention in body which subsequently leads to weight gain. Beside this high salt intake is known to increase adeponectin levels in body which subsequently increases fat in body (Kamari, 2010).

**Protein and Fat:** A source of protein is an essential element of a healthy diet, allowing both growth and maintenance of the 25,000 proteins encoded within the human genome, as well as other nitrogenous compounds, which together form the body's dynamic system of structural and functional elements that exchange nitrogen with the environment (Griffiths, 2005). Fats enhance the taste and acceptability of foods. Lipid components largely determine the texture, flavor and aroma of foods. In addition, fats slow gastric emptying and intestinal motility, thereby prolonging satiety. Dietary fats provide essential fatty acids (EFA) and facilitate the absorption of lipid soluble vitamins.

**Fruits and Vegetables:** Fruits and vegetables are important components of a healthy diet, and their sufficient daily consumption helps to prevent weight gain. High fiber content of fruits and vegetables promote weight loss. High fiber content food increases satiety levels that will prevent overeating. Beside this soluble fibre present in them will form viscous solution that will prevent absorption of fat and cholesterol. A minimum of 400g to 500 gm. of fruits and vegetables per day (excluding potatoes and other starchy tubers) is recommended controlling weigh gain and CVD (WHO, 17a).

### 2.8. Comorbidities of overweight and obese adolescent

Childhood and adolescent obesity is associated with a higher chance of obesity, premature death and disability in adulthood. But in addition to increased future risks, obese children experience breathing difficulties, increased risk of fractures, hypertension, and early markers of cardiovascular disease, insulin resistance and psychological effects(Keerthan Kumar *et al.*, 2011). 50 to 80 % of obese children fall into the risk group. Effective prevention of adult obesity will require the prevention and management of childhood and adolescent obesity and awareness regarding factors leading to obesity. WHO has also emphasized on urgent need of understanding the prevalence trend, factors contributing and developing strategies for effective intervention(Gupta, 2015). Thus, the present study was planned and conducted to assess the lifestyle and habits associated with obesity among the school children which will help in

estimating the local prevalence factors associated with the condition and hence will assist to organize primary prevention accordingly in this area.

## 2.9. Measurement of obesity (nutritional assessment)

Nutritional assessment can be defined as the interpretation of information obtained from anthropometric, dietary, biochemical and clinical studies. The information obtained is used to determine the health status of individual or population group as influenced by their intake and utilization of nutrients. Nutritional assessment provides timely, high quality and evidence based information for setting targets, planning, monitoring, and evaluating programs aiming at eradicating hunger and reducing the burden of malnutrition(Kasperson *et al.*, 2005). The assessment of nutritional status of individual member of a community is carried out by anthropometric, biochemical, biophysical and clinical examinations. To determine the nutritional status of any community or its section, techniques should be applied to all members of community, or in such a way that the sample is representative to all ages, sexes and socioeconomic group of community (Sweeting, 2007).

According to (Jellife, 1966) the assessment of nutritional status can be done by direct or indirect method as below:

### 2.9.1. Direct method

Direct method of Nutritional assessment is summarized as ABCD

a. Anthropometric Method
b. Biochemical and laboratory method
c. Clinical examination
d. Dietary evaluation method

### 2.9.2. Indirect Method

Indirect method use community indices that reflect the community nutritional status or need. Indirect method of Nutritional assessment can be summarized as:

a. Vital health statistics such as: Age specific Mortality rates; mortality and morbidity rates related to malnutrition and nutritionally relevant diseases like diarrhea, measles, parasitic infection etc.
b. Ecological factors can be classified as: conditioning infections, food consumption, cultural influences, socio-economic factors, food production, and medical and educational services(Jellife, 1966)

### 2.9.3. Anthropometric Assessment

Anthropometric assessment means physical measurements of body weight and dimensions. The measurement varies with age and degree of nutrition and as a result are useful in assessing imbalances of energy.

Anthropometric measurements are of two types:

- Growth measurement
- Body composition measurement

**Anthropometric indicators of nutritional status of adolescents**

Anthropometric assessment of adolescents is more complex than children's because of the transition in body composition, and of the variable timing of the growth spurt. Anthropometric assessment allows to detect adolescents exposed to under nutrition, and to screen adolescent girls who will likely be at risk when they are pregnant because of low stature. With adolescents, in contrast to under-five children, weights and heights alone are less specific indicators of nutritional status (Briend *et al.*, 2012).

Anthropometric data can help identifying stunting, underweight, overweight and obesity. For the determination of stature, traditional cut-offs of height for age are used but the assessment of obesity and adiposity level is more difficult in adolescents than in adults because of rapid changes in body composition. But BMI for age incorporates age along with height and weight (Reilly, 2006). The results of a validation study of BMI against other measures of adiposity, provided age is taken into account (Sardinha, 2016 #2). The following are specific WHO recommendations for adolescent anthropometry:

**Table 2.3 Anthropometric indicators of nutritional status for adolescents**

| | **Cut-offs** | **Indicators** | |
|---|---|---|---|
| | | **Height for Age** | **BMI for Age** |
| Z-score range | Below -3 SD | Severely stunted | Severely thin |
| | -2 SD to -3 SD | Moderately stunted | Moderately thin |
| | -1 SD to -2 SD | Normal | Normal |
| | +1 SD to +2 SD | Normal | Overweight |
| | +2 SD to +3 SD | Normal | Obese |
| | Above +3 SD | Normal | Severely Obese |

(Blössner *et al.*, 2009; de Onis, 2015; de Onis *et al.*, 2007)

Waist circumference and waist-hip ratios are also used as measures of body fat distribution and provide indicators of metabolic disease risk. However, their usefulness is limited in the absence of validated cut-off points (WHO, 2005).

### 2.9.4. Dietary assessment

Food consumption survey referred to as food intake survey or dietary surveys. It is defined as the collection of data regarding the extent of dietary deficiencies and the quantity and type of foods required for overcoming them. It constitutes an essential part of any complete study of nutritional status of individual or group. Dietary assessment can be done in different level national, household and individual level.

**Methods for individual dietary assessment**

At individual level, different qualitative and quantitative methods can be used. Quantitative methods are helpful assessing both present and past intakes. Some of these methods are as below:

a. 24 Hrs. dietary recall
b. Food frequency questionnaire
c. Dietary history since early life
d. Dietary diversity score
e. Food dairy technique
f. Observed food consumption

**A) 24 hrs. Dietary recall**

This is based on the principle that, food consumption for a specified period of time prior to the interview i.e. in the last 24 hrs. Can be recalled as accurately as possible. In this method respondents recall what was consumed and when was it consumed.

**Merits:** It is quick, easy, and depends on short-term memory

**Demerits:**

- May not be truly representative of the person usual intake
- Subject may not report the actual amount

**B) Food frequency questionnaire**

In this method the subject is given a list of many food items to indicate his or her intake (frequency) per day, per week and per month. Quantitative data can also be taken using standardized cups.

**Merits:** Cheap, more representative and easy to use

**Limitations:**

- Long questionnaire
- Needs updating with new commercial food products

### 2.10. Dietary diversity score

Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals. The dietary diversity questionnaire represents a rapid, user-friendly and easily administered low-cost assessment tool. Scoring and analysis of the information collected with the questionnaire is straightforward. The dietary diversity scores consist of a simple count of food groups that a household or an individual has consumed over the preceding 24 hours. The data collected can also be analyzed to provide information on specific food groups of interest (kennedy 2010)

The household dietary diversity score (HDDS) provides a brief look to the economic ability of a household to access a variety of foods. Studies have shown that an increase in dietary diversity is associated with socio-economic status and household food security (household energy availability). Individual dietary diversity scores (IDDS) aim to reflect nutrient adequacy. Studies in different age groups have shown that an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet (kennedy 2010)
Scores are found to be positively correlated with adequate micronutrient density of complementary foods for non-breast-fed children, adolescents and adults. Some of these validation studies refer to only one country while others have attempted to validate dietary diversity scores for several countries. Nevertheless, research is on-going and there is currently no international consensus on which food groups to include in the scores at the individual level for different age/sex groups. The seven food groups are provided by WHO (2010) includes

a. Grains, roots and tubers
b. Legumes and nuts
c. Dairy products (milk, yogurt, cheese)
d. Flesh foods (meat, fish, poultry, and liver/organ meats)
e. Eggs

f. Vitamin A rich fruits and vegetables
g. Other fruits and vegetables

Using these food groups, the minimum dietary diversity indicator is calculated by using formula below:

$$\frac{\text{No. of subjects consuming minimum 4 food groups} \times 100}{\text{Number of total subjects}}$$

## 2.11. Prevalence and trends of overweight and obesity

### 2.11.1. Global trends of overweight and obesity:

The World Health Organization (WHO) has declared overweight as one of the top ten health risks in the world and one of the top five in developed nations. In 2016, 39% of adults aged 18 years and over (39% of men and 40% of women) were overweight. Overall, about 13% of the world's adult population (11% of men and 15% of women) was obese in 2016. The worldwide prevalence of obesity nearly tripled between 1975 and 2016. Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016.The prevalence of overweight and obesity among children and adolescents aged 5-19 has risen dramatically from just 4% in 1975 to just over 18% in 2016. The rise has occurred similarly among both boys and girls: in 2016 18% of girls and 19% of boys were overweight. While just under 1% of children and adolescents aged 5-19 were obese in 1975, more 124 million children and adolescents (6% of girls and 8% of boys) were obese in 2016 (WHO, 2016).

Although Asian countries have some of the lowest prevalence of overweight and obesity worldwide, they are experiencing alarming rates of increase in recent years. Vietnam and India have the lowest rates of obesity in Asia Pacific (1.7 % and 1.9 % respectively). Malaysia has the highest obesity prevalence at 14 % in the South East Asia region and Thailand (8.8 %). In the Oceanic countries, with 26.8 % obesity rates in Australia and 28.3 % in New Zealand. The prevalence of obesity in these countries is similar to rates seen in the United Kingdom (26.9 %) and US (33 %).Between 1980 and 2013, China's overweight and obesity prevalence in adults rose from 11.3 % to 27.9 % and in individuals below age 20 from 5.7 % to 18.8 % (Cheong and Re, 2014).

