

**FACTORS ASSOCIATED WITH NUTRITIONAL STATUS
AMONG ADOLESCENTS OF KATHMANDU
METROPOLITAN CITY: A COMPARATIVE STUDY
BETWEEN PUBLIC AND PRIVATE SCHOOLS**

By

Ruby Manandhar

NHRC No: 690/2023

Nepal Health Research Council

Ram Shah Path, Kathmandu

Nepal

August, 2024

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Research approval letter



Government of Nepal
Nepal Health Research Council (NHRC)



Ref. No.: 967

5 January 2024

Ms. Ruby Manandhar
Principal Investigator
CAFODAT College, Lalitpur

Ref: Approval of research protocol

Dear Ms. Manandhar,

This is to certify that the following protocol and related documents have been reviewed and granted approval through the expedited review process for its implementation.

Protocol Registration No/ Submitted Date	690/2023 28 November 2023	Sponsor Protocol No	NA
Principal Investigator/s	Ms. Ruby Manandhar	Sponsor Institution	NA
Title	Factors associated with Nutritional Status among Adolescents of Kathmandu Metropolitan City: A Comparative Study between Public and Private Schools		
Protocol Version No	NA	Version Date	NA
Other Documents	1. Data collection tools 2. Informed Consent Form 3. Assent form 4. Support letters 5. Role and responsibility 6. Ethics training certificate 7. Col Declaration letter 8. Work plan	Risk Category	Minimal risk
Co-Investigator/s	1. Mr. Raj Kumar Sangroula		
Study Site	Kathmandu Metropolitan City		
Type of Review	☒ Expedited ☐ Full Board Review Date: 5 January 2024	Timeline of study 5 January 2024 to April 2024 Duration of Approval 5 January 2024 to 4 January 2025 This approval will be valid for one year	Frequency of continuing review NA
Total budget of research	NRs 90,000.00		
Ethical review processing fee	NRs 5,000.00		

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Acknowledgements

I would like to express my deepest gratitude to my co-investigator Mr. Raj Kumar Sangroula, Assistant Professor, Little Buddha College of Health Science for his valuable support and consistence responsiveness throughout my research work. I would also like to express my sincere thanks to Sr. Dt and Assistant Professor Nani Shova Shakya for her constant support for the path to achieve the success for the paper.

I would like to sincere thanks to the Principal, Prof. Jagat Bahadur KC and Vice Principal, Mr. Man Bahadur Shrestha of CAFODAT college for their constant motivation. This endeavor would not have been possible without the general support of Prof. Kalpana Tiwari, Head of Department, Nutrition and Dietetics Department

I would also like to convey my special thanks to the respective Principals of the schools, who have given me the consent and opportunity to conduct data collection of my research. Also, would like to thanks all the students who participated during my study. I am extremely grateful to my family members especially to my husband, uncle and friends who provided me with a moral support and enthusiastic participation to help me during my research paper.



Ruby Manandhar

Abstract

Adolescence is a critical period of growth and development, second only to infancy in terms of rapid changes and nutritional needs. Overweight and obesity are major risk factors for several chronic diseases, including diabetes, cardiovascular diseases, and cancer. This study aimed to assess the prevalence and factors associated with nutritional status among the adolescents of private and public schools of Kathmandu Metropolitan City. An analytical cross-sectional study was carried out among 293 adolescents from public (158) and private (135) schools. A simple random sampling was used for the selection of the schools and students. Anthropometric measurement was used to determine adolescents' nutritional status and household measurements was used for the 24-hour recall diet. SPSS version 26 was applied to analyze the structured questionnaire data using the chi-square test, binary and multiple logistic regression.

Out of 293 participants, 2.4% were found severely thin, 14.7% thin, 61.1% normal, 17.1% overweight and 4.8% obese. Prevalence of overweight/obesity was higher in private schools than public school i.e. 22% and 12.7% respectively. Private school adolescents were statistically significant with overweight/obese ($p=0.008$) than public school adolescents. Dietary factors like intake of nuts ($COR=2.031$, 95% CI 1.014-4.065; $p=0.045$), processed/fast food ($COR=2.094$, CI 1.156-3.793; $p=0.015$) were significantly associated with overweight/obesity. Adolescents who had intake of eggs ($AOR=3.704$, 95% CI 1.174-11.688; $p=0.026$), protein ($AOR=5.465$, 95% CI 1.518-19.683; $p=0.009$), and calorie intake ($AOR=2.431$, 95% CI 1.096-5.391; $p=0.029$) were more likely to be overweight/obesity. Thus, it suggests a need for interventions targeting dietary habits esp. in private schools to address high prevalence of overweight/obesity among adolescents.

Table of contents

Research approval letter	iii
Acknowledgements	iv
Abstract.....	v
List of tables.....	x
List of figures	xi
List of abbreviations.....	xii
Part I.....	1
Introduction.....	1
1.1 Background.....	1
1.2 Statement of the problem	3
1.3 Significance of the study	4
1.4 Research questions	5
1.5 Objective of the study	5
1.5.1 General objective	5
1.5.2 Specific objective	5
1.6 Conceptual framework	6
1.7 Limitation of the study	6
Part II.....	7
Literature review	7
2.1 Introduction.....	7
2.2 Review of literature.....	7
2.2.1 Adolescence nutrition	7
2.2.2 Physical activity.....	9
2.2.3 Dietary pattern	9
2.2.4 Prevalence of overweight/obesity.....	9
2.2.5 Waist-hip ratio	11
2.2.6 Nutritional status of adolescents.....	12
2.2.7 Minimum dietary diversity.....	12
2.2.8 Eating habits	12

2.2.9 Screen time.....	13
Part III	15
Methods and materials.....	15
3.1 Study design.....	15
3.2 Study duration.....	15
3.3 Study area	15
3.4 Study population	15
3.5 Study unit.....	15
3.6 Selection criteria	15
3.6.1 Inclusion criteria.....	15
3.6.2 Exclusion criteria.....	16
3.7 Sample size	16
3.8 Criteria for sample selection.....	16
3.9 Sampling techniques	17
3.10 Sampling technique procedure.....	18
3.11 Data collection tools.....	19
3.11.1 Dietary recall questionnaire	19
3.11.2 Food frequency questionnaire (FFQ).....	19
3.12 Data collection techniques.....	19
3.12.1 Dietary recall	19
3.12.2 Dietary intake assessment	19
3.12.3 Food frequency method	20
3.12.4 Anthropometric measurements.....	20
3.13 Data management and analysis.....	20
3.14 Pretesting of the tools	21
3.15 Validation and reliability of the study tools	21
3.16 Study variables.....	22
3.16.1 Dependent variables.....	22
3.16.2 Independent variables	22
3.17 Operational definitions	22
3.18 Ethical consideration	26
Part IV	27
Results & discussions.....	27

4.1 Results	27
4.1.1 Socio-demographic characteristics	27
4.1.2 Nutritional status of public and private school's students	29
4.1.3 Waist-hip ratio of adolescents of public and private schools.....	29
4.1.4 Life style characteristics among adolescents of public and private schools	30
4.1.5 Adolescent physical parameters	32
4.1.6 Nutritional status of both schools among adolescents	33
4.1.7 Age wise classification of nutritional status of adolescents.....	33
4.1.8 Sex-wise classification of nutritional status among adolescents.....	34
4.1.9 Ethnicity wise distribution with nutritional status.....	34
4.1.10 Family type wise distribution with nutritional status among adolescents	35
4.1.11 Family monthly income	35
4.1.12 Dietary pattern among adolescents of public and private schools.....	36
4.1.13 24-hour recall diet of public and private schools among adolescents	39
4.1.14 Age-wise distribution of macro-nutrients according to 24-hour dietary recall	40
4.1.15 24-hour dietary recall among adolescents of public and private schools	40
4.1.16 Minimum dietary diversity among adolescents of public and private schools	42
4.1.17 Association of overweight/obesity with socio-demographic characteristics of public and private schools.....	43
4.1.18 Association of overweight/obesity with life style characteristics of public and private schools.....	45
4.1.19 Association of overweight/obesity with dietary pattern of public and private schools	48
4.1.20 Association of overweight/obese with 24-hour dietary recall of public and private schools.....	51
4.1.21 Binary logistic regression of public and private schools with overweight/obesity	52
4.1.22 Binary logistic regression of socio-demographic characteristics of public and private schools.....	53
4.1.23 Binary logistic regression of life style characteristics of public and private school's students	55
4.1.24 Binary logistic regression on dietary pattern among adolescent of public and private schools.....	57
4.1.25 Binary logistic regression between associated variables of 24-hour recall diet	60
4.1.26 Multiple regression analysis of overweight and obesity with associated factors	61

4.2 Discussion.....	65
Part V	72
Conclusions & recommendations.....	72
5.1 Conclusions.....	72
5.2 Recommendations.....	73
Part VI	74
Summary.....	74
6.1 Summary.....	74
References	76
Annex-I	82
Assent to participate in a research subject	82
Annex-II.....	83
Annex-III	84
Informed consent form.....	84
Annex-IV.....	85
Nepali Consent Form	85
Annex V	86
Questionnaire.....	86
Annex VI.....	91
24-hour dietary recall form.....	91
Annex-VII	92
Letters from schools	92
Annex- IX.....	96
Standardization of food.....	96
Photo gallery	99

List of tables

Table 1: Socio-demographic characteristics of public and private schools.....	28
Table 2: Adolescents WHR distribution according to WHO (n=293)	30
Table 3: Lifestyle characteristics of public and private schools among adolescents	31
Table 4: Adolescents physical parameters (n=293)	32
Table 5: Ethnicity wise distribution with nutritional status among adolescents	35
Table 6: Family monthly income distribution with nutritional status	36
Table 7: Dietary pattern among adolescents in public and private schools.....	38
Table 8: Mean and SD of 24-hour dietary recall.....	39
Table 9: Age-wise distribution of macro-nutrients according to 24-hour dietary recall....	40
Table 10: 24-hour dietary recall among adolescents of public and private schools	41
Table 11: Socio-demographic characteristics of public schools	43
Table 12: Socio-demographic characteristics of private schools	44
Table 13: Association between life style characteristics of public schools	46
Table 14: Association of overweight/obese with lifestyle characteristics among adolescents	47
Table 15: Association of overweight/obesity with dietary pattern in public schools	48
Table 16: Association of overweight/obesity with dietary pattern in private schools	49
Table 17: Association of overweight/obese with 24-hour dietary recall of public school's students	51
Table 18: Association of overweight/obese with macronutrients of private schools.....	52
Table 19: Binary logistic regression of public and private schools with overweight/obesity	52
Table 20: Binary logistic regression of socio-demographic characteristics of public and private schools.....	54
Table 21: Binary logistic regression of lifestyle characteristics of public and private schools	56
Table 22: Binary logistic regression on dietary pattern of public and private schools	59
Table 23: Binary logistic regression analysis of 24-hour dietary recall.....	61
Table 24: Multiple regression analysis of overweight/obese with associated factors.....	63
Table 25: Multiple regression analysis of overweight/obesity with associated factors	64