Adolescence is a critical phase for the development of obesity because of various biological, Psychological, social and environmental changes. Adolescence overweight and obesity may persist into adulthood. A prospective longitudinal study showed that the 56% of male subjects and 42% of female subjects who were overweight in adolescence remained

overweight in adulthood, and the 47% of male subjects and 55% of female subjects who were obese in adulthood(Dietz, 1994). Adolescence overweight and obesity may increase the risk of developing NCDs at a younger age and consequently a premature death. In addition to future health risks, Overweight and obese adolescents also suffer short-term health consequences. In addition, their participation in school and other daily activities is also limited depending on the degree of obesity(Laitinen *et al.*, 2001).

Prevalence has increased substantially in children and adolescents in developed countries; 23.8% of boys and 22.6% of girls were overweight or obese in 2013. The prevalence of overweight and obesity has also increased in children and adolescents in developing countries, from 8.1% to 12.9% in 2013 for boys and from 8.4% to 13.4% in girls(Marie Ng, 2014).

### 2.10.2. Overweight and obesity in Nepal:

A national survey conducted in Nepal in 2013 reported the prevalence of overweight among Nepalese people (15 to 69 years age) to be 17.7%(Aryal *et al.*, 2015). Research on the prevalence and factors associated with overweight among Nepalese adolescents has so far been limited.

According to the cross-sectional study conducted in higher school students in Lalitpur, Nepal, prevalence of overweight among adolescents in Nepal was found to be 12.2%, which is lower than that reported by studies from Pakistan, India and China. The male students were nearly three times more likely to be overweight than the female students. Students studying in private schools were 2.1 times more likely to be overweight than students studying in government schools. Similarly, students from rich families were 4.77 times more likely to be overweight than students from poor families. Students who spent more than 2 h per day watching television were 8.86 times more likely to be overweight than students who spent less than 2 h per day watching television). Students who consumed fruit four times or less a week were 3.13 times more likely to be overweight than students who consumed fruit more than four times a week(Piryani, 2016).

# PART III

# Materials and Methods

## 3.1. Materials

Instruments used for the research work were:

a) Stadiometer: A well calibrated stadiometer, measuring up to 200 cm with least count of 0.1 cm, to assess the height of participants.
b) Digital weighing balance: A digital weighing balance (microlife WS50), measuring up to 180 kg with least count of 0.1 kg.
c) Questionnaire: Well designed and pretested set of questionnaire to collect information on demographic variables, socio-economic condition, dietary practices and relate habits, environmental conditions of the targeted participants.

## 3.2. Research design

A cross sectional survey was conducted to assess the risk factor associated with adolescents studying in eight private schools of Ratnanagar Municipality. It include**s** semi structured questionnaires and measurement of anthropometric variables.

## 3.3. Study variables

- ✓ Dependent variable: BMI, BMI for Age
- ✓ Independent variable:
    - Socio-economic and demographic variables: Caste, family size, family type, Number of siblings, number of adolescents in family, parent's occupation, family income, literacy of parents, source of food
    - Physical activity
    - Dietary habit: Food frequency, food habit related variables (vegetarian/non-vegetarian, skipping of meal, fast food consumption etc.), dietary intake
    - Adolescent's characteristics: Age, sex, physical activity, sleeping hours.

## 3.4. Target population

Study was done in eight private school of Ratnanagar Municipality. Ratnanagar is a municipality in Chitwan District of Province No. 3 in Nepal. It is adjacent to Chitwan National Park, and serves as a gateway to the park. The area of this municipality is 1440 sq km. The total population of this area is 5,337. (Municipality)

**Inclusion criteria**:

The participants with following criteria were included in study:

- Must be adolescent (10 to 19 years).
- Students whose permanent residence is Ratnanagar.
- Students who willingly signed consent forms.

**Exclusion criteria**

The population with any one of the following characters is excluded from the study:

- Students below 10 years and above 19 years of age.
- Students whose permanent residence is outside Ratnanagar.
- The student who is absent in school or who is seriously ill during the survey.
- Students not interested in the study.

### 3.5. Sampling

For sampling, probability proportional to size (PPS) method was used. First eight private were selected randomly out of thirty-five schools (teaching above class 5). Units of sample were selected proportionally from each school as below:

**Table 3.1:** Selected schools and respective sample size

| S.N. | School Name | Address | Students included in sample |
|---|---|---|---|
| 1. | Skyrider Higher Secondary School | Ratnanagar-12 | 50 |
| 2. | Panchakanya Vidhya Mandir | Ratnanagar-2 | 30 |
| 3. | Himalayan Secondary English Boarding school | Ratnanagar-1 | 20 |
| 4. | Annapurna Shishuniketan English School | Ratnanagar-2 | 21 |
| 5. | Bhanu Memorial Secondary English Boarding School | Ratnangar-16 | 21 |
| 6. | Northpoint Academy | Ratnanagar-14 | 14 |
| 7. | Ekata Shishuniketan English Boarding School | Ratnanagar-10 | 31 |
| 8. | Unique Academy | Ratnanagar-4 | 26 |
| | Total | | 213 |

### 3.5. Sample size

The sample size was determined by using a single proportion formula assuming the combined prevalence rate of adolescents overweight and obesity to be 50% in the survey area, 95% confidence interval (CI), 7% margin of error (d) and 8.5% non-response rate is added to total calculated sample size.

N= Sample size,

p= estimated proportion of an attribute present in the population (50%),

z= confidence interval at 95% (standard value of z is 1.96).

Sample size (N) = $Z^2 \times p\ (1-p)/d^2$

Now, $N=1.96^2 \times 0.50 \times (1-0.50)/ (0.07)^2 = 196$

Then adding non-response rate (8.5%), sample size is calculated to be 213.

### 3.6. Pre-testing

Pretesting was done in Five Girls and Five Boys for the feasibility and practicability of the tool. The questionnaire was developed in English and reviewed by supervisor of this study. The prepared sets of questionnaire and anthropometric instruments were pre-tested among few Girls and Boys who were under sampling plan. Pre-testing of the questionnaire was performed to gather information about understanding ability, time consumed by each question, acceptability and to check the interpretation of the variables. After pre- testing all the ambiguous, misleading and wrongly interpreted questions were omitted and questionnaires were revised in accordance with the findings of pre-testing.

### 3.7. Validity and reliability

To ascertain the degree to which the data collection instruments measure what they are purposed to measure, the instruments were validated. Validity of weighing balance was ascertained by comparing the data provided by our weighing balance with standard weights. Validity of stadiometer was ascertained by comparing the measurement from our stadiometer and UNICEF's stadiometer.

Before data collection, detailed study was done to know whether the research instruments and questionnaires are in line with the objectives of the study. The questionnaire was also pre-tested prior to data collection to ascertain validity. Questionnaire and the food frequency questionnaire were checked daily for completeness, consistency and clarity as mentioned earlier.

### 3.8. Data collection techniques

Data collection was spread over two phases, namely, initial contact with the participant, completing the semi structured questionnaire and taking anthropometric measurements. The socio-demographic and economic variables part involved asking the respondents about their age, income, education and occupation. Information on other variables and data on anthropometric measurements were obtained by following methods.

**Height measurement**:

In order to measure height subject was first asked to stand straight without shoes on horizontal platform with heels together and hanging the arms loose. Head was made at Frankfurt plane, buttocks and shoulder blades in contact with vertical surface of stadiometer. He was asked to take deep breath and stand tall to aid the straightening of the spine and shoulders relaxed. Movable headboard was lowered until it touches crown of head. Height measurement was taken at maximum inspiration, with examiner's eyes in level with headboard to avoid parallax error. Reading was taken to nearest millimeter. For reading falling between two values, lower reading was recorded (Gibson, 1993).

**Weight measurement**:

Measurement was taken after bladder was emptied and minimal clothing. The balance was placed on hard, flat surface and the scale was made zero. Subject was asked to stand unassisted, in the center of the platform and look straight ahead standing relaxed but still. Body weight was recorded to nearest 0.1 kg (Gibson, 1993).

**Dietary intake**:

Data was collected using 24 hour diet recall and food frequency questionnaire. Twenty-four diet recall was used to obtain information of calorie intake, carbohydrate intake, protein intake, fat intake and minerals (calcium and fat) in a day. The food frequency questionnaire was used to obtain information on the type of foods consumed by the respondents in the preceding days and the frequency of consumption of those foods. Various foods from different food groups were read out to the respondent, who in return was required to state the number of times she had consumed the food in the preceding days.

**Physical activity measurement**:

Physical activity part was used to collect data on type, frequency, duration and intensity of physical activity during work, transportation and leisure time in a typical week. WHO recommends at least 60 minutes of moderate-to vigorous-intensity Physical activity accumulated every day (WHO, 2020). Data on physical activity were collected using WHO

recommendation. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health-related physical activity (IPAQ, 2002).

### 3.9. Data analysis

The questionnaire were checked and rechecked at the end of each day. After the data are manually edited and coded, they are entered into a database immediately. Microsoft Excel 2010 and SPSS version 20 were used to analyze data. Descriptive analysis was used to describe percentage and distribution of respondents by socio demographic variables, physical activity, dietary patterns, medical characteristics and behavioral characteristics. Likewise, qualitative data were transcribed and coded by assigning labels to various categories. Verified test parameters were used to establish the relationships between the variables and indicators of overweight and obesity in adolescents.

### 3.10. Logistic and ethical consideration

Permission to take materials required and conduct survey was first taken from department of Nutrition and Dietetics, Central Campus of Technology. Ethical clearance was obtained from Nepal Health Research Council (appendix – B) and permission to conduct survey in Ratnanagar Municipality was obtained from the office of Ratnanagar Municipality. Written consent from school administration and from study subjects was obtained and the objective of the study was explained clearly to them. Privacy and confidentiality of collected information was ensured at all level.

# PART IV

## Result and Discussion

The study explores risk factors associated with overweight and obesity among adolescents studying in private schools of Ratnanagar Municipality. Moreover, socio-economic and demographic variable, adolescent's characteristic factors, dietary behavior factors, environmental condition factors associated with overweight and obesity were analyzed and results obtained are explained in the following headings:

### 4.1. Adolescent Characteristics

Of total 213 adolescents, 44.1% (94) were Girls and 55.9% (119) were Boys as shown in table 4.1. Similarly, 65.7% (140) were early adolescents while 34.3% (73) were late adolescents as shown in the table 4.1. According to National population and housing census 2011(CBS, 2012), 51.09% (5749) were early adolescents and 48.90% (5503) were late adolescents.

**Table 4.1** Percentage distribution of age group and gender of study population (n=213)

| **Age Category** | **Gender** | | **Total** |
|---|---|---|---|
| | **Boys** | **Girls** | |
| 10-14 years | 77 (36.2%) | 63 (29.6%) | 140 (65.7%) |
| 15-19 years | 42 (19.9%) | 31 (14.6%) | 73 (34.3%) |
| Total | 119 (55.9%) | 94 (44.1%) | 213 (100%) |

### 4.2. Heredity Characteristics

Out of 213 adolescents, 48.4% Children's Father were overweight and 40.8% Children's Mother were overweight as shown in the table 4.2.

**Table 4.2** Percentage distribution of Heredity characteristics of study population (n=213)

| **Parent Characteristics** | | **Frequency (N)** | **Percentage (%)** |
|---|---|---|---|
| Father overweight | Yes | 103 | 48.4% |
| | No | 110 | 51.6% |
| Mother overweight | Yes | 87 | 40.8% |
| | No | 126 | 59.2% |

### 4.3. Demographic Characteristics

Out of the 213 adolescents, 168 (78.9%) were from nuclear family and 45 (21.1%) were from joint family. Table 4.3 shows sample included 88.7% Hindu, 7.5% Buddhist, 0.9% Christian and 2.8% Muslim. Moreover, 61.5% were Brahmin, followed by 22.1% Janjati and very few 4.2% Madhesi. The result of CBS, 2011 survey also resulted that majority of population were Hindus and Brahmin in Ratnanagar Municipality. Out of 213 adolescents, 55.4% buy food from market whereas 44.6% are engaged with agriculture for food source.

**Table 4.3** Frequency distribution of demographic characters of study population (n=213)

| Variables | Frequency | Percentage |
|---|---|---|
| **Family Type** | | |
| Nuclear | 168 | 18.9% |
| Joint | 45 | 21.1% |
| **Religion** | | |
| Hindu | 189 | 88.7% |
| Buddhist | 16 | 7.5% |
| Christian | 2 | 0.9% |
| Muslim | 6 | 2.8% |
| **Ethnicity/Caste** | | |
| Brahmin/ Chhetri | 131 | 61.5% |
| Madhesi | 9 | 4.2% |
| Janjati | 47 | 22.1% |
| Dalit | 15 | 7% |
| Others | 11 | 5.2% |
| **Source of food** | | |
| Agriculture | 95 | 44.6% |
| Market purchase | 118 | 55.4% |

### 4.4. Socioeconomic Characteristics

From the table 4.4, shows that highest number 35.7% (76) adolescents father were educated up to secondary level followed by 30% (64) Higher secondary level whereas 5.2% (11) subjects fathers were illiterate. From the study about mother's education level, highest number 39.4% (84) of mothers was educated up to secondary level, whereas only 8.5% (18) of mothers had got university level education. Of total, 26.8% of mothers were educated up to primary level, 20.7% had got higher secondary level and 4.7% of mothers were illiterate. The national census data 2011 showed that 3.11% of adult Boys, and 3.49% of adult Girls are illiterate in Ratnanagar. Of total literate, 84.38% were educated up to School level and equivalent and 15.61% were educated above School level(Gurung, 2014).

**Table 4.4** Frequency distribution of education level of parents (n=213)

| **Variable** | Frequency | Percentage |
|---|---|---|
| **Father Education** | | |
| Illiterate | 11 | 5.2% |
| Primary level | 37 | 17.4% |
| Secondary level | 76 | 35.7% |
| Higher secondary level | 64 | 30% |
| Graduate | 25 | 11.7% |
| **Mother education** | | |
| Illiterate | 10 | 4.7% |
| Primary level | 57 | 26.8% |
| Secondary level | 84 | 39.4% |
| Higher secondary | 44 | 20.7% |
| Graduate | 18 | 8.5% |

The occupation type determines the income of family. Distribution of income and occupation are shown in Table 4.5. Family income was divided as below or above NRs 30,000 (NRB 2016). Table 4.5 shows 12.7% (27) families had monthly income less than or below NRs. 30,000 and 87.3% family had monthly income more than NRs. 30,000. The income of family was reported as per the occupation of family on non-respondent subject.

The study shows that the major occupation of father was Business 31.9% (68) followed by Service 27.2% (58) and foreign employment 26.3% (56). Only 10.8% (23) and 2.3% (5) of fathers were involved in Agriculture and labor respectively. From the table below, it can be seen that majority of mothers were housewife, 9.4% of mothers had their occupation as business and 8.5% as service worker. Only, 1.9% were employed as laborer, 1.4% in agriculture and 3.3% on others; meaning absent or subject do not know.

**Table 4.5** Frequency distribution of socio-economic characteristics of studied family (n=213)

| **Variable** | Frequency | percentage |
|---|---|---|
| **Income** | | |
| More than 30,000 | 186 | 87.3% |
| Less than 30,000 | 27 | 12.7% |
| **Father occupation** | | |
| Agriculture | 23 | 10.8% |
| Service | 58 | 27.2% |
| Labor | 5 | 2.3% |
| Business | 68 | 31.9% |
| Foreign employment | 56 | 26.3% |
| Others | 3 | 1.4% |
| **Mother occupation** | | |
| Housewife | 161 | 75.6% |
| Service | 18 | 8.5% |
| Labor | 4 | 1.9% |
| Business | 20 | 9.4% |
| Agriculture | 3 | 1.4% |
| Others | 7 | 3.3% |

### 4.5. Environmental Condition

From the finding as seen in table 4.6, the major source of drinking water in the house of adolescents were found to be tap water with 83.1% while 15% of households were using Tube well as major source of drinking water, 0.5% depends on river flow water and remaining 1.4% on other source like mineral water jar or they do not know about the source. Among the 213 families, 56.8% used to purify water while 43.3% did not. About water intake, 38% adolescents drink water along with meal whereas 24.9% drink water before meal and 37.1% in between meal as shown in the table below:

**Table 4.6** Frequency distribution of environmental characteristic of studied families (n=213)

| Variables | Frequency | Percentage |
|---|---|---|
| **Source of drinking water** | | |
| Tube well | 32 | 15% |
| River | 1 | 0.5% |
| Drinking water tap | 177 | 83.1% |
| Other | 3 | 1.4% |
| **Water purification** | | |
| Yes | 121 | 56.8% |
| No | 92 | 43.2% |
| **Water Intake time** | | |
| Along with meal | 81 | 38% |
| Before meal | 53 | 24.9% |
| In between meal | 79 | 37.1% |

### 4.6 Dietary Habit and behavior

Among 213 participants, 87.8% (187) majorities were non vegetarian while 12.2% (26) were vegetarian. From the study, 81.2% bring pocket money for snacks and rest 18.8% brings their snacks from home. Moreover, highest number of adolescents 34.7% (74) has their meal 3 times a day. Of total, 14.6% have meal less than 3 times a day, 30% for 4 times, 19.7% for 5 times and very few 0.9% (2) for 6 times a day.

**Table 4.7** Frequency distribution of dietary habit and behavior of adolescents (n=213)

| Variables | | Frequency | Percentage |
|---|---|---|---|
| **Type of food** | Vegetarian | 26 | 12.2% |
| | Non vegetarian | 187 | 87.8% |
| **Daily pocket Money** | Yes | 173 | 81.2% |
| | No | 40 | 18.8% |
| **Meal frequency** | Less than 3 times | 31 | 14.6% |
| | 3 times | 74 | 34.7% |
| | 4 times | 64 | 30% |
| | 5 times | 42 | 19.7% |
| | 6 times | 2 | 0.9% |
| **Try avoid sugar** | Yes | 82 | 38.5% |
| | No | 131 | 61.5% |
| **Try losing weight** | Yes | 147 | 69% |
| | No | 66 | 31% |
| **Feel about figure** | Overweight | 112 | 52.6% |
| | Normal | 93 | 43.7% |
| | Thin | 8 | 3.8% |
| **Eat in front of TV** | Daily | 11 | 5.2% |
| | Twice a week | 13 | 6.1% |
| | 3 to 4 Times a week | 132 | 62% |
| | Never | 57 | 26.8% |
| **Skip breakfast** | Daily | 67 | 31.5% |
| | Once a week | 21 | 9.9% |
| | 2 to 3 times a Week | 62 | 29.1% |
| | Never | 63 | 29.6% |

| | | | |
|---|---|---|---|
| **Knowledge overweight** | Yes | 146 | 68.5% |
| | No | 67 | 31.5% |
| **Knowledge on disease** | | | |
| | Yes | 164 | 77% |
| | No | 49 | 23% |

Among the participants 38.5% (82) try to avoid sugar in their meal. Furthermore, 69% (147) subjects try losing their weight. Almost half of the participants feel their body status to be overweight and only 3.8% of them found themselves thin. Moreover, 23.5% of subjects eat daily being in front of television. On contrary, 35.2% never eat in front of television. From the findings 31.5% skip their breakfast daily, 9.9% once a week 29.1% 2 to 3 times a week whereas 29.6% subjects never skip their breakfast as shown in the table above. The table shows that 68.5 % (146) subjects had knowledge about overweight but 31.5% (67) did not have knowledge. Similarly, 77% of them had known about disease cause because of obesity on contrary 23% did not have idea to that topic.

### 4.7 Physical activity level

Of total subject majority of them sit or stand during school break. While, only 8.5% walk and 6.6% run or play games during break time. Moreover, 22.1% sleep for less than 7 hours, 42.3% sleep about 7 to 8 hours and 35.7% sleep for more than 8 hours. From the table 4.8 most of the adolescent spent their time more in watching television or playing mobile games. It shows 41.3% spent 1 to 2 hours in mobile or television; also 3.8% spent more than 2 hours. From the finding most of them prefer school vehicle. Of total, 11.3% had private transport, 22.1% had cycle and 31.9% walk. The table below shows 62.9% of them prefers outdoor game and only 37.1% play indoor game. Also, 80.3% play game outside school.