List of figures

Figure 1: Adolescent's BMI distribution of public and private schools (n=293).....	29
Figure 2: Nutritional status of both schools among adolescents	33
Figure 3: Age-wise classification of nutritional status among adolescents	33
Figure 4: Sex-wise classification of nutritional status among adolescents.....	34
Figure 5: Family type wise distribution with nutritional status among adolescents	35
Figure 6: Minimum dietary diversity among adolescents of public schools	42
Figure 7: Minimum dietary diversity among adolescents of private schools	42

List of abbreviations

Abbreviations	Full form
AOR	Adjusted Odd's Ratio
BMI	Body Mass Index
BAZ	BMI-for-age
CDC	Centre for Disease Control
CI	Confidence Interval
COR	Crude Odd's Ratio
DV	Dependent Variable
ERB	Ethical Review Board
FAO	Food and Agriculture Organization of United Nations
FANTA	Food And Nutrition Technical Assistance
FFQ	Food Frequency Questionnaire
FCT	Food Composition Table
GT	Greater Than
GSHS	Global School-based Student Health Survey
HCI	Human Capital Index
HDL	High Density Lipoprotein
ICMR	Indian Council of Medical Research
IV	Independent Variable
KMC	Kathmandu Metropolitan City
LMICs	Low Middle-Income Country's
IT	Less than
MOHP	Ministry of Health and Population
MSNP	Multi-sectoral Nutrition Plan
MDD	Minimum Dietary Guidelines
NCDs	Non-Communicable Disease's
NDHS	Nepal Demographic Health Survey
NIN	National Institute of Nutrition

OD	Odd's Ratio
RDA _s	Recommended Dietary Allowances
SD	Standard Deviation
SDG	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
T2D	Type 2 Diabetes
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist-Hip Ratio
UNICEF	United Nations International Children's Emergency Fund

Part I

Introduction

1.1 Background

Adolescence is a vital stage of development, marked by negotiating difficult social situations and consolidating identity as adolescents' journey into emerging adulthood. Adolescence is the phase of life between childhood and adulthood, from 10 to 19 years, early 10-14 years & late 15-19 years (1). Adolescence is also a period of rapid development, second only to the first year of life, and as such, nutritional requirements rise significantly.

Obesity is one of the most serious worldwide public health concerns of the twenty-first century. Abnormal or excessive fat buildup that poses a risk to health is considered as "overweight" and "obesity." Overweight is defined as having a body mass index (BMI) above 25, and obesity as having a BMI over 30 (2). In addition to biological risk factors, social position, health literacy, and various environmental effects, obesity is a complex, chronic disorder with many underlying causes (3). Obesity is an improper and excessive buildup of fat that might damage physical processes. It is a complex chronic disorder that is influenced by genetic, metabolic, behavioral, environmental, cultural, and socioeconomic variables, and is one of the main risk factors for the majority of chronic illnesses linked to food and body mass index (4). Overweight and obesity are major risk factors for several chronic diseases, including diabetes, cardiovascular diseases, and cancer (3).

As stated by WHO, maximum percentage of overweight children is in developing countries with a higher rate of increment as compared to the developed world. Estimates from 2016 (3) shows that between 11 million to 124 million school-aged children and adolescents worldwide are obese, a more than 10-fold rise in just 40 years (4). Adolescent is a crucial period which gain 50% of their adult weight, more than 20% of their adult height and 50 % of adult body mass (5). Adolescents' nutritional status is moulded by socio-cultural, environmental and economic factors and had an influence by their food habits and physical activity. In 2016, there were approximately 340 million overweight or obese children and adolescent between 5-19 years. Overweight and obesity now rank as the fifth leading risk for mortality worldwide. According to Nepal Demographic Health Survey (3) prevalence of overweight or obesity among 6% among adolescents' girls. Five percent of the adolescents

aged 15-19 years are overweight. While, there were 39% of adults worldwide who were overweight and obese (BMI ≥ 25 kg/m²) and 13% of individuals who were obese (BMI ≥ 30 kg/m²) in 2016. According to Global school health survey (GSHS) 2015, 10.9% adolescents' students were underweight, 6.7% overweight and 0.6% obese respectively. In a study, prevalence of adolescent obesity and overweight in Asian countries was 8.6% & 14.6% (6).

A comparative study carried out in developing nations, teenagers in Asia had a greater prevalence of obesity (4). The waist circumference, waist hip ratio, and waist height ratio are among the waist indicators. WHO suggests that waist to hip ratio (WHR) is a better predictor of the risk of cardiovascular disease in adults and adolescents than the BMI. Many studies, however, discovered that ratios like WHR are stronger indicators of obesity (7).

Central obesity is associated with cardiovascular risk factors in both adults and children. Waist circumference (WC) measurement is a straightforward technique for determining abdominal obesity. In children and adolescents, WC was a greater predictor of elevated insulin levels and changes in plasma triglycerides than BMI was. It also showed a higher positive connection with both systolic and diastolic blood pressure. In order to define the "pear shape" or "apple shape" distribution of body fat, the waist-to-hip ratio (WHR) cut-offs have been utilized, particularly in adults. A few nations have created WHR reference systems for children, which allow for the assessment of hip and abdominal fat distribution. Gillum's research revealed a favorable correlation between WHR and the ratio of total serum cholesterol to high-density lipoprotein (HDL) cholesterol in pre- and post-pubertal girls (7).

Adolescence is a crucial time for exploring and adopting new behavioral and lifestyle choices, it is detrimental to a person's nutritional state. Teenagers' eating patterns and level of physical activity have an effect on their nutritional status, which is influenced by sociocultural, environmental, and economic variables. Even though obesity and overweight have grown epidemic in the developing world, this issue was largely ignored up until very recently. But both in wealthy and emerging nations, the prevalence of teenage obesity has grown (9).

Low and middle-income countries (LMICs) are experiencing an alarming rise in the incidence of overweight and obesity. LMICS account for 77% of all NCD-related fatalities globally. The NCDs risk factor collaboration noted a faster rise in BMI in southeast Asian and south Asian nations, including Nepal, Bangladesh, and India, which have historically

had high rates of undernutrition. The Sustainable Development Goals (SDGs), which include a one-third reduction in premature death from NCDs by 2030, are under jeopardy due to the steadily growing incidence of overweight and obesity and the concurrent rise in obesity-related NCDs (11). Developing countries that undergo economic growth and attain middle- and upper-middle-class status will bear a disproportionate share of the cost of overweight and obesity, rendering them more vulnerable to shocks to their health and economies. Obesity has a major impact on the human capital index (HCI), which is a key factor in developing human capital and is a core driver of sustainable growth and poverty reduction. Optimal nutrition can only be achieved if the world's poor have access to the information, materials, and services required (7).

1.2 Statement of the problem

Obesity and undernutrition are coexisting in Nepal as it transitions. However, there is a lack of accurate information on childhood and adolescent obesity or overweight in Nepal. Previous studies in Nepal have mainly focused on socio demographic factors related to childhood obesity and none reported diet and physical activity-related risk factors and its association. In contrast to industrialized countries, the prevalence and risk of overweight and obesity among adolescents are rising more quickly in emerging countries. Adolescents make up nearly one fourth of the population of Nepal, or roughly 23.45% of the total. Along with the ongoing issue of undernutrition, the problem of overweight and obesity is becoming a public health hazard. However, Nepalese do not have a strong understanding of the risk factors linked to obesity and overweight.

Unhealthy eating behaviors such as snacking on highly processed and calorie-dense foods between meals, eating in front of the television, skipping breakfast, dining out regularly, and emotional eating. A few studies have linked increased intake of sweet and salty snacks, as well as decreased consumption of fruits and vegetables, to increased obesity in teenagers (8). Adult overweight and obesity are more common, up from 4% in 2000 to 6% in 2016. Studies revealed that adult overweight prevalence varies from 16.1% to 25.3% and obesity prevalence ranges from 5.6% to 16.2%. Overweight and obesity have developed into a complex problem as a result of a confluence of genetic, behavioral, cultural, and environmental influences which leads to changes in public policy, social environment, and cultural norms in addition to behavioral changes on an individual level. Children who are

overweight and obese during adolescence have a higher likelihood of remaining obese well into maturity. Children who are overweight or obese can have short-term health effects. These adolescents don't participate very much in school or other everyday activities (14). Furthermore, the prevalence of overweight and obesity among adolescents in underdeveloped and developing countries are rising at a higher rate compared to developed nations. Adolescents spend more time away from their families than younger children do, so they are exposed to a wider variety of meals than they may be used to at home. Adolescents are more likely to acquire obesogenic habits as their levels of independence rise, which raises the risk of obesity. However, the factors associated with overweight and obesity are not well understood in Nepal. Although there have been fewer studies the prevalence of overweight among adolescents in Nepal has been reported to be 12.2%, 8.1%, and 1% (4) still the factors associated with these studies have not been thoroughly investigated. An effective substitute for BMI is the waist-hip ratio, which also has the added benefit of diagnosing central obesity. These ratios with a single cutoff value can be utilized by non-professionals like teachers and health care providers to find numerous obese youngsters who have not yet received a diagnosis (9).

Moreover, only few studies have been conducted in public and private schools of Kathmandu valley. Thus, the study aimed to assess the factors associated with adolescent nutritional status among in private and public schools of Kathmandu Metropolitan City. This study also beholds waist-hip ratio and in adolescents. The study's findings may be helpful for health professionals and other researcher in designing preventive initiatives for adolescent obesity in Nepal with a similar environment.

1.3 Significance of the study

The study reveals significant differences in the nutritional status of adolescents attending public versus private schools of KMC, highlighting potential disparities in diet, nutrition and health. By comparing public and private school students, the study can provide insights into how socioeconomic status influences nutritional habits and health outcomes. Improved understanding can lead to initiatives that not only enhance health but also academic achievement. It can inform the development of health promotion programs in schools, tailored to the specific needs of students in different educational settings. The study fills a gap in the existing literature on the comparative analysis of nutritional status between public

and private school students. Findings can pave the way for future research on interventions and policies aimed at reducing nutritional disparities among adolescents. Overall, this study has the potential to make significant contributions to future researchers to conduct interventional studies in the nutritional status among adolescents in different school settings.

1.4 Research questions

- What is the nutritional status among adolescents of public and private schools of Kathmandu Metropolitan City?
- What are the factors associated with nutritional status among adolescents of public and private schools of Kathmandu Metropolitan City?

1.5 Objective of the study

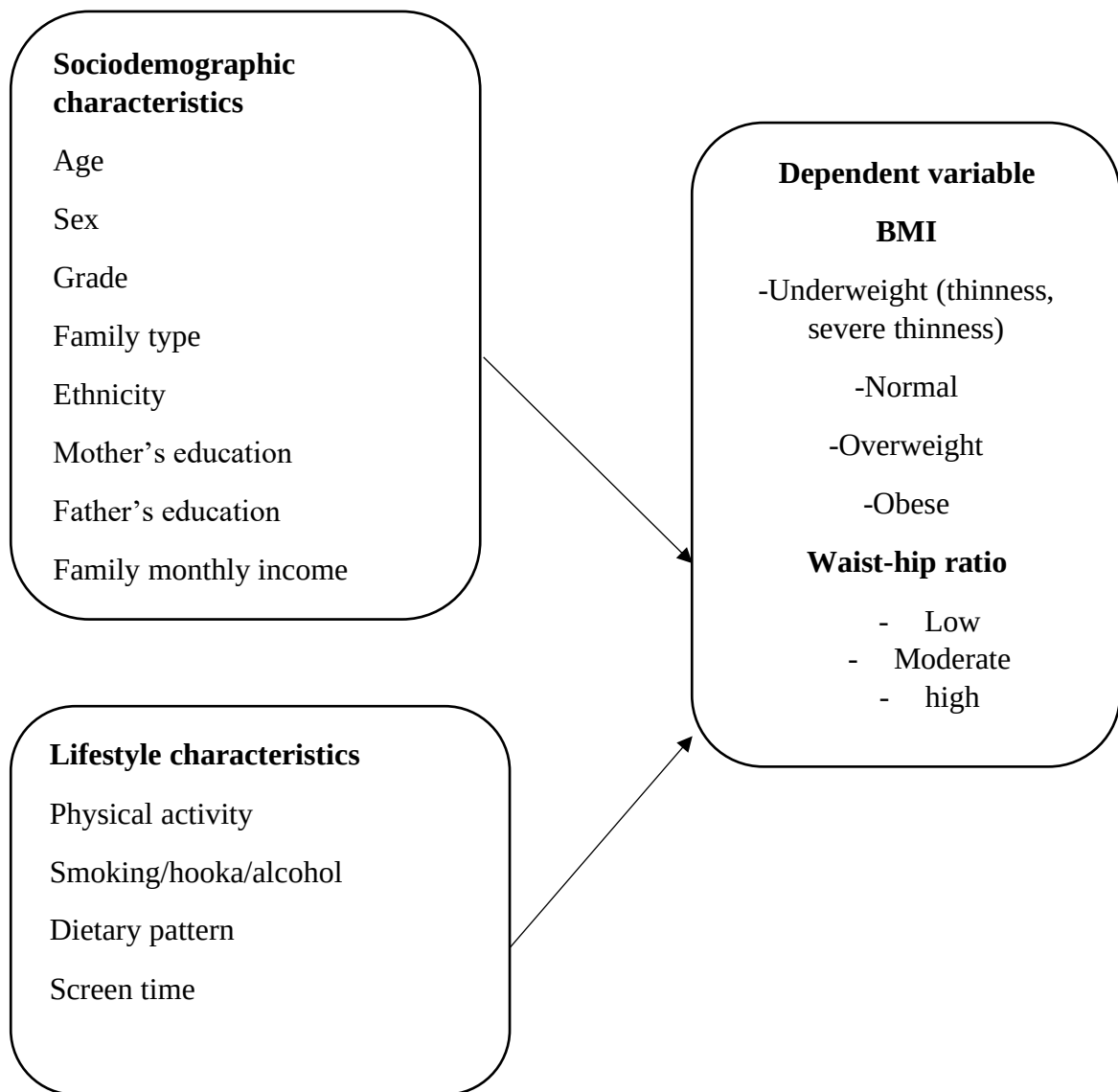
1.5.1 General objective

- To assess the prevalence and factors associated with nutritional status among the adolescents of private and public schools of Kathmandu Metropolitan City.

1.5.2 Specific objective

- To identify the nutritional status of adolescents of public and private schools.
- To determine the association of nutritional status with the selected variables among adolescents in public and private schools.
- To compare the nutritional status of adolescents in the public and private schools.

1.6 Conceptual framework



Conceptual framework for prevalence and factors associated with nutritional status among adolescents (10-19) years of age. The conceptual framework illustrated the relationship between dependent and independent variables. BMI and WHR are dependent variables while demographic variables and lifestyle characteristics are independent variables affecting the dependent variable.

1.7 Limitation of the study

A limitation of the study could be potential for recall bias, as participants might not accurately remember or report their food and beverage intake from the previous day during the 24-hour food recall.

Part II

Literature review

2.1 Introduction

This chapter presents the literature reviewed on prevalence and factors associated with overweight and obesity among adolescents of (10-19) years in private and government schools of Kathmandu valley. Electronic searches were used in finding out relevant literature. The key words used in online search were overweight, obesity, adolescent, factors and prevalence. The search included both research as well as non-research literature. The online websites used for literature review were pub med, science direct, research gate, scriber and google scholar. The reviewed literatures were summarized/ paraphrased and organized according to the related variables and are presented in section 2.2.

2.2 Review of literature

2.2.1 Adolescence nutrition

Adolescence is the phase of life between childhood and adulthood, from 10-19 years, early 10-14years & late 15-19years. Adolescents grow and develop quickly, which has an effect on their health and wellness for the rest of their lives. Furthermore, the nutritional state of teenagers, and particularly females, lays the groundwork for the following generation's ability to grow and develop normally as well as their susceptibility to illness. Positive steps have been taken in recent years in the lancet commission on adolescent health and wellbeing (9).

An institutional based cross-sectional analytical study was conducted in rural schools of Gosaikunda municipality, Rasuwa district. Among 267 participants, 14.6% were obese and 14.6% were overweight. 16.5% of participants were underweight, including 14.0% of women and 20.4% of men. More than three-fourths (83.5%) of the respondents belonged to the tamang ethnic group, and the majority (70%) were buddhist. Approximately 27.3% of the individuals ate fruits every day, and almost three quarters (74.2%) were physically sedentary. The prevalence of overweight/obesity was significantly higher among female participants 39.6% than males 12.6%. In relation to the age group, the students age 15–17

years had a significantly higher prevalence of overweight/obesity than age groups of 11–14 years and 18–21 years. Similarly, the number of obese/overweight students was significantly higher (41.9%) in grade ten than in grade nine 24.2% and grade eight 20.2%. 32.8% physically inactive students were overweight/obesity which was significantly higher among those who were physically active 18.8% (10).

A research study in United States adolescents revealed that 30.7% of the participants were overweight/obese. Male adolescents were more likely to be overweight or obese 32.3% and 29.0% than female. Adolescents who didn't get the necessary amount of sleep or physical exercise were more likely to be overweight or obese 31.8% or 25.7%. The incidence of overweight/obesity among adolescents who spent more than four hours on a computer or portable device was 36.6%, compared to 29.5% among those who spent one to three hours online and 27.5% among those who spent less time online. Teenagers who did not fulfill the recommendations for physical exercise while watching tv or playing video games for 1-3 hours were 1.88 times more likely to be overweight or obese. Similarly, adolescents who exceeded the recommended amount of tv or video game time but did not fulfill the recommendations for physical exercise had a 3.04 times higher risk of becoming overweight or obese. Adolescent females who spent more than four hours using a computer or handheld device and did not meet the recommendations for physical activity had a higher risk of being overweight or obese (OR = 2.15) than those who used a computer or handheld device for less than an hour and also meet the recommendations for physical activity (11).

According to a cohort study of 532 adolescents from north Norway, risks of being overweight or obese at 15-17 years of age were higher for adolescents who were overweight or obese at 5-7 years of age compared to thin or normal weight children, (COR: 11.1). When it came to children who were overweight or obese at age 5-7, six out of ten were still overweight or obese by age 15 to 17. A study conducted on Israeli 2.3 million adolescents examined the association between BMI in late adolescence and death from cardiovascular causes in adulthood. Obesity during adolescence increases the risk of developing type 2 diabetes (T2D) and cardiovascular disease in adulthood. In a cohort study of 292,827 individuals aged 7-13 years, above-average BMIs were positively associated with T2D in adult life. These associations were stronger in women than men, in younger compared with older generations, and at younger adult ages at diagnosis (12).

2.2.2 Physical activity

Frequent physical activity is associated with benefits in the management and prevention of non-communicable diseases (NCDs), including diabetes, heart disease, hypertension, stroke, and a number of malignancies. It enhances well-being, mental health, and quality of life in addition to aiding in the maintenance of a healthy body weight (13).

A research study with cross-sectional study design was conducted in Indonesia, regarding physical activities and incidence of obesity. The findings illustrated that there was significant correlation between physical activity and obesity among adolescent with ($p=0.000$) i.e. ($p < 0.05$). The study's incidence of obesity revealed that 29.80% of the sample, were obese and 70.20%, were not classified as obese (20).

2.2.3 Dietary pattern

Dietary variety pertains to the assortment of food types that are used in assessing the diversity and sufficiency of nutrients in diets. Consuming at least four of the seven mentioned food categories the day before is considered a minimal dietary variety (14). The four food groups were: grains, roots and tubers, dairy products, vitamin A-rich fruits and vegetables.

An observational study using cross sectional design was conducted in Uttarakhand, India among adolescents of Rohtak district. Total sample of 385 were studied. In this study, 82.3% were vegetarian and 60% did not regularly consume fast food while 59.2% chose to had their food in front of TV. Ratios for participation in sport events were 1:1 and 64.9% got engaged in physical activity. Among the total participants, prevalence of obesity was 6.8% and overweight was 17.1%. while 53.8% had normal BMI and 22.3% were underweight. Overall prevalence of obesity among teenagers was 23.9%. The teenagers who were exposed more than 2 hour of screen time were more obese and responsible for teenage obesity (22).

2.2.4 Prevalence of overweight/obesity

Overweight is defined as having a body mass index (BMI) above 25, and obesity as having a BMI over 30 (2). Overweight and obesity can be determined by the help of WHO z-score.

BMI-for-age greater than 1 standard deviation (SD) above the WHO growth reference median. Obesity: > 2 standard deviations (SD) above the WHO growth reference median.

A cross-sectional research of 1955 adolescents, aged 11-18 years, was carried out in Changchun City, China, using stratified cluster sampling. Participants in the study were parents and child-care providers. To examine the link between overweight/obesity and associated variables, both single-variable and multivariate logistic regression analyses were carried out. Obesity prevalence was 4.9% and overweight prevalence was 12.7% respectively. According to multivariate logistic regression, eating rapidly (OR=1.37, 95% CI 1.06 to 1.78) and eating fresh fruit more than two days a week (OR=1.41, 95% CI 1.09 to 1.84) were substantially linked with overweight and obesity. Less likely to get in trouble were students who were not fussy (OR=0.69, 95% CI 0.53 to 0.90).

Dietary habits like eating fruits weekly, picky eating and slowly eating and parental weight were important factors for overweight and obesity in adolescents. In contrast, students who consumed fruits more than twice a week ($p=0.029$), ate slowly ($p=0.004$) and were had picky eating habits ($p=0.028$) had a higher prevalence of overweight in the research study. As well as Paternal weight ($p=0.018$) and maternal weight ($p=0.006$) also lead to increase the weight of their children (15).

In a study conducted in South Africa, a high prevalence of overweight and obesity was found 36.1% in black female adolescents ($p<0.05$) and a high prevalence of poor dietary practices was observed with urban-rural differences. It was found that dietary practices were significantly associated with breakfast consumption in overweight and obesity ($p=0.003$). Grade 12 students was found higher risk than another grade (OR = 1.95; $p < 0.05$) (8).

A cross-sectional study was conducted on the prevalence of overweight and obesity among the secondary schools of Bharatpur. There was total 266 respondents of class 9 and The study period was for a month. 6 public and 5 private schools were chosen, by using non-probability sampling method. The study depicts that 9.77% students were overweight and 3% obese. 5.4% male were overweight and among female 15.3% were overweight. Whilst, 6% overweight/obesity was found in public schools and 20% was found in private schools. Regarding the eating pattern, students eating snacks by watching television were found substantially overweight as compared to those who do not 13.33% vs 6.11%.