**Table 4.8** Frequency distribution of physical activities in adolescents (n=213)

| Variables | Frequency | Percentage |
|---|---|---|
| **Activities on School break** | | |
| Sitting/standing | 181 | 85% |
| Walking | 18 | 8.5% |
| Run or Playing games | 14 | 6.6% |
| **Sleep** | | |
| Less than 7 Hours | 47 | 22.1% |
| 7 hours to 8 hours | 90 | 42.3% |
| More than 8 hours | 76 | 35.7% |
| **Time spent in mobile/TV** | | |
| Less than 30 min | 40 | 18.8% |
| 30 min to 1 hour | 77 | 36.2% |
| 1 hour to 2 hours | 88 | 41.3% |
| More than 2 hours | 8 | 3.8% |
| **Transport use** | | |
| Private vehicle | 24 | 11.3% |
| School transport | 74 | 34.7% |
| Cycle | 47 | 22.1% |
| Walk | 68 | 31.9% |
| **Type of Game** | | |
| Indoor game | 79 | 37.1% |
| Outdoor game | 134 | 62.9% |
| **Game outside school** | | |
| Yes | 171 | 80.3% |
| **No** | 42 | 19.7% |

WHO (2010) recommended for at least 60 minutes of moderate to vigorous intensity daily physical activity for adolescents but among the study subjects, 72.3% (154)% of them had achieved the required physical activity level as shown in table 4.9. To sum up, 59 (27.7%) adolescents are insufficiently active.

**Table 4.9** Distribution of physical activity perform by adolescents (n=213)

| | **Physical activity** | |
|---|---|---|
| | Insufficiently active | Active |
| Male | 39 (18.3%) | 80 (37.6%) |
| Female | 20 (9.4%) | 74 (34.7% ) |
| Total | 59 (27.7%) | 154 (72.3%) |

### 4.8 Dietary diversity score

Table 4.10 shows that majority of children 82.16% were consuming varieties of food while 17.84% were having less than four food groups in a day.

**Table 4.10** Frequency distribution of IDDS categories of studied population (n=213)

| IDDSI score | Frequency | Percentage |
|---|---|---|
| Less than 4 | 38 | 17.84% |
| 4 or more than 4 | 175 | 82.16% |

### 4.9 Dietary Intake

#### 4.9.1 Dietary intake in preceding one day

Table 4.11 shows distribution of intake of nutrients like carbohydrate, protein, fat, calcium and salt intake of respondents. Dietary intakes of the participants were compared with RDAs provided by ICMR (2010) and divided as adequate and inadequate.

The study revealed that the nutrient intake of majority of adolescents was above RDA. 31.5% of the study population had insufficient intake of energy according to their age and sex. The study concluded that majority of respondents had high carbohydrate intake i.e. 67.1% while 32.9% had low carbohydrate intake. The result of this study showed that 47.9% (102) of

the respondents consumed adequate protein while 52.1% (111) had low intake. Fat intake of adolescents below RDA was 55.9% and that for above RDA was 44.1%.

**Table 4.11:** Distribution of dietary intake of survey populations (n=213)

| Variables | Frequency | Percentage |
|---|---|---|
| **Adequacy of Energy Intake** | | |
| Low | 67 | 31.5% |
| Adequate | 138 | 64.8% |
| High | 9 | 4.2% |
| **Adequacy of Carbohydrate Intake** | | |
| Low | 70 | 32.9% |
| Adequate | 134 | 62.9% |
| High | 7 | 3.3% |
| **Adequacy of Protein Intake** | | |
| Low | 111 | 52.1% |
| Adequate | 102 | 47.9% |
| High | 0 | |
| **Adequacy of Fat Intake** | | |
| Low | 118 | 55.4% |
| Adequate | 63 | 29.6% |
| High | 32 | 15% |
| **Adequacy of Calcium Intake** | | |
| Below RDA | 112 | 52.6% |
| Above RDA | 101 | 47.4% |
| **Salt Intake** | | |
| Less than 5gm | 25 | 11.7% |
| Equal or greater than 5gm | 188 | 88.3% |

Table 4.11 also showed only 47.4% adolescents had sufficient intake of calcium and it may be related with the irregular and insufficient consumption of milk and its products.
Daily intake of salt should be restricted to less than 5gm per day(He and MacGregor, 2003). This study revealed that majority of adolescents had high salt intake. It might be due to lack of knowledge regarding the appropriate amount of salt consumption.

### 4.9.2 Consumption of food groups

Dietary practices and habits of the respondents were assessed using the food frequency questionnaire. The consumption of food was considered "regular" if ingested at least once a day, "frequent" when ingested 2-4 times a week, rarely if ingested once a week or less and Never if not like or consumed(Sato *et al.*, 2010).

For fiber intake assessment whole or unpolished cereals and pulses, and fruits and vegetables were taken in FFQ. As indicated in Table 4.12, 6.1% (13) consumed whole wheat flour majority of them 55.4% (118) consumed it rarely. Pulses and legumes was consumed by 26.8% (57) adolescents regularly, Green leafy Vegetables consumption was only 33.8% (72) regularly and for Fruits only 43.7% (93) consumed it regularly. This result reflect lack of variety in the food consumption pattern might be associated factors for increasing trend of overweight and obesity. Majority of the adolescents preferred rice over other cereals as it is easy to prepare and majority of people in Nepal prefer to eat rice on daily basis. Fruits which is good source of fibre and antioxidants, 6.1% (13) subjects never consume fruits.

Since dairy products are rich source of calcium, it was seen that 49.3% (105) adolescents consumed Milk on daily basis, 10.8% (23) consumed frequently while 19.7% (42) consumed it rarely and 20.2% (43) never consumed. Since meat and egg are rich source of protein very few subjects consumed meat and egg regularly.

**Table 4.12** Distribution of food/food groups intake (n=213)

| Food Groups | Variables | Frequency | Percentage |
|---|---|---|---|
| **Consumption of fiber** | | | |
| Whole wheat flour | Regular | 31 | 14.6% |
| | Frequent | 38 | 17.8% |
| | Rarely | 112 | 52.6% |
| | Never | 32 | 15% |
| Millet/Maize | Regular | 13 | 6.1% |
| | Frequent | 22 | 10.3% |
| | Rare | 118 | 55.4% |
| | Never | 60 | 28.2% |
| Pulses and legumes | Regular | 57 | 26.8% |
| | Frequent | 51 | 23.9% |
| | Rarely | 75 | 35.2% |
| | Never | 30 | 14.1% |
| polished dal | Regular | 104 | 48.8% |
| | Frequent | 40 | 18.8% |
| | Rarely | 42 | 19% |
| | Never | 27 | 12.7% |
| Green leafy vegetable | Regular | 72 | 33.8% |
| | Frequently | 54 | 25.4% |
| | Rare | 57 | 26.8% |
| | Never | 30 | 14.1% |
| Other Vegetable | Regular | 107 | 50.2% |
| | Frequently | 44 | 20.7% |
| | Rare | 38 | 17.8% |

| | | | |
|---|---|---|---|
| | Never | 24 | 11.3% |
| Root and tubers | Regular | 110 | 51.6% |
| | Frequently | 34 | 4.2% |
| | Rarely | 39 | 18.3% |
| | Never | 30 | 14.1% |
| Fruits | Regular | 93 | 43.7% |
| | Frequently | 56 | 26.3% |
| | Rarely | 51 | 23.9% |
| | Never | 13 | 6.1% |
| **Milk and milk products** | | | |
| Milk | Regular | 105 | 49.3% |
| | Frequent | 23 | 10.8% |
| | Rarely | 42 | 19.7% |
| | Never | 43 | 20.2% |
| Curd | Regular | 50 | 23.5% |
| | Frequently | 53 | 24.9% |
| | Rarely | 66 | 31% |
| | Never | 44 | 20.7% |
| Ghee | Regular | 54 | 25.4% |
| | Frequent | 40 | 18.8% |
| | Rarely | 65 | 30.5% |
| | Never | 54 | 25.4% |
| Paneer | Regular | 8 | 3.8% |
| | Frequent | 23 | 10.8% |
| | Rarely | 105 | 49.3% |
| | Never | 77 | 36.2% |

| | | | |
|---|---|---|---|
| **Meat and egg** | | | |
| White meat | Regular | 24 | 11.3% |
| | Frequently | 52 | 24.4% |
| | Rarely | 108 | 50.7% |
| | Never | 29 | 13.6% |
| Red Meat | Regular | 7 | 3.3% |
| | Frequently | 17 | 8% |
| | Rarely | 103 | 48.4% |
| | Never | 86 | 40.4% |
| Egg | Regular | 46 | 21.6% |
| | Frequently | 50 | 23.5% |
| | Rarely | 77 | 36.2% |
| | Never | 40 | 18.8% |
| **Energy dense food** | | | |
| Sweet beverage | Regular | 54 | 25.4% |
| | Frequently | 44 | 20.7% |
| | Rarely | 91 | 42.7% |
| | Never | 24 | 11.3% |
| Fast food | | | |
| Chowmein | Regular | 56 | 26.3% |
| | Frequently | 48 | 22.5% |
| | Rarely | 92 | 43.2% |
| | Never | 17 | 8% |
| Noodles | Regular | 40 | 18.8% |
| | Frequently | 58 | 27.2% |
| | Rarely | 96 | 45.1% |

| | | | |
|---|---|---|---|
| | Never | 19 | 8.9% |
| Biscuit | Regular | 76 | 35.7% |
| | Frequently | 52 | 24.4% |
| | Rarely | 65 | 30.5% |
| | Never | 20 | 9.4% |
| Chocolate | Regular | 86 | 40.4% |
| | Frequently | 50 | 25.5% |
| | Rarely | 57 | 26.8% |
| | Never | 20 | 9.4% |
| Chatpat | Regular | 53 | 24.9% |
| | Frequently | 60 | 28.2% |
| | Rarely | 83 | 39% |
| | Never | 17 | 8% |

Sweet beverages which contains high amount of sugar and calories, 20.2% respondents consumed it regularly. Similarly nearly half of the respondents consumed different kind of fast foods which are usually energy dense food. Majority 40.4% (86) of them consumed chocolates regularly 35.7% (76) of them consumed biscuits. The number of adolescents consuming fast food frequently is high but number of respondents consumed never is very low. Preference of fast food rather than preparing food by themselves is increasing. As, fast foods are easily available and no tedious involved. Consumption of fast foods and carbonated drinks lead to obesity as they are calorie dense.