Moreover, there was no significant association between overweight and obesity with ethnicity, religion, type of family, family history of diabetes, socio-economic status, food consumption frequency, hours of watching television and not involving in physical activities (24).

2.2.5 Waist-hip ratio

WHR is the dimensionless ratio of the circumference of the waist to that of the hips. It is calculated as waist measurement divided by hip measurement (waist/hip). WHR is used as an indicator to measure the risk of developing serious health problems.

In adults and children, cardiovascular risk factors are related to central obesity. The measurement of waist circumference (WC) is a simple method to assess abdominal adiposity. In children and adolescents WC, compared to BMI, had a stronger positive correlation with systolic and diastolic blood pressure and was a better predictor of plasma triglyceride alterations and high insulin levels. WHR cutoffs have been used especially in adults, to define the distribution of body fat as “pear shape” or “apple shape”. The reference systems of WHR for children have been established in a few countries and enable assessing abdominal and hip fat distribution. Research showed that WHR was positively associated with the ratio of total serum cholesterol to high-density lipoprotein (HDL) cholesterol in pre- and post-pubertal girls (10).

A cross-sectional study was conducted in Ahmedabad, Gujrat where the 4 schools were selected purposively for the study. It was a six months study period among 10-17 years adolescent in the private schools of Sabarmati area. In a total of 446 teenagers, 59.5% of the students had an underweight, 37.6% had a normal BMI, and 2.9% had an overweight BMI; 69.2% of the students were from private schools. No student had a BMI that put them in the obese zone. The study reveals that, 28% of adolescents were overweight, 23.9% were obese, and 47.9% were normal, according to WHR. WHR values below 0.79 were regarded as typical in adolescents. Age had no discernible effects on the WHR reflected. 2.9% of teenagers had an overweight BMI, which is between 25 and 29.9, according to statistics. However, according to WHR, the proportion of overweight and obese people increased to 28% and 23.7%, respectively (25).

In a study conducted in India, the proportion of overweight people 17.4% and obese people 6.9% had a WHR of 43.1%. Three things that increased the likelihood of becoming

overweight or obese were eating junk food, drinking carbonated drinks, and lack of exercise (16).

2.2.6 Nutritional status of adolescents

Nutritional status of adolescents in public and private secondary schools' study was carried out in Nigeria. The prevalence of stunting 39%, thinness 47%, underweight 23%, normal weight 61%, overweight 16% which was higher in private boarding school than compared to private day school. A statistical analysis demonstrated a substantial ($p < 0.05$) association between underweight and socioeconomic status, underscoring the susceptibility of adolescents from lower socioeconomic backgrounds (17).

An institutional based cross-sectional study was conducted in Shuklaphanta Municipality of Kanchanpur District, Nepal among the adolescent girls in government and private schools. The study revealed majority of adolescent (64.3%) underweight where 32% were normal and 1.7% were overweight/obese. A significant association was found between family type and BMI for age of adolescent girls ($p = 0.004$) which has a strong level of association with Cramer's (28).

2.2.7 Minimum dietary diversity

About 98% of the participants in a cross-sectional study involving 632 children and adolescents with parents in Ethiopia ingested starchy staple foods in a 24-hour period, comprising a mix of cereals and white roots and tubers. Over 80% of the participants consumed fruits and vegetables high in vitamin A, as well as other fruits and vegetables with a dark green color. Organ meat intake was less than those of the other dietary groups. According to this study, eating meals or snacks outside the home was noted by 57.7% and 53.9% of overweight or obese participants at the household and individual levels, respectively (18).

2.2.8 Eating habits

Teenagers are growing up to be increasingly self-sufficient and making a lot of their own eating choices. A lot of teenagers go through a growth spurt, which increases their hunger and necessitates the consumption of healthful meals. Compared to younger children,

adolescents often consume more meals away from home. Their peers have a big impact on them as well. Many teenagers prioritize meal convenience and it's possible that they consume excessive amounts of unhealthy items including processed meals, soft drinks, and fast food (19).

The study on the effect of eating habits on obesity among adolescent students was conducted in China. It was cross-sectional study conducted among 536 college students Hebei medical university in Shijiazhuang, the capital of Hebei province in China. Pearson's chi-square test was used to investigate the relationship between participants' general characteristics, dietary habits, and BMI. The alpha value was set to 0.05 for all tests. The association between participants' eating patterns and their BMI revealed that sex, place of residence, eating speed, frequency of daily meals, sweets-eating patterns, and the quantity of sugar-sweetened drinks drank each week were all associated with BMI. The research study reveals that the number of meals consumed per day was negatively correlated with BMI ($p=0.018$). While consuming a high-sugar diet was positively correlated with BMI ($p=0.023$) but the effect on BMI was relatively small. Eating rapidly showed a significant positive correlation with BMI ($p < 0.001$) (20).

In a comparative cross-sectional study between public and private secondary schools of Ethiopia, not eating dinner every day (AOR=5.3) and engaging in moderate-intense physical activity for at least 10 minutes every day (AOR=0.19) were linked with overweight or obese. Compared to men, women had two times the odds of being overweight or obese (AOR=2.03; 95% CI=2.08-3.8). Private school students engaged in more physical activity than their public-school counterparts, accounting for 60.8% and 14.9% of the total, respectively (32).

2.2.9 Screen time

According to WHO, children and adolescents should engage in vigorous-intensity physical exercise at least three times a week and moderate-to-vigorous physical activity for at least an hour each day. Screen time is defined as "the time spent using a device such as a computer or games console" by the Oxford English dictionary. Nonetheless, these days, screen-based media is gradually replacing time spent actively, and screen time has grown in both children and adolescents globally, contributing significantly to the development of obesity (21).

Adolescents are particularly susceptible to the opportunities and risks of new technologies. The development of socio-affective brain circuits can increase sensitivity to social information, impulsiveness toward rewards, as well as a preoccupation with peer evaluation. excessive screen time is related to recent increases in mental health problems (22). Adolescents at private schools were 3.7% more likely than those in municipal schools to use their phones for more than three hours every day. 85.6% of them watched TV for 1-3 hours each day, whereas 3.8% watched it for more than 3 hours per day. Thus, parents must focus on the daily screen time of adolescents before it becomes a toxic habit (35).

A meta-analysis study on central obesity and screen use revealed that there was no any association between obesity and screen time (OR 1.136; 95% CI 0.965-1.337; $p=0.125$). Additionally, WC was 1.23 cm greater in children and teenagers who used screens the most than in children and teenagers who used screens the least (95% CI=0.342–2.112; $p=0.007$) (23)

Part III

Methods and materials

3.1 Study design

An analytical cross-sectional study was conducted among adolescents of private and public-school students Kathmandu Metropolitan City.

3.2 Study duration

The study duration was 6 months period from December 2023-May 2024. Data collection period was from 2nd week of January-end of February 2024.

3.3 Study area

The study was conducted in private and public schools of Kathmandu Metropolitan City of Bagmati province of Nepal. It was selected because there might be differences in the nutritional status of adolescent students of private and public schools. So, to assess the adolescent's nutritional status differences in Kathmandu Metropolitan City school was the best and easiest way for data collection.

3.4 Study population

The target population was all the adolescent students (10-19) years of grade 8 and 9 of public and private schools.

3.5 Study unit

Each adolescent students of public and private schools of Kathmandu Metropolitan City.

3.6 Selection criteria

3.6.1 Inclusion criteria

Adolescent students of 8 and 9 students of public and private schools.

3.6.2 Exclusion criteria

Disabled adolescent students and seriously ill students were excluded from the study.

3.7 Sample size

The required sample size for the research was found to be 286 which was calculated by taking 9.3% of prevalence in previous studies conducted in Makwanpur, Nepal (4).

Using the formulae of **single proportionate formula:**

$$n = z^2 pq / e^2$$

Where,

n= is the desired sample size

z= is the critical value at 95% confidence level (1.96)

P= prevalence

$$q = 1 - p$$

$$= 1 - 0.093$$

e= is the margin of error at 5% which is 0.05

Now,

$$n = z^2 pq / e^2$$

$$= (1.96)^2 \times 0.093 \times (1 - 0.093) / (0.05)^2$$

$$= 130 \times 2 \text{ (where 2 is the desired effect)}$$

$$= 260$$

Sample size= 260

Adding 10% non-response rate sample size was= 286.

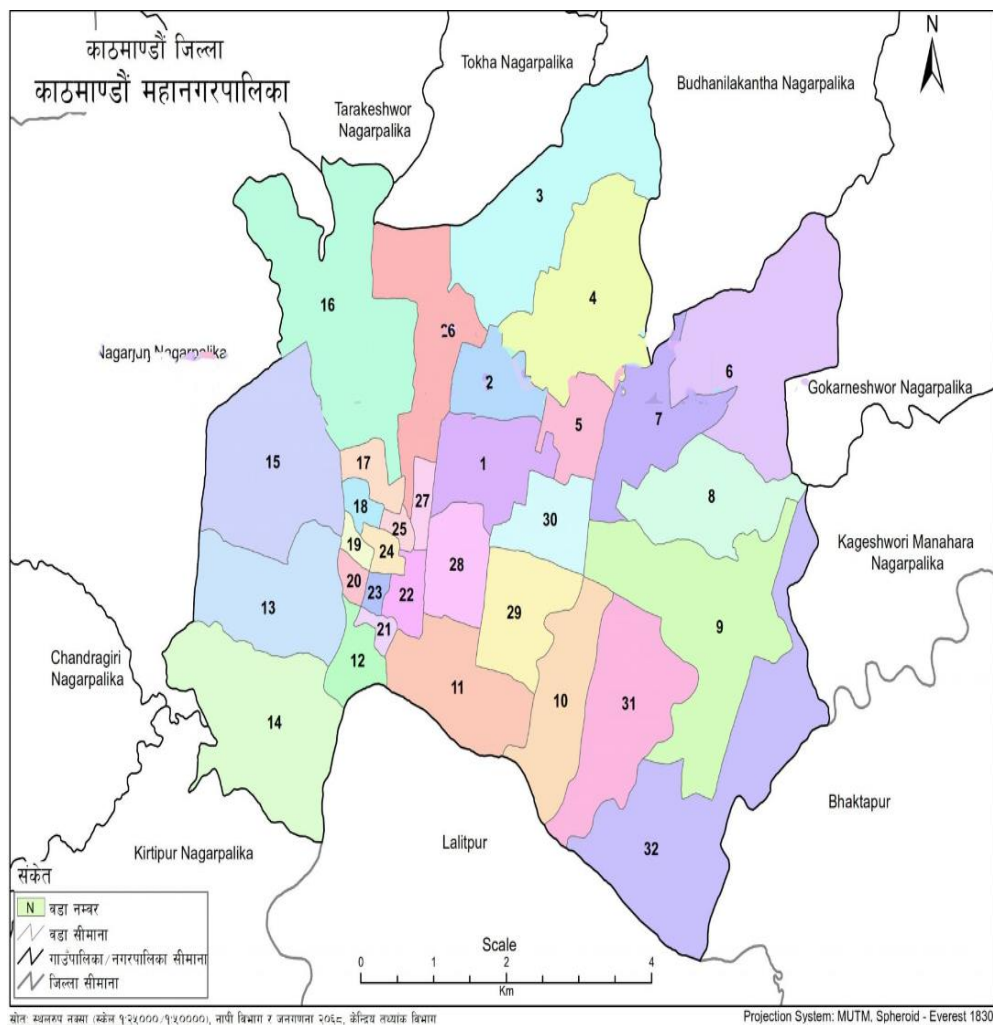
Total of 355 students were sampled for data collection. While after generating from random number table from SPSS the sample was 293.

3.8 Criteria for sample selection

There are 504 private schools 89 public schools in Kathmandu Metropolitan City. Simple random sampling was used for the selection of school. All students of class 8 and 9 who were willing to participate except ill and disabled students were selected for the data collection.

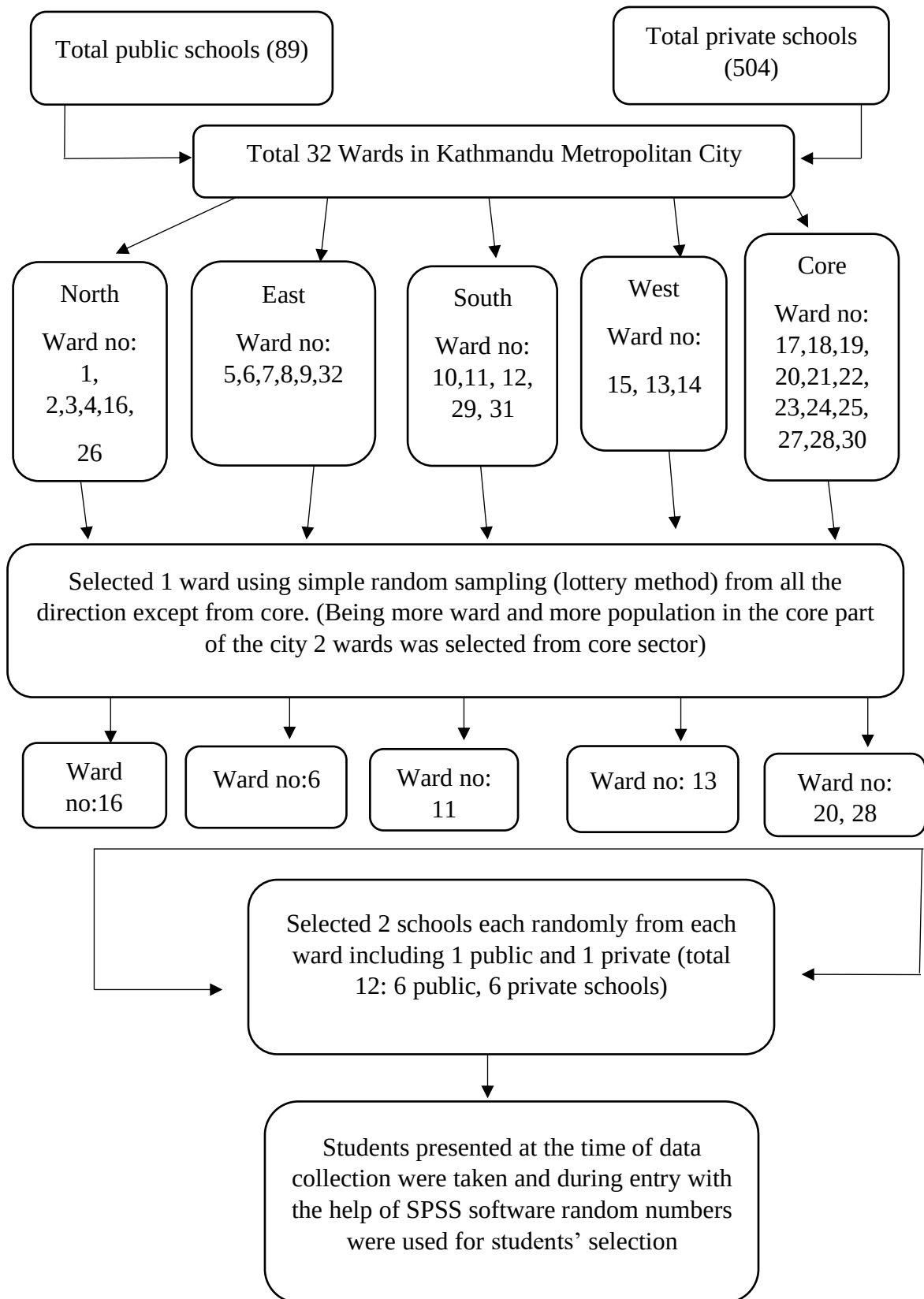
3.9 Sampling techniques

The study collected sample of 293 adolescent students of private and public schools of KMC. The respondents were adolescents of class 8 and 9 students. The data collection was done by using simple random sampling for the selection of the schools. The concerned authorities of KMC provided the most recent list of secondary schools of public schools and private schools list was obtained from PABSON and N-PABSON organization of schools. There are 32 wards in Kathmandu Metropolitan City. Each ward was categorized according to the direction (north, east, west, south and core). 1 public and 1 private school were chosen from each ward by using simple random sampling. Students presented at the time of data collection who was willing to participate was sampled. While during analysis all the student's data was entered and selected with the software generated random numbers in SPSS.



Map of Kathmandu metropolitan city (KMC)

3.10 Sampling technique procedure



3.11 Data collection tools

Data collection tools that were applied by using validated structured questionnaire from adolescent nutrition survey 2014 for assessing adolescents' sociodemographic characteristics and anthropometric measurement. Global school-based student health survey (GSHS) 2021 was used for the physical activity. Height and weight were measured using stadiometer and seca digital weighing machine respectively. As well as the waist to hip circumference was measured by using measuring tape. Physical activity was also assessed by using the guidelines of GSHS 2021.

3.11.1 Dietary recall questionnaire

Tools such as 24-hour dietary recall questionnaire was used to access the food intake.

3.11.2 Food frequency questionnaire (FFQ)

Structured questionnaire was used to capture the frequency and variety of foods consumed over a specified period. Dietary pattern was adopted from minimum dietary guidelines of FAO.

3.12 Data collection techniques

3.12.1 Dietary recall

Using a 24-hour recall dietary form, the type and amount of food consumed over the previous 24 hours was evaluated. How much they had consumed the day before or over the course of the previous 24-hour was a question posed to the respondents. Throughout the interview, respondents were asked to recall everything they had eaten in the previous day, both inside and outside of their homes. To measure the amount of food consumed in millimeters or grams, common household items like spoons, glasses, bowls, and plates were used. The principal investigator approached 24-hour recall diet questions.

3.12.2 Dietary intake assessment

Every adolescent who participated in the dietary assessment had a face-to-face interview to collect data for the 24-hour dietary recall. Throughout the investigation, six standard bowls, one plate, one glass, and three spoons in different sizes were used. Cooked rice was

standardized and labeled as either half or full plate. Depending on the food item, measurements of foods and beverages were taken using either standardized cooked food, measuring instruments, or a photographic food atlas of India that served as a pictorial size guide. The total energy, macronutrients (carbohydrate, fats, protein) and fast food were entered in MS-excel and the entered data was imported in SPSS. Adolescents' food intake was quantified for nutrients using the Nutri-survey application and the food composition table (FCT) of Nepal. The obtained data on estimated intake of carbohydrate, fats, proteins and energy were compared to RDA of ICMR, NIN, 2020, separately for boys and girls.

3.12.3 Food frequency method

FFQs was administered to assess the habitual dietary intake of the specified period (eg: weekly, monthly).

3.12.4 Anthropometric measurements

Student's heights were recorded twice on a level, hard surface without shoes using a Stadiometer. Participants were asked to remove any hair bands that might interfere with the measurement of their height. The participants were instructed to stand with their heels together, heads looking straight ahead, arms to the side, legs straight, and shoulders relaxed. The researcher made sure the back of the head, scapulae, heels, and buttocks were all in contact with the stadiometer's vertical surface. At eye level, the measurement was taken.

Weight was measured using an electronic digital weighing scale seca in accordance with WHO standard protocol. The scale was read to zero before each measurement. The participants took the measure without shoes, wearing only the barest minimum of clothing and removing bulky outerwear like jackets, hooded sweatshirts, thick belts, etc. On the scale, they were instructed to stand with their weight evenly distributed across both feet, their feet slightly apart, their arms hanging loosely at their sides, and their heads facing forward. With the assistance of another enumerators, weight and height were measured.

3.13 Data management and analysis

The accuracy and consistency of the data was examined after it has been collected. Data was be edited, coded, and categorized and analysis was performed on it. After processing the data, IBM SPSS statistics version 26 was entered and analyzed it. Descriptive statistics

(frequency, percentage, mean and standard deviation) and non-parametric test, chi-square test was used to examine the relationship between variables. Additionally, using SPSS, the WHO's BMI-for-age z-score (BAZ) was computed and categorized in accordance with the guidelines for the age group of 5-19 years. A wall-mounted clinical stadiometer was used to measure the subjects' height in centimeters. Weight was measured with a portable digital weighing machine and recorded in kilograms (kg). Additionally, the BMI Z-score-a measure of body mass index for age was computed and categorized into five categories: normal (+1 to -1 SD), obese ($> +2$ SD), overweight ($> +1$ SD), thin (< -2 SD), and severely thin (< -3 SD).

Further, to express the magnitude in relation to the reference category in the odds ($OR > 1.00$ or $OR < 1.00$) of the variables of interest, unadjusted and adjusted odds ratios (OR) were presented in the results. The cutoff point for the significance level of the results was set at a p-value < 0.05 and a 95% confidence interval (CI). For quantifying the amount of food in 24-hour recall diet food model was used. 24-hour recall diet analysis was done using food composition table (FCT) of Nepal, food model and food atlas of India for consumption of cereals and grains, vegetables, fruits, meat, fish, egg, processed food. The consumed food was calculated on the basis of standardization of food according to the food composition table of Nepal.

3.14 Pretesting of the tools

A small pilot test was carried out in a Manaslu secondary school in Nayabazar, ward no 16 among participants with (10%) to assess the appropriateness and clarity of the questionnaire. The developed questionnaire was pretested among adolescent's school student who were under sampling plan. The pretesting provided evidence for the validity of the questionnaire developed. Pretesting helped to determine if respondents understand the questions as well as if they could perform the tasks or have the information that questions require. After pretesting all the ambiguous, misleading and incorrectly interpreted questions was omitted and questionnaire was revised in accordance with the findings of pretesting.

3.15 Validation and reliability of the study tools

The formulation of the research idea and tools, data collection and data analysis were carried out under the direction of supervision and following a sufficient evaluation of the literature

in order to maintain the validity and reliability of the study. The development of the study tools was based on the goals. An identical 10% sample size was used for the pre-testing. After the preliminary testing, the relevant toll settings and modification was applied. It was as simple and clear as possible to grasp the research study.

3.16 Study variables

3.16.1 Dependent variables

Body Mass Index (BMI): BMI is categorized into underweight (severe thin, thin), normal, overweight and obese.

3.16.2 Independent variables

3.16.2.1 Sociodemographic and socio-economic variables

Age, sex, grade/class, family type, ethnicity, mother's education, father's education, family monthly income.

3.16.2.2 Lifestyle variables

Physical activity, smoking/hooka/alcohol use, dietary pattern/eating habits, screen time.