### 4.10. Prevalence of overweight in adolescents

#### 4.10.1. According to International BMI classification

The result of the study was analyzed according to International BMI categorization as given by WHO. This figure 4.1 illustrates the fact that most of the boys and girls of age 10 to 19 years in Ratnanagar Municipality are overweight and obesity. 19.25% were found to be overweight while 3.76% were obese. Thus the prevalence of overweight and obesity was found to be far more than the prevalence of overweight and obesity as per the study conducted in Kaski district.

The study revealed 8.1% prevalence of overweight and obesity of among higher secondary level school adolescents with 5.8% overweight and 2.3% obese.

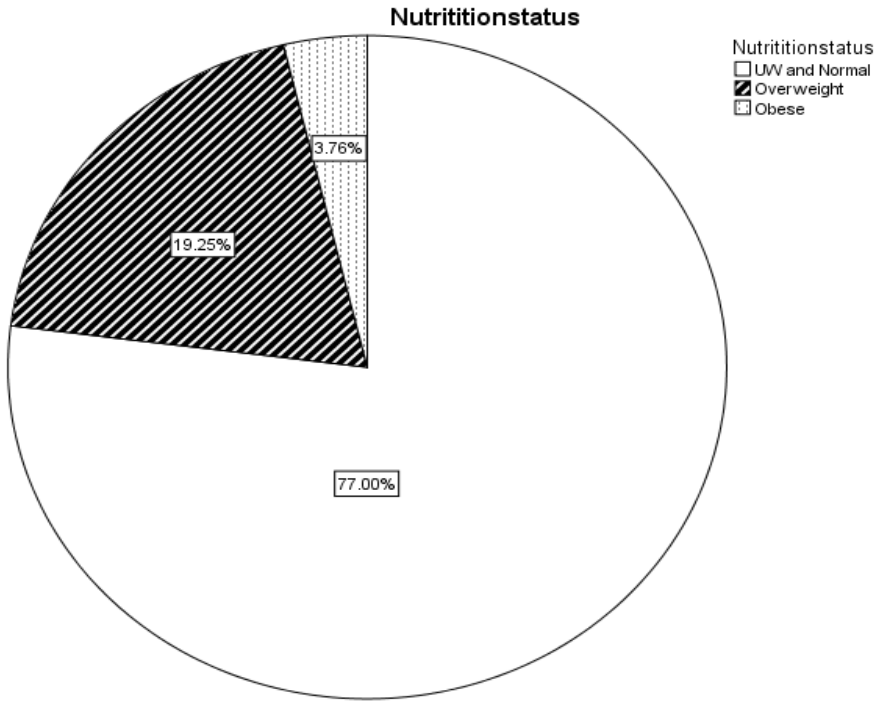


**Fig 4.1** Prevalence of overweight and obesity in adolescents.

While taking the gender in consideration, overweight was most prevalent in girls i.e. 22.34% of girls and 16.81% of boys were overweight. The mean BMI for boys was found to be 21.92±4.677 kg/m² and 22.86±4.152 kg/m² for girls.

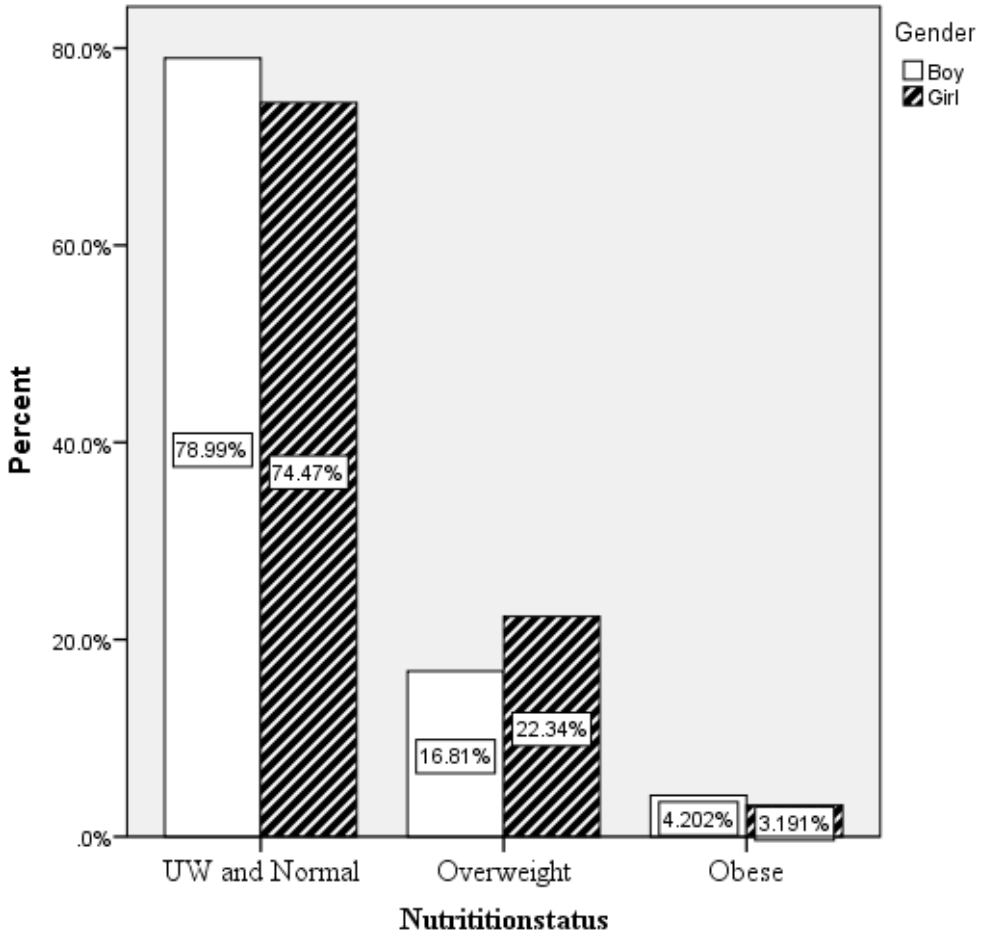


**Fig 4.2** Prevalence of overweight and obesity among adolescents according to gender

### 4.10.2. According to BMI for Age

Table 4.13 revealed that overweight and obesity were higher than thin and normal status. This shows adolescents are more at risk status. Prevalence of overweight was higher in female. Prevalence of obese status was higher in boys (15.5%) than that of girls (7%). Similarly 3(1.4%) were severely obese.

**Table 4.13** Frequency distribution of BMI for Age status according to gender of adolescents (n=213)

| | BAZ Status | | | |
|---|---|---|---|---|
| | Thin and Normal | Overweight | Obese | Severely Obese |
| Boys | 50 (23.5%) | 34 (16%) | 33 (15.5%) | 2 (0.9%) |
| Girls | 40 (18.8%) | 38 (17.8%) | 15 (7%) | 1 (0.5%) |
| Total | 90 (42.3%) | 72 (33.8%) | 48 (22.5%) | 3 (1.4%) |

The BMI for age Z-score curve is slightly skewed to the right side of WHO standard curve as shown in the figure 4.3. The median BMI for age z-score was found to be 0.1 WHO standard. Among 213 surveyed populations from private school of Ratnanagar Municipality, the prevalence of overweight was found to be 31.8%, 22.5% obese and 1.4% severely obese. BAZ-score was found to be 0.84±1.707 in Boys and 1.02±1.136 in Girls.

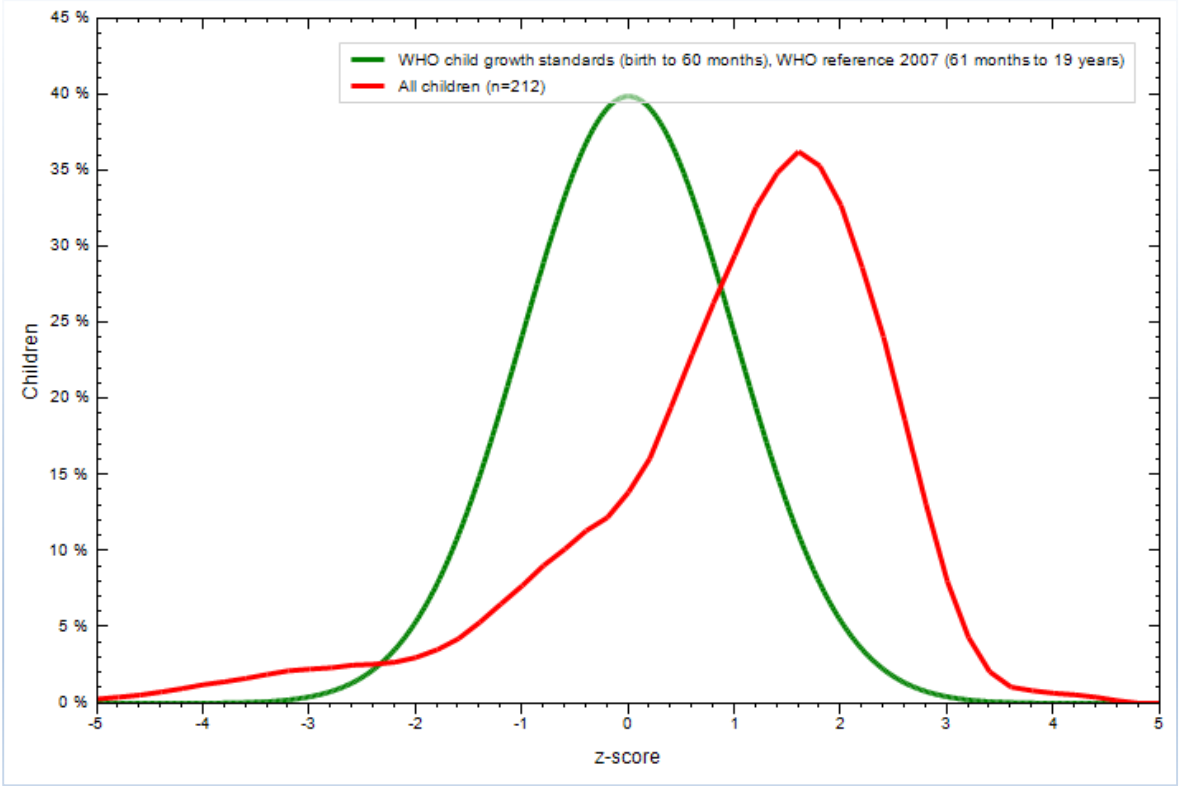


**Fig 4.3** Prevalence of overweight and obesity among adolescents according to BMI for Age

### 4.11. Factors associated with obesity

Over nutrition is assessed by BMI using WHO international cut-off and BMI for age for adolescents. Chi-square test was used to identify the characteristics that were related to overweight and obesity among adolescents.

#### 4.11.1 Factors associated with International BMI

The chi-square analysis showed that Skip breakfast (P=0.026), Feel about figure (P=0.000), try losing weight (P=0.000), Knowledge of overweight (P=0.025), eat in front of TV (P=0.000), hours spent in TV (P=0.043), try avoid sugar (P=0.002) and Physical activity (P=0.000) were significantly associated with BMI as shown in Table 4.13

**Table 4.14** Risk factors associated with overweight and obesity based on International BMI classification of adolescents (n=213)

| Factors | Category | Frequency | % | Chi-value | P-value |
|---|---|---|---|---|---|
| Gender | Male | 119 | 55.9% | 0.607 | 0.436 |
| | Female | 94 | 44.1% | | |
| Religion | Hindu | 189 | 88.7% | 3.530 | 0.475 |
| | Buddhist | 16 | 7.5% | | |
| | Christian | 2 | 0.9% | | |
| | Muslim | 4 | 1.9% | | |
| | Other | 2 | 0.9% | | |
| Skip Breakfast | Daily | 20 | 9.4% | 9.286 | 0.026* |
| | Once a week | 0 | 0% | | |
| | Twice a week | 17 | 8% | | |
| | Never | 12 | 5.6% | | |
| Feel about figure | Overweight | 40 | 18.8% | 21.930 | 0.000** |
| | Normal | 9 | 4.2% | | |
| | Thin | 0 | 0% | | |
| Try Losing weight | Yes | 39 | 18.3% | 21.930 | 0.000** |
| | No | 10 | 4.7% | | |
| Knowledge | Yes | 40 | 18.8% | 5.056 | 0.025* |
| | No | 9 | 4.2% | | |
| Eat in front of TV | Daily | 11 | 5.2% | 66.158 | 0.000** |
| | Twice a week | 10 | 4.7% | | |
| | 3 to 4 Times a week | 22 | 10.3% | | |

| | | | | | |
|---|---|---|---|---|---|
| | never | 6 | 2.8% | | |
| Hours spent in T.V. | <30 mins | 3 | 1.4% | 8.174 | 0.043* |
| | 30mins to 1hr | 19 | 8.9% | | |
| | 1hr -2hrs | 26 | 12.2% | | |
| | >2hrs | 1 | 0.5% | | |
| Try avoid sugar | Yes | 28 | 13.1% | 9.344 | 0.002* |
| | No | 21 | 9.9% | | |

Statistically Significant (P<0.05) * and (P<0.01) **

The study showed that overweight and obesity was found more in respondents consuming more calories than respondents consuming below RDA. High calorie intake than the requirement, results in storage of fat in the body leading calories(Jayamani *et al.*, 2013). High calories intake than the requirement, results in storage of fat in the body leading to overweight and obesity(Hall *et al.*, 2015) . This study concluded that respondents consuming high carbohydrate were found to be more overweight and obese than respondents consuming low carbohydrate.

Salt is not a direct cause of obesity but it is a major influencing factor(Ma *et al.*, 2015). Recently high salt intake has also been found to both be associated and predict the development of obesity, insulin resistance, and metabolic syndrome(Lanaspa *et al.*, 2018). In 2015, British and Chinese researchers reported that body fat increased for children and adults on high-salt diets. Eating an extra gram of salt each day increased the risk of obesity in children by 28% and in adults by 26% (McMillen *et al.*, 2009). Using the data from four waves of NHANES (1996-2006), it was found that each 1g increment in sodium intake led to 15% and 24% increases in the risks of obesity and central obesity, respectively(Deshmukh-Taskar *et al.*, 2013). Additionally, the results also revealed that increases in daily sodium intake or dietary sodium density were linked with significant elevations in measures of body composition, such as body fat mass, body lean mass, and total percent fat in the U.S. general population(Yang *et al.*, 2012).

**Table 4.15** Adequacy of nutrient intake

| Factors | Category | Frequency | % | Chi-square | P-value |
|---|---|---|---|---|---|
| Calories | Low | 8 | 3.8% | 10.538 | 0.005* |
| | Adequate | 36 | 16.9% | | |
| | High | 5 | 2.3% | | |
| Protein | Low | 25 | 11.7% | 0.30 | 0.862 |
| | Adequate | 24 | 11.3% | | |
| Calcium | Below RDA | 32 | 15% | 4.132 | 0.042* |
| | Above RDA | 17 | 8% | | |
| Salt | Less than 5g | 0 | 0% | 8.465 | 0.004** |
| | Equal or more than 5g | 49 | 23% | | |
| Sweet beverage | Regular | 37 | 17.4% | 14.319 | 0.003** |
| | Frequently | 20 | 9.4% | | |
| | Rarely | 50 | 23.5% | | |
| | Never | 16 | 7.5% | | |

Statistically Significant (P<0.05) * and (P<0.01) **

Other factors like sleeping time, protein intake, salt intake, unpolished dal consumption and green leafy vegetables intake were not significantly associated with overweight and obesity.

### 4.11.2 Factors associated with BMI for Age

The chi-square analysis showed that Mother overweight (P=0.013), try losing weight (P=0.000) eat in front of TV (P=0.000), hours spent in TV (P=0.043), feel about figure (P=0.000) and Physical activity (P=0.000) were significantly associated with BAZ score as shown in Table 4.15. According to the study on parenteral nutrition status and overweight children/adolescent in Rio de Janerio (de Marins, 2004) the study found that 20.7% of girls and 26.9% of boys were overweight, with a larger prevalence among children aged less than 9 years. These results

demonstrate the relationship between maternal nutritional status and overweight children and adolescents.

In current study there is significant association between try losing weight and overweight status. The finding of a cross national survey(Ojala *et al.*, 2007) indicate that most overweight adolescents were motivated to reduce their weight. The importance of promoting a healthy body image for all adolescents was highlighted by the fact that self-perception of overweight was found to be the most important factor leading to attempts to lose weight. One meta-analysis on relationship between watching television and overweight and obesity among child and adolescents revealed that eating while watching television was positively associated with being overweight(Ghobadi *et al.*, 2018).

**Table 4.16** Risk factors associated with overweight and obesity based on BMI for Age of adolescents (n=213)

| Factors | Category | Frequency | % | Chi-value | P-value |
|---|---|---|---|---|---|
| Mother overweight/obese | Yes | 59 | 27.7% | 6.112 | 0.013* |
| | No | 64 | 30% | | |
| Source of food | Agriculture | 47 | 22.1% | 5.824 | 0.054 |
| | Market | 76 | 35.7% | | |
| | Other | 0 | 0% | | |
| Skip Breakfast | Daily | 44 | 20.7% | 7.073 | 0.07 |
| | Once a week | 7 | 3.3% | | |
| | Twice/Thrice a week | 37 | 17.4% | | |
| | Never | 35 | 16.4% | | |
| Try losing weight | Yes | 101 | 47.4% | 23.360 | 0.000*∗ |
| | No | 22 | 10.3% | | |
| Eat in front of TV | Daily | 11 | 5.2% | 19.925 | 0.000*∗ |

| | | | | | |
|---|---|---|---|---|---|
| | Twice a day | 13 | 6.1% | | |
| | 3 to 4 times a week | 68 | 31.9% | | |
| | Never | 31 | 14.6% | | |
| Hours spent on TV | <30mins | 23 | 10.8% | 8.079 | 0.044* |
| | 30mins to 1Hr | 43 | 20.2% | | |
| | 1hr to 2hrs | 56 | 26.3% | | |
| | >2hrs | 1 | 0.5% | | |
| Feel about figure | Overweight | 85 | 39.9% | 36.917 | 0.000** |
| | Normal | 38 | 17.8% | | |
| | Thin | 0 | 0% | | |
| Calorie | Low | 26 | 12.2% | 17.747 | 0.000** |
| | Adequate | 88 | 41.3% | | |
| | High | 9 | 4.2% | | |
| Carbohydrate | Low | 32 | 15% | 8.031 | 0.018* |
| | Adequate | 88 | 41.3% | | |
| | High | 9 | 4.2% | | |
| Protein | Low | 66 | 31% | 0.279 | 0.598 |
| | Adequate | 57 | 26.8% | | |
| Fat | Low | 73 | 34.3% | 2.758 | 0.254 |
| | Adequate | 31 | 14.6% | | |
| | High | 19 | 8.9% | | |
| Calcium | Below RDA | 71 | 33.3% | 3.086 | 0.079 |

| | | | | | |
|---|---|---|---|---|---|
| | Above RDA | 52 | 24.4% | | |
| Salt | Below RDA | 0 | 0% | 38.710 | 0.000** |
| | Above RDA | 123 | 57.7% | | |
| Polished dal | Regular | 41 | 19.2% | 8.216 | 0.042* |
| | Frequent | 25 | 11.7% | | |
| | Rarely | 38 | 17.8% | | |
| | Never | 19 | 8.9% | | |
| Chocolate | Regular | 44 | 20.7% | 9.523 | 0.023* |
| | Frequently | 24 | 11.3% | | |
| | Rarely | 40 | 18.8% | | |
| | Never | 15 | 7% | | |

Statistically Significant (P<0.05)* and (P<0.01)**

Table 4.19 shows significantly associated factors with BMI for age i.e. Calorie intake (0.000), Carbohydrate Intake (P= 0.018), Salt Intake (P=0.000), Polished dal (P= 0.042) and chocolates (P= 0.023). Comparison of high-calorie, low-nutrient dense food consumption among obese and non-obese adolescent student Consumption of High Calorie from chips and soda significantly affect BMI for Age (Bandini, 1999).Dietary fiber too affect overweight and obesity. Carbohydrate intake and obesity sample population consuming low fiber food were found to be overweight in the study of vandam (Van Dam, 2007). Similarly, study done in Saudi adolescents shows compared with non-obese, obese boys and girls were less active, especially in terms of physical activity, had high carbohydrate food, high consumption of chocolates and sweetened beverage, but had lower intake of fibre rich food which is related to the study(Al-Hazzaa, 2012). Moreover, after adjustment for potential confounding factors including energy intake, salt intake 1g/d higher was associated with BMI higher by 0.28 in Japan, 0.10 in China, 0.42 in the United Kingdom, and 0.52 in the United States (Zhou, 2019).