3.17 Operational definitions

A. Adolescence: It is the phase of life between childhood and adulthood, from ages 10 to 19 years. It is a unique stage of human development and an important time for laying the foundations of good health (1). In this study, individuals in the age group of 10-19 years of age were considered as adolescents in the age group of 10-13 years, 14-16 years and 17-19 years being early, middle and late adolescents respectively.

B. Body mass index (BMI): Classification of the body mass index (BMI) was performed according to the according to WHO z-score for adolescent.

According to WHO z-score for adolescent

Indicator	WHO classification of BMI for adolescent (z-score)
Underweight	
Severe thinness	-3 SD
Thinness	-2 SD
Normal	-1 to +1
Overweight	+1 SD
Obese	+ 2 SD

C. BMI-for-age is measured in z score standard deviations (SD). Adolescent status BMI-for-age Too thin for height Less than -1 SD normal between -1 SD and $+1$ SD overweight between $+1$ SD and $+2$ SD obese greater SD (3).

D. Height: Normal height for 13-15years adolescent is 156 – 162 cm and for 16-18 years is 163 cm.

E. Weight: Normal body weight (kg) for adolescents of 13-15 years is 46-52.8 kg and for 16-18 years 54.7-56.7 kg (24).

F. Overweight and obesity can be defined as an abnormal or excessive fat accumulation that threatens health. Overweight and obesity are defined as follows for children aged between 5–19 years:

- Overweight: BMI-for-age greater than 1 standard deviation (SD) above the WHO growth reference median
- Obesity: > 2 standard deviations (SD) above the WHO growth reference median.
- Underweight: Those adolescents whose body mass index (BMI) is less than two standard deviations below the median.
- Thinness: It is defined as body mass index (BMI) for age below -2 Z-score of the 2007 WHO standard reference value.
- Moderate thinness: It is defined as BMI for age between -2 and -3 Z-scores of 2007 WHO reference value.
- Severely thinness: it is defined as adolescents whose BMI for age Z-score is below minus 3 (-3) SD below the mean on the 2007 WHO growth standards (25).

G. Waist-hip ratio: Measuring was done in accordance with WHO STEP guidelines.

With the arms at the sides, the feet together, and the stretch resistance tape not constraining the body, the waist circumference was measured. The students were instructed to unwind and take a few slow, natural breaths before the measurements, which was taken at the halfway between the top of the iliac crest and the lower edge of the last perceptible rib, was completed. The broadest part of the buttocks was used to gauge the hip circumference.

Waist-hip ratio: Waist circumference (cm)/Hip circumference (cm).

According to the WHO, abdominal obesity is defined as a waist-hip ratio more than 0.90 for men and greater than 0.85 for women.

According to the **WHO a moderate** WHR is:

- 0.9 or less in men
- 0.85 or less for women

In both men and women, a WHR of 1.0 or higher increases the risk of heart disease and other conditions that are linked to having overweight.

Health risk	Women	Men
Low	0.08 or lower	0.95 or lower
Moderate	0.81 – 0.85	0.96 – 1.0
High	0.86 or higher	1.0 or higher

***Reference: WHO, 2011**

H. Physical activity

They should engage in physical activity of moderate to strenuous intensity, primarily aerobic, at least 60 minutes each day on average throughout the course of the week (13). Physical activity is any activity that increases your heart rate and makes you breathe hard. It can be done in sports, playing with friends, walking to school or in physical education in class. Some examples of physical activity are running, bicycling, dancing, playing football, basketball (26).

I. Smoking: questions asked for collecting information about current smoking use among adolescents were and “During the past 30 days, on how many days did you smoke

cigarettes?” respectively. responses for both of these questions ranged from “0 day” to “all 30 days” (27) .”

J. Hookah: Hookahs are water pipes that are used to smoke specially made tobacco that comes in different flavors, such as apple, mint, cherry, chocolate, coconut, licorice, cappuccino, and watermelon (28).

K. Alcohol: Consuming alcohol in the past 30 days was considered alcohol consumption (current) question: “During the past 30 days, on how many days did you have at least one drink containing alcohol?” Those students who drank alcohol/smoked cigarettes for 1 day or more were considered among “current alcohol use” and “current smoking” (27).

L. Dietary pattern: The dietary pattern was assessed by using food frequency questionnaire (FFQ) as well as by 24-hour recall diet. 24-hour recall diet will be quantified by the use of food model. By the use of food model (food pictures) we can know the amount of consumption pattern of the students. Also, by the help of the standardization of the consumed food particles we can calculate the calories consumed by the adolescent students.

M. Minimum dietary diversity: is a dichotomous indicator of whether or not Adult or adolescent have consumed at least five out of ten defined food groups the previous day or night (29).

The **ten food groups** are:

1. Grains, white roots and tubers, and plantains
2. Pulses (beans, peas and lentils)
3. Nuts and seeds
4. Dairy
5. Meat, poultry and fish
6. Eggs
7. Dark green leafy vegetables
8. Other vitamin A-rich fruits and vegetables
9. Other vegetables
10. Other fruits

Minimum dietary diversity was measured by counting the food items consumed within previous 24 hour and were categorized as more than 5 food groups and less than 5 food groups.

N. Recommended dietary allowance (RDA): The recommended dietary allowances for the age group 13-15 years and 16-18 years were protein 43.2-44.9 gm and 46.2-55.4 gm, Visible fats 35-50 gm and 35-40 gm as well as Carbohydrate 130gm for both age groups. (ICMR, 2020).

O. Sweet beverages: include fruit juice and fruit-flavored drinks, sodas, malt drinks, sports drinks and energy drinks, sweetened tea, coffee, herbal drinks, sweet lassi, horlicks, bournvita, viva, and other sweetened liquids.

P. Fast foods: include sweet foods such as cakes, biscuits, cookies, jeri/jalebi, mithai, toffees, and ice cream and fried and salty foods such as chips, kurkure, cheeseball, instant noodles (wai-wai, rara), samosa, pakora, puri, momo, and tareko khaja (30).

Q. Screen time: Excessive screen time was defined as watching television and playing video/mobile games or using any electronic devices for more than 2 hours per day (31).

3.18 Ethical consideration

Ethical approval was taken from ethical review board of NHRC (ERB). Written and verbal consent was taken from the school administration, parents and students. Only adolescents who brought the written informed consent form signed by their parents were included in the study. No respondents were forced to answer the questions. Research detail purpose and of the study were explained to all the respondents. Participants were informed that they could withdraw from the study at any time without providing a reason. All information was kept confidential i.e. respondent's privacy was maintained.

Part IV

Results & discussions

4.1 Results

4.1.1 Socio-demographic characteristics

The Socio-demographic data of public and private school adolescents like age, sex, grade, family type, ethnicity, mother's education, father's education and family income were considered for descriptive analysis with nutritional status among adolescents. A total of 293 adolescents participated in this study. More than half of the respondents (158) were from public schools. The mean and standard deviations age of the study participants was slightly higher (15.20 ± 0.98) in public schools than in private schools 4.42 ± 1.06 . Almost (87.4%) students belonged to the age group of 13-15 years in private schools while only 62% of them belonged in public schools.

There were higher number of male students (53.2% and 56.3%) in both schools while less than half (46.8% and 43.7%) were female students. Furthermore, around one third (33.5%) were dalit in public schools whereas more than one third (45.2%) were janajati in private schools. More than half (51.1%) students were from grade 8 in private schools and near to two third (61.4%) of them studied in grade 9 in public schools. Likewise, 64.6% of public-school students belonged to nuclear family whereas 41.5% of them were from joint family in private school.

Still, mothers of adolescents attending public schools were less (45.6%) literate than mothers of adolescents attending private schools 11.1%. Whereas, more than one third (35.6%) mothers of private school students had higher secondary and above level education and only 19% mothers of public-school student had education level of higher secondary and above. On the other hand, only 22.8% of the respondent fathers in public schools and near to half (46.7%) of those in private schools, had higher education, respectively. Almost, (82.2%) of the adolescents in private schools reported having a monthly income of more than one lakh, whereas around 81% of adolescents in public schools reported having a family income of between Rs (10,000 - 50,000) per month.

Table 1: Socio-demographic characteristics of public and private schools

Socio-demographic characteristics	Public schools (n=158) N (%)	Private schools (n=135) N (%)
Age in years		
13-15	98 (62%)	118 (87.4%)
16-18	60 (38%)	17 (12.6%)
Mean $\pm$ SD	15.20 $\pm$ 0.98	14.42 $\pm$ 1.06
Sex		
Male	84 (53.2%)	76 (56.3%)
Female	74 (46.8%)	59 (43.7%)
Ethnicity		
Brahmin/ chhetri	12 (7.6%)	42 (31.1%)
Dalit	53 (33.5%)	6 (4.4%)
Janajati	27 (17.1%)	61 (45.2%)
Madheshi/muslim	66 (41.8%)	26 (19.3%)
Family type		
Nuclear	102 (64.6%)	79 (58.5%)
Joint/extended	56 (35.4%)	56 (41.5%)
Grade		
8	61 (38.6%)	69 (51.1%)
9	97 (61.4%)	66 (48.9%)
Mother's education		
Illiterate	72 (45.6%)	15 (11.1%)
Primary level	30 (19%)	29 (21.5%)
Secondary level	26 (16.5%)	43 (31.9%)
More than secondary/ higher secondary	30 (19%)	48 (35.6%)
Father's education		
Illiterate	67 (42.4%)	10 (7.4%)
Primary level	31 (19.6%)	19 (14.1%)
Secondary level	24 (15.2%)	43 (31.9%)
More than secondary/higher secondary	36 (22.8%)	63 (46.7%)
Family monthly income (Rs)		
10000-50000	128 (81%)	24 (17.8%)
50001- 150000	30 (19%)	111 (82.2%)
Mean $\pm$ SD= 57643.34 $\pm$ 28451.59		