# Part V

## Conclusions and Recommendations

### 5.1. Conclusions

The study focuses on the factors associated with overweight and obesity in adolescents studying in private schools of Ratnanagar Municipality. Following conclusions can be drawn from the study:

1. 19.25% respondents were overweight and 3.76% were obese. While based on BMI for age, total 31.8% were overweight, 22.5% were obese and 1.4% were severely obese.
2. 16.81% boys and 22.34% girls were overweight and 4.202% boys and 3.19% girls were obese. According to BMI for age, 16% boys and 17.8% were overweight, 15.5% boys and 7% girls were obese and 0.9% boys and 0.5% girls were severely obese.
3. Mean BMI was found to be 21.92 ± 4.677 kg/m² in Boys and 22.86 ±4.152 kg/m² in Girls, BAZ-score was found to be 0.84±1.707 in Boys and 1.02±1.136 in Girls.
4. The study showed that skip breakfast (P= 0.026), feel about figure (P=0.000), try losing weight (P=0.068), knowledge about overweight (P=0.025), hours spent on mobile and television (P=0.043) try avoiding sugar (P=0.002) and physical activity (P=0.000) were significantly associated with BMI (WHO cutoff)
5. The main associating factors with BAZ-score were Mother overweight (P=0.013), try losing weight (P= 0.000, hours spent on mobile and television (P=0.044) feel about figure (P= 0.000) and physical activity (P=0.000). And were found to have a significant association with Calorie intake (P=0.000), high carbohydrate intake (P=0.018), salt intake (P=0.000).
6. In today's time every individual is in the risk of being overweight and obese due to various associated factors such as high calorie intake, increase in sedentary habits, lack of balance foods etc. So, taking in concern with every associated factors, problem of overweight and obesity must be taken as a disease and given a major importance to reduce it.

## 5.2. Recommendations

Based on the results of the study following recommendations could be made:

1. The study point to a need for behavior change related to improve lifestyle through increased physical activity and improved dietary practices. For this, Provision of playing ground and quality food providing canteen should be made.
2. There is need of awareness program related to overweight and obesity in schools. The awareness could focus on areas like food diversity, nutrition requirement, making a healthy choices and eating balanced diet.
3. Knowledge about the importance of consuming homemade and local food products and ways of creating nutritious meals for children can be advocated through training.
4. Further study should be done to see other unexplored factors that were not included in the present study.

# Part VI

## Summary

Adolescence is the stage of life of an individual when there is tremendous pace in growth and change that is second only to that of infancy. And it demands for higher intake of energy and nutrients. There dietary intakes and habits are greatly influenced by various social and psychological factors while the influence of the family tends to decline. This ultimately affects the nutritional status. The foundations of health in adulthood and old age are laid during childhood and adolescence so, the health and nutritional status during adolescence becomes more important. Obesity is a major health problem, and there is an increasing trend of overweight and obese individuals in developing countries like Nepal. The prevalence of non-communicable diseases is increasing in Nepal. Overweight and obesity are the major risk factors for non-communicable diseases.

A cross sectional survey was conducted to assess the risk factors associated with overweight and obesity of adolescents studying in private schools of Ratnanagar municipality, Chitwan district. From randomly selected eight schools, 213 adolescents were chose by random selection according to proportion. A well designed and pretested set of questionnaire to collect sanitation conditions, Behavioral characteristics, physical activity and dietary practices of the target population was prepared. Weight and height were measured by using digital weighing balance (measuring up to 180 kg and least count 0.1 kg) and stadiometer respectively. Dietary intake was assessed by 24 hour dietary recall and food frequency questionnaire. Data collected was analyzed using WHO Anthroplus version 1.0.4, SPSS version 20 and Microsoft excel. Chi-square test was used to analyze the factors associated with BMI.

Out of 213 adolescents 55.9% were boys and 44.1% were girls and the result concluded that 19.25% respondents were overweight and 3.76% were obese using WHO BMI criteria. Likewise, 57.7% of total respondents were under overweight, obese and severely obese. Mean BMI was found to be 21.92±4.677 kg/m² for male and 22.86±4.152 kg/m² for female. Skip breakfast, try losing weight, hours spent on television, try avoiding sugar, physical activity were significantly associated with overweight and obesity. Proper intervention programs should be implemented in order to correct risk factors associated with overweight and obesity.

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# Appendices

## Appendix A

**Tribhuvan University**

**Central Campus of Technology**

**Informed ascent form for study participants**

Namaste,

My name is Kiran Tiwari, a student of Nutrition and Dietetics at Central Campus of Technology, Dharan is going to conduct dissertation work in Private schools of Ratnanagar Municipality for the award of bachelor's degree in Nutrition and Dietetics. I am going to give you information about this research and invite you to participate in this research.

The topic for the study is **RISK FACTORS ASSOCIATED WITH OVERWEIGHT AND OBESITY AMONG ADOLESCENT STUDYING IN PRIVATE SCHOOL OF RATNANAGAR MUNICIPALITY, CHITWAN.**

Under this study, risk factors associated with obesity and overweight among adolescent will be study. This study will provide information about the prevalence and risk factors associated with obesity and overweight. During the study height and weight of the participants will be measured and socio demographic and economic factors, behavioral factors, physical activity, dietary factors and health related factors will be assessed. The information obtained from the participants will be kept confidential.

You have been selected for the study, you will be asked some questions and some physical measurements will be taken. This study will make you known about your nutritional status. Some questions may be personal, all information you provide will be important and the privacy of information will be maintained and they will not be misused. Your participation in this study will be voluntary. You may not answer some or all questions if you feel them personal or sensitive. But I hope you will be participated in this study.

Do you want to get participated in this study?

Yes, I want to be participated in the study and permit to take all measurements and ask the questions required for the study.

**Name of participant: ……**

**Signature of participant: ……..…**

**Name of school: ……..**

**Date ……**

## Appendix B

## Survey questionnaire

### QUESTIONNAIRE

Code No: | | | |

**A. General Information:**

1. Name of Participant: .....

2. Date of birth:

| | | |
|---|---|---|
| | | |

Year month day

3. Age: ..... 4. Gender: .....

1. Address: Ratnanagar.....
2. Father's Name:.....
3. Mother's Name: .....
4. Contact: .....
5. Is your father overweight/obese? Yes/no .....
6. Is your mother overweight/obese? Yes/no .....

**B. ANTHROPOMETRIC MEASUREMENT**

| | Reading1 | Reading2 | Reading3 | Mean |
|---|---|---|---|---|
| Height (cm) | | | | |
| Weight (Kg) | | | | |

**C. Socio-demographic and economic status**

7. Number of total family member: .....

Female..... Male.....

8. Type of family: a. small
b.joint

9. What is your religion?
   a. Hindu b. Buddhist

c. Christian
d. Muslim
e. Others (specify) ……..

10. What is the occupation of father?
a. Agriculture
b. Service
c. Labor
d. Business
e. Foreign employment
f. Others (specify).....

11. What is the occupation of mother?
a. Housewife
b. Service
c. Labor
d. Business
e. Agriculture
f. Others (specify)……...

12. Mother's educational qualification
a. Illiterate
b. Primary level
c. Secondary level
d. Higher secondary
e. Graduate

13. Father's educational qualification
a. Illiterate b. Primary level c. Secondary level d. Higher secondary level and e.Graduate

14. Total family income per month
a. >30,000 b. 30,000 c. <30,000

15. Which ethnic group do you belong?
a. Brahmin/chhetri
b. Madhesi
c. Janjaati
d. Dalit
e. Others (specify)……..

16. What is the main source of food in the house?
a. Agriculture
b. Market purchase
c. Donation
d. Other (specify).....

**D. Behavioral Factor:**

22. What is your source of drinking water?
a. Tube well
b. River
c. Well
d. Drinking water tap
e. Other (specify)……

23. Do you purify drinking water?
a. Yes
b. No

24. How often do you eat in front of TV?
a. Daily
b. Twice a week
c. 3-4 times a week
d. Never

25. Do you wake at night, get out of bed and eat?
a. Daily
b. Twice a week
c. 3-4 times a week
d. Never

26. Do you smoke or not?
    a. Past smoking c)non-smoker
    b. Current smoking

27. Do you drink? (alcoholic drink)
    a. Yes b) No

28. Do you drink Soft drink? a. Yes b. No

29. How often do you skip breakfast?
    a. Daily c) twice/Thrice a week
    b. Once a week d) Never

30. How many hours do you sleep at night? ……..

31. How many hours you spend doing homework? ……..

32. How many hours you spent infront of television? ……

33. Do you Help parent in doing Domestic activities? ……

34. What do you do at school break ?

    a. Sitting (talk/eat/read) b. Stand/walk c. Run or play games

35. Do you have daily pocket money? 1) Yes 2) No 3) Sometimes(_____times a week)

36. Do you buy food from school canteen/ shops /vendor? 1) Yes 2) No

If yes, what do you usually buy? _____

37. How do you feel about your figure? 1) Overweight 2) Right weight 3) Thin

38. Have you ever tried losing weight? 1) Yes 2) No

39. How often do you have stress?
    a. Daily c) 2-3 times in a week
    b. Never

40. how many food groups you consume a day?

    a. 2 b. 3 c. 4 d. 5 e. 6 or more

41. If yes which type of food do you prefer?
    a. Processed packet food c) Cereals
    b. Fruits and vegetables

42. Do you have any knowledge regarding obesity and overweight?
    a. Yes b. No

43. Do you know obesity cause diseases? A. Yes b. No

**D. Physical activities (SHORT IPAQ)**

44. Which form of transport do you normally use when travel to and from school and apart from your journey to and from school?