4.1.2 Nutritional status of public and private school's students

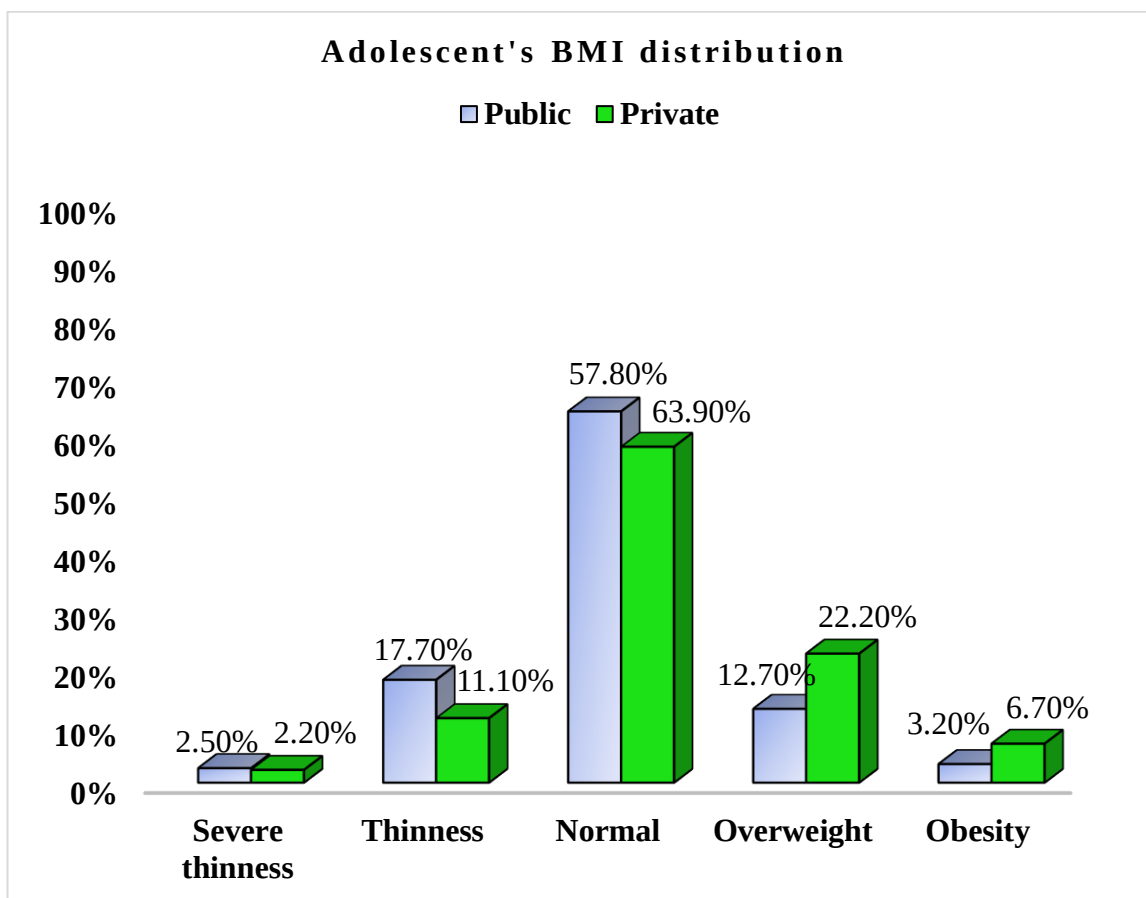


Figure 1: Adolescent's BMI distribution of public and private schools (n=293)

BMI categories based on the WHO scale showed that private schools had higher percentage of overweight 22% and obese 6.70% students than compared to public school's students which was nearly by double. On the other hand, severe thin and thin were found higher in public schools (2.50% and 12.70%) than compared to private school's students.

4.1.3 Waist-hip ratio of adolescents of public and private schools

Among the total respondents, private school adolescent's girls had high (10.2%) WHR than compared to public school adolescent's girls 4% respectively. Similarly, 32.2% of private school's girls had moderate WHR than boys of private schools 1.2%. In addition, almost (84%) girls and majority (98.8%) boys had low WHR in public schools. Beside 96% in boys and 57.6% in girls of private schools had low WHR.

Table 2: Adolescents WHR distribution according to WHO (n=293)

Waist Hip Ratio (WHR)	Public schools N (%)	Private schools N (%)
Boys		
Low (0.95 or lower)	82 (98.8%)	73 (96.1%)
Moderate (0.96-1.0)	1 (1.2%)	2 (2.6%)
High (1.0 or high)	0	1 (1.3%)
Girls		
Low (0.88 or lower)	63 (84%)	34 (57.6%)
Moderate (0.81-0.85)	9 (12%)	19 (32.2%)
High (0.86 or higher)	3 (4%)	6 (10.2%)

4.1.4 Life style characteristics among adolescents of public and private schools

Among the total 293 respondents, compared to adolescents attending private schools, just 41.5% of them engage in physical activity for at least 60 minutes per day, whereas over half (55%) of adolescents attending public schools were active for the full seven days. Although teenagers were physically active for one to three days in 44.9% of public schools and 58.5% of private schools. The mean days that student at public and private schools did physical exercise was 2.26 ± 0.44 . Hence, near to one third (27.2%) of the students of public schools did physical exercise for all 7 days than private school adolescent 22.2%. Only 37.3% of respondents in public schools do walking or cycling for 30 minutes to one hour, compared to 49.6% of respondents in private schools. Physical education was unavailable in the majority (84.2%) of public schools but it is available in 71.9% of private schools, with two third (66%) of them offering once a week followed by 20% of them had it once a week in public schools.

Almost all (100%) of private schools and near to three quarter (72.2%) of public schools offered a sports day program while 27.8% public schools didn't offer it. Around, 26.7 % of respondents who attended private schools play sports all 7 days and on the other hand only few (13.9%) of the respondent in the public schools played sports for all 7 days. On the other hand, less than one third (25.9%) of private school adolescents and only 18.4% of public-school adolescents play sports only once a week. While majority (86.1%) of teenagers in public schools helped their parents with household tasks, and 42.1% of teenagers in private schools always assist their parents with household chores. Likewise, less than one third (26.7%) of private school adolescents and 13.9% of public-school adolescents often assist their parents in the household chores.

About 5.9% of teenagers attending private schools reported smoking for less than 30 days, compared to 3.8% of teenagers attending public schools. Teenagers attending both public and private schools reported smoking an average of 1.07 ± 0.26 days per month. Adolescents attending private schools 26.7% consumed more alcohol beer/wine than those attending public schools 7.6%. In both schools, alcohol consumption was found to have been less than 30 days prior. Around 11% of adolescents in both schools were exposed to screen (tv, mobile, playing mobile and computer games, I-pad and other electronic gadgets) for > 4 hours each day. While, more than two third (69.6%) of private school adolescents used the electronic gadgets for 2-4 hours per day. However, Majority (88%) of the respondents in public schools often used digital devices while eating their food followed by more than three fourth (78.5%) in private schools. While 21.5% in private and 12% in public schools' adolescents always used digital devices while eating their food.

Table 3: Lifestyle characteristics of public and private schools among adolescents

Lifestyle characteristics	Public schools n=158 N (%)	Private schools n= 135 N (%)
Physically active for at least 60 minutes		
1-3 days	71 (44.9%)	79 (58.5%)
All 7 days	87 (55.1%)	56 (41.5%)
Mean $\pm$ SD= 1.48 ± 0.50		
Physical exercise (strengthen muscle)		
1-5 days	115 (72.8%)	105 (77.8%)
All 7 days	43 (27.2%)	30 (22.2%)
Mean $\pm$ SD = 2.26 ± 0.44		
Time spending walking or bicycling		
< 30 minutes	60 (38%)	44 (32.6%)
30-60 minutes	59 (37.3%)	67 (49.6%)
60-120 minutes	39 (24.7%)	24 (17.8%)
Class of physical education		
Yes	25 (15.8%)	97 (71.9%)
No	133 (84.2%)	38 (28.1%)
Physical education class		
Once a week	20 (80%)	64 (66%)
Twice a week	5 (20%)	33 (34%)
Playing sports	n=114	n=135
Once a week	21 (18.4%)	35 (25.9%)
Twice a week	79 (69.3%)	65 (48.1%)
All 7 days	14 (12.3%)	35 (25.9%)
Helping parents in household activities		

Lifestyle characteristics	Public schools n=158 N (%)	Private schools n= 135 N (%)
Always	136 (86.1%)	99 (42.1%)
Sometimes	22 (13.9%)	36 (26.7%)
Habit of smoking		
Yes	6 (3.8%)	8 (5.9%)
No	152 (96.2%)	127 (94.1%)
Consumption of alcohol, beer and wine (n=48)		
Yes	12 (7.6%)	36 (26.7%)
No	146 (92.4%)	99 (73.3%)
Exposure to screen time		
< 1 hour	42 (26.6%)	26 (19.3%)
2-4 hours	98 (62%)	94 (69.6%)
>4 hours	18 (11.4%)	15 (11.1%)
Mean $\pm$ SD = 2.18 $\pm$ 0.91		
Eating food using digital devices		
Often	139 (88%)	106 (78.5%)
Always	19 (12%)	29 (21.5%)
Mean $\pm$ SD = 2.15 $\pm$ 0.96		

4.1.5 Adolescent physical parameters

The physical characteristics of adolescents of both public and private schools were described in the table below. The average weight and height were 50.92 ± 9.83 and 158 ± 7.85 , respectively.

Table 4: Adolescents physical parameters (n=293)

Variables	Mean	SD
Height	158.44	7.85
Weight	50.92	9.83

4.1.6 Nutritional status of both schools among adolescents

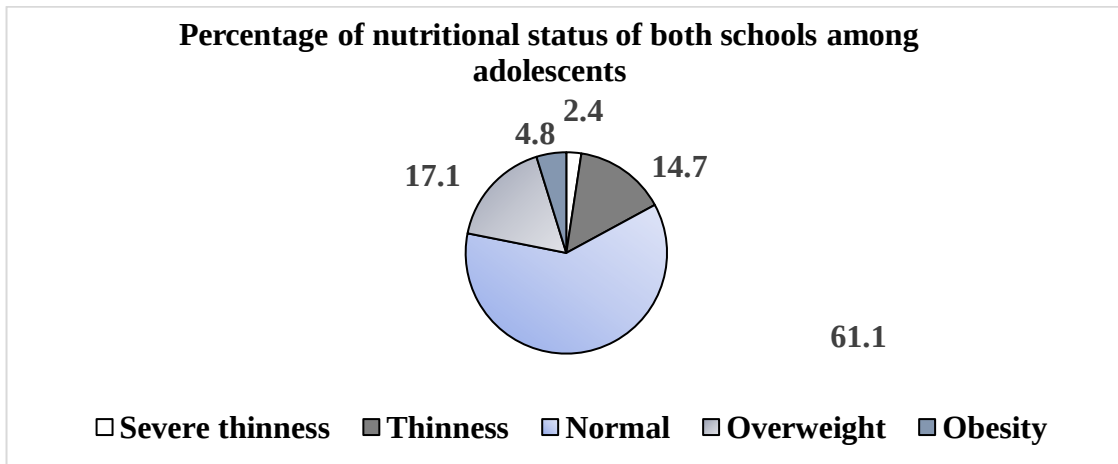


Figure 2: Nutritional status of both schools among adolescents

The above figure depicted the overall nutritional status of 293 adolescents of both public and private schools of Kathmandu Metropolitan City. It illustrated that in underweight, 2.4% of them were found severe thin followed by 14.7% of thin. Highest percentage (61.1%) of students fall within normal BMI while 17.1% were overweight and 4.8% were obese.