1) Private vehicle 2) Cycle 3) Public/school transport 4) Walk

How many minutes you usually spend for exercise?

a. 30 min b. 60 min c. 90 min d. more

| Activity | Type/Intensity (low-moderate-high) | Days per weeks | Duration (minutes) |
|---|---|---|---|
| Stretching/yoga | | | |
| Cardio/Aerobics (walking, jogging, biking etc.) | | | |
| Strength-training (weight lifting, pilates (without equipment) | | | |
| Sports or leisure | | | |
| Others (specify/describe) | | | |

**E. Food consumption pattern**

45. What type of food do you consume?
    a. Vegetarian
    b. non-vegeterian

46. What is your staple food?
    a. Rice
    b. Wheat
    c. Millet
    d. Maize
    e. Others (specify)

47. How frequently do you eat meat?
    a) Once a week
    b) Twice a week
    c) Thrice a week
    d) Daily

48. How often do you skip breakfast?
    a) Daily
    b) Twice/ thrice a week
    c) Twice/ thrice a week
    d) Once a week

49. Do you try to avoid eating foods that contain sugars?
    a) Yes
    b) No

50. How many meals do you eat in a day? _ _ _ _ _

51. When do you take water?
    a) Along with meals
    b) Before meals
    c) In between meals

52. Do you buy food from school canteen/ shops /vendor?

1) Yes 2) No

If yes, what do you usually buy? _____

**F. FOOD FREQUENCY TABLE**

| Types of food | More than once a day | Daily | Thrice a day | Once a week | Once a fortnight | Once in a month | Never | Remarks |
|---|---|---|---|---|---|---|---|---|
| CEREALS | | | | | | | | |
| Rice | | | | | | | | |
| Wheat | | | | | | | | |
| Maize/ Millet/ Barley | | | | | | | | |
| PULSES/LEGUMES | | | | | | | | |
| Whole daal | | | | | | | | |
| Polished daal | | | | | | | | |
| GLV/SPINACH | | | | | | | | |
| OTHER VEGGIES | | | | | | | | |
| ROOTS & TUBERS | | | | | | | | |
| FRUITS | | | | | | | | |
| DAIRY PRODUCTS | | | | | | | | |
| Milk | | | | | | | | |
| Curd | | | | | | | | |
| Ghee | | | | | | | | |
| Butter | | | | | | | | |
| Paneer | | | | | | | | |
| Cheese | | | | | | | | |
| MEAT | | | | | | | | |
| White meat (chicken/ fish) | | | | | | | | |
| Red meat (mutton/ goat/beef) | | | | | | | | |
| EGG | | | | | | | | |
| PROCESSED PACKAGED FOODS | | | | | | | | |
| Sweetened beverages/ soft drinks | | | | | | | | |
| Chowmein/Momo/ eggrolls/ pizza | | | | | | | | |
| Instant noodles | | | | | | | | |
| Cookies/biscuits | | | | | | | | |
| Sweets/chocolate | | | | | | | | |
| Chatpatey/ paanipuri | | | | | | | | |

**G. 24 Hours food recall**

| TIMING | Description of food | serving | Amounts |
|---|---|---|---|
| Breakfast | | | |
| Lunch | | | |
| Snacks | | | |
| Dinner | | | |
| 11pm-6am | | | |

## Appendix C

## Study site


Ratnanagar

44200

## Appendix D

## NHRC Approval Letter

Government of Nepal

**Nepal Health Research Council (NHRC)**

Estd. 1991

Ref. No.: 2084

**9 April 2020**

**Mr. Kiran Tiwari**
Principal Investigator
Central Campus of Technology
Dharan

**Ref: Approval of thesis proposal**

**Dear Mr. Tiwari,**

This is to certify that the following protocol and related documents have been reviewed and granted expedited from review by the Expedited Review Sub Committee for implementation.

| | | | |
|---|---|---|---|
| **ERB Protocol Registration No.** | 172/2020 BT | **Sponsor Protocol No** | NA |
| **Principal Investigator/s** | Mr. Kiran Tiwari | **Sponsor Institution** | NA |
| **Title** | Risk factors associated with overweight and obesity among adolescents studying in the private school of Ratnanagar Municipality, Chitwan | | |
| **Protocol Version No** | Version 2.0 | **Version Date** | 16 February 2020 |
| **Other Documents** | 1. Data collection tools<br>2. Acceptance letter from study site<br>3. Assent form | **Risk Category** | Less than minimal risk |
| **Expedited Review** | Proposal: √<br>Amendment:<br>Re-submitted:<br>**Meeting Date:** 6 April 2020 | **Duration of Approval** 9 April 2020 to 9 April 2021 | **Frequency of continuing review** |
| **Total budget of research** | **NRs 8,500.00** | | |
| **Ethical review processing fee** | **NRs 1,000.00** | | |

Tel: +977 1 4254220, Fax: +977 1 4262469, Ramshah Path, PO Box: 7626, Kathmandu, Nepal
Website: http://www.nhrc.gov.np, E-mail: nhrc@nhrc.gov.np

Government of Nepal

# Nepal Health Research Council (NHRC)

Estd. 1991

Ref. No.: 2084.

**Investigator Responsibilities**

- Any amendments shall be approved from the ERB before implementing them
- Submit progress report every 3 months
- Submit final report after completion of protocol procedures at the study site
- Report protocol deviation / violation within 7 days
- Comply with all relevant international and NHRC guidelines
- Abide by the principles of Good Clinical Practice and ethical conduct of the research

If you have any questions, please contact the Ethical Review M & E Section at NHRC.

**Thanking you,**

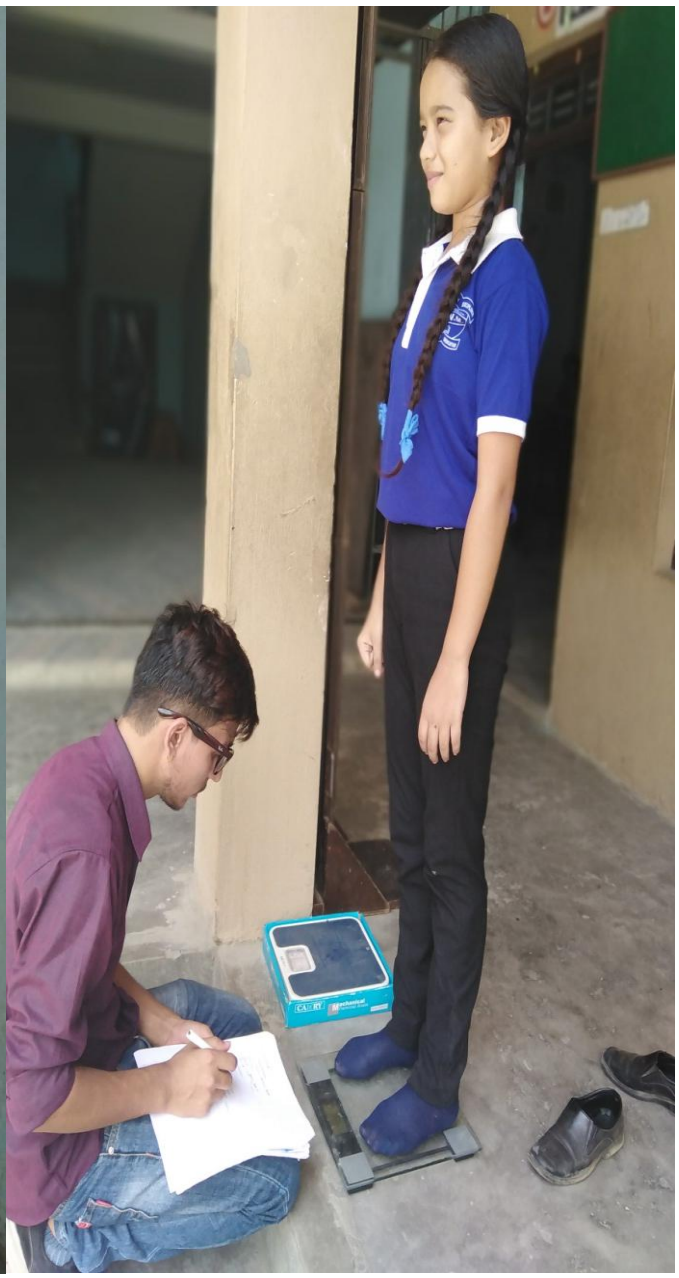
**Dr. Pradip Gyanwali**
**Executive Chief**
**(Member-Secretary)**

Tel: +977 1 4254220, Fax: +977 1 4262469, Ramshah Path, PO Box: 7626, Kathmandu, Nepal
Website: http://www.nhrc.gov.np, E-mail: nhrc@nhrc.gov.np

## Appendix E

## Photo Gallery

**Measurement of Height**



**Measurement of Weight**

**Correlations**

| | | Nutritionstatus | Energy | Carb | pro | Lipid |
|---|---|---|---|---|---|---|
| Nutritionstatus | Pearson Correlation | 1 | .294** | .212** | .013 | -.073 |
| | Sig. (2-tailed) | | .000 | .002 | .854 | .286 |
| | N | 213 | 213 | 213 | 213 | 213 |
| Energy | Pearson Correlation | .294** | 1 | .818** | .005 | -.024 |
| | Sig. (2-tailed) | .000 | | .000 | .939 | .725 |
| | N | 213 | 213 | 213 | 213 | 213 |
| Carb | Pearson Correlation | .212** | .818** | 1 | .002 | .009 |
| | Sig. (2-tailed) | .002 | .000 | | .974 | .894 |
| | N | 213 | 213 | 213 | 213 | 213 |
| pro | Pearson Correlation | .013 | .005 | .002 | 1 | .143* |
| | Sig. (2-tailed) | .854 | .939 | .974 | | .037 |
| | N | 213 | 213 | 213 | 213 | 213 |
| Lipid | Pearson Correlation | -.073 | -.024 | .009 | .143* | 1 |
| | Sig. (2-tailed) | .286 | .725 | .894 | .037 | |
| | N | 213 | 213 | 213 | 213 | 213 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).