4.1.7 Age wise classification of nutritional status of adolescents

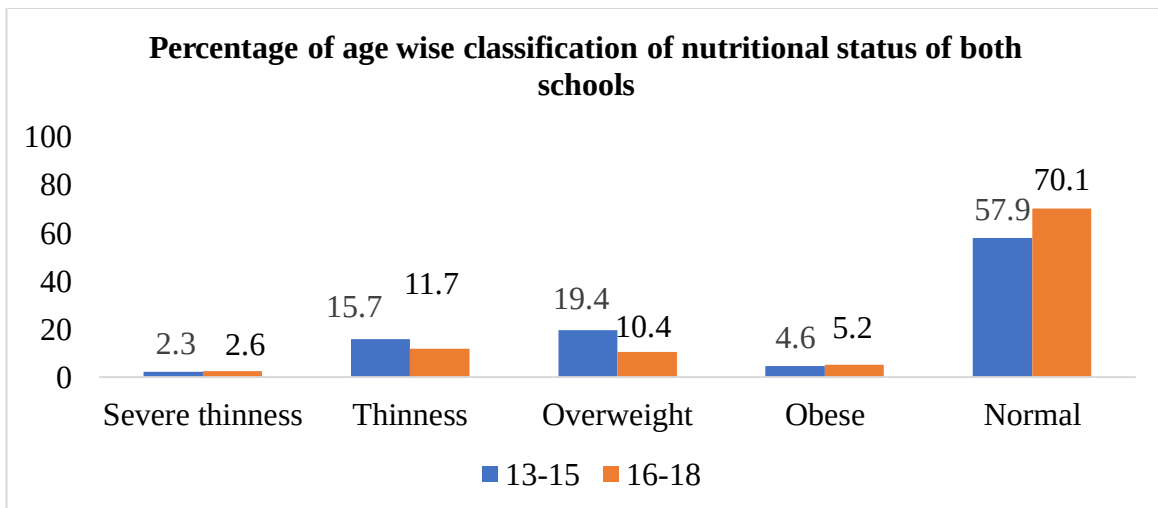


Figure 3: Age-wise classification of nutritional status among adolescents

The following graph displayed regarding the age-wise classification of nutritional status of public and private schools among adolescents of Kathmandu Metropolitan City. The above chart showed that among teenagers between the ages of 16 and 18, 5.2% were obese and

10.4% were overweight. Likewise, 19.4% were overweight and 4.6% obese in the age group of 13-15 years. Hence, it showed that higher percentage 19.4% of adolescents of age group 13-15 years were overweight and obesity was more (5.2%) among the age group of 16-18 years of adolescent students of both private and public schools. Additionally, 15.7% of them were thin and 2.3% severely thin in 13-15 years age followed by 2.6% severe thin and 11.7% thin in the age group of 16-18 years.

4.1.8 Sex-wise classification of nutritional status among adolescents

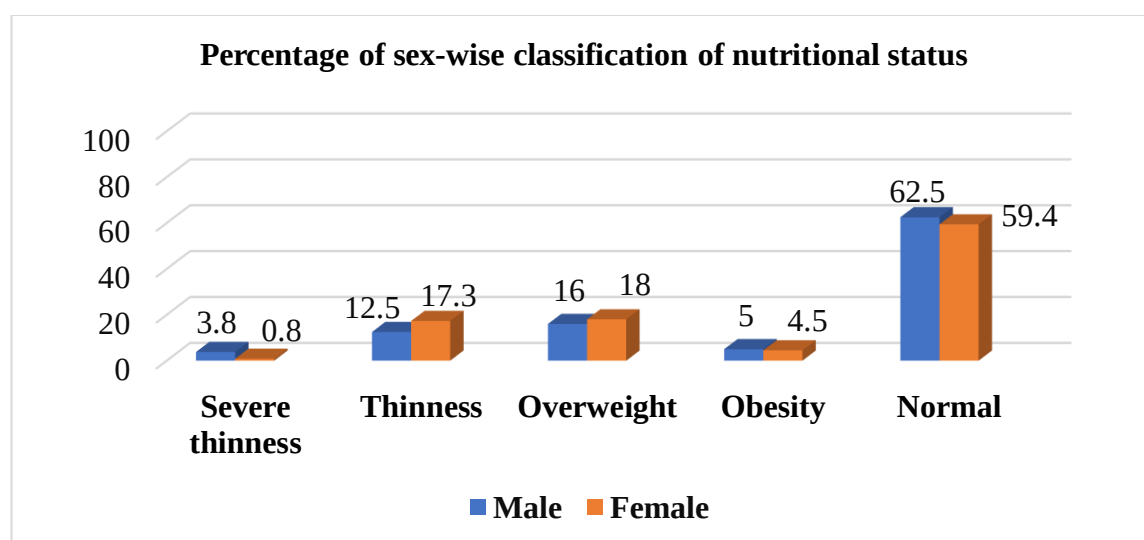


Figure 4: Sex-wise classification of nutritional status among adolescents

The given graph showed the sex-wise classification of nutritional status of adolescents of Kathmandu Metropolitan City. It showed that male was found obese 5% than female 4.5%. Further, 18% female were overweight as compared to male 16%. Furthermore, it was revealed that 17.5% of females were thin than males 12.5% followed by 3.8% severe thin among male than female 0.8% respectively.

4.1.9 Ethnicity wise distribution with nutritional status

Under ethnicity, the highest percentage 4.3% severe thin was found among madhesi/muslim including thin 21.7%. Furthermore, the highest percentage were overweight 22.7% among janajati while the lowest was found among brahmin (11%). Likewise, highest percentage of obese students were found in dalit (8.5%). While the highest (70.4%) of them were found to be normal respectively.

Table 5: Ethnicity wise distribution with nutritional status among adolescents

Ethnicity	Severe Thinness N (%)	Thinness N (%)	Overweight N (%)	Obesity N (%)	Normal N (%)
Brahmin	1 (1.9%)	6 (11.1%)	7 (13%)	2 (3.7%)	38 (70.4%)
Dalit	-	7 (11.9%)	8 (13.6%)	5 (8.5%)	39 (66.1%)
Madhesi/ Muslim	4 (4.3%)	20 (21.7%)	15 (16.3%)	1 (1.1%)	52 (56.5%)
Janajati	2 (2.3%)	10 (11.4%)	20 (22.7%)	6 (6.8%)	50 (56.8%)

4.1.10 Family type wise distribution with nutritional status among adolescents

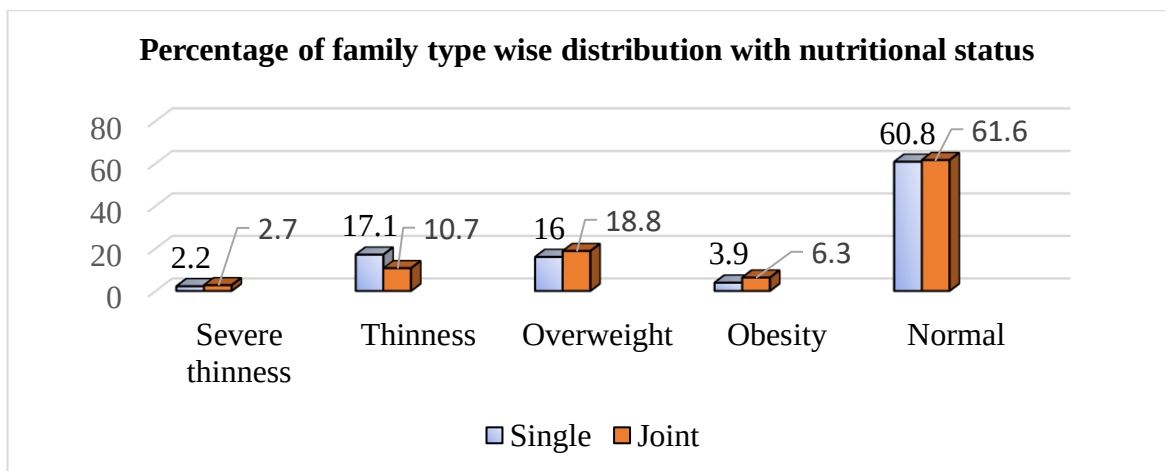


Figure 5: Family type wise distribution with nutritional status among adolescents

Joint family tends to have higher percentage of normal (61.16%), overweight (18.8%) and obese (6.3%) students compared to single family.

4.1.11 Family monthly income

The table denoted that around 23% overweight and 6.4% obese adolescent prevailed in those whose family monthly income in more than NRs 50,000. Additionally, around 20% thin and 61.8% normal were found amongst the parents having monthly income less than 50 thousand.

Table 6: Family monthly income distribution with nutritional status

Family monthly income (Rs)	Severe thin N (%)	Thin N (%)	Overweight N (%)	Obesity N (%)	Normal N (%)
10000-50000	6 (3.9%)	30 (19.7%)	17 (11.2%)	5 (3.3%)	94 (61.8%)
50001-150000	1 (0.7%)	13 (9.2%)	33 (23.4%)	9 (6.4%)	85 (60.3%)

4.1.12 Dietary pattern among adolescents of public and private schools

Among total study participants, almost all (100%) in the public and (100%) in private schools had the daily intake of cereals and pulses. Majority (84.2%) of public school's students daily had pulses compared to that of private school students 62.2%. About 10.8% of the respondents in public schools and only 7.4% in private school's students were vegetarian. Additionally, majority (92.6%) of them in private and 89% in private schools' adolescents were non vegetarian. Whereas 16% of participants in private schools and 12.1% in public schools consumed meat every day.

Most of the respondents (80.9%) engaged in public schools eat it twice a week in contrast to two third (66.4%) in private school students. Furthermore, adolescents in private schools consumed more (27.3%) eggs on a daily basis than those in public schools 16.9%. One third (33.8%) of the public school's students consumed eggs once a week than compared to private school students 22.7%. Just 20.3% of private school students eat fish once a week and more than three quarter (79.7%) of them eat it twice a month, compared to 24.3% of public-school students who eat it once a week and three fourth (75.7%) of them eat it twice a month. Majority (86.7%) adolescents attending private schools were found to consumed more milk than those attending public school's adolescents 75%.

Among 158 participants at public schools, near to one third (32.3%) eat seasonal vegetables more than five days a week, while more than two third (67.7%) eat them fewer than five days. Comparably, 54.8% of public-school adolescents eat seasonal vegetables more than five days a week. Whilst near to two-third (63.7%) of students at private schools routinely eat fruits and vegetables high in vitamin A, just 36.3% of them in public schools do so. Furthermore, the average consumption of fruits and vegetables high in vitamin A was 2.6 days. Whereas, near to three fourth (74.1%) and more than one third (36.3%) of them in

public and private schools consume vitamin A rich fruits and vegetables at least 3 times per week. Similarly, two fifth (43.7%) of private school teenagers consume other fruits for more than three days per week than compared to public school teenagers 25.3%. Compared to teenagers attending private schools 56.3%, three fourth (75%) of respondents in public schools reported consuming other fruits and vegetables less than three days per week.

Majority (86.1%) of public-school adolescents eat less than 2 servings of fruits per day in comparison to private school adolescents 62.2%. In the same way, adolescents at private schools were more likely to consumed over two servings of fruit daily 37.8% than those attending public schools 13.9%. Meanwhile, 2 servings of fruits were consumed on an average per day. Comparably, 23% of adolescents at private schools eat nuts every day, whilst 77% of them do so occasionally. In public schools, majority (91.1%) consumed nuts occasionally, and only 8.9% eat them every day. Conversely, most (86.7%) of teenagers of public schools consumed processed/fast food than adolescents of private schools 60%. Almost (96.8%) teenagers at private schools were found to consume carbonated soft drinks more frequently 1–3 times daily which was found similar in public schools 93.2%. When it comes to eating outside at restaurant, 22.2% of teenagers in public schools choose to do so alternatively.

On the other hand, 80% of teenagers in private schools do so occasionally. Likewise, more than two third (68.9%) of private school respondents had their food from outside at home occasionally and only 46.8% public school students had their meal at home from outside. Moreover, more than one third (36.7%) of public-school adolescents never had their food from outside at home in comparison to private school adolescents 15.6%. Moreover, near to two third (62%) from students at public schools had 1-4 glasses of water than private school students 52.6%. Only 47.4% of private school's students drank 5-6 glasses versus 38% by public school students, respectively.

Table 7: Dietary pattern among adolescents in public and private schools

Dietary pattern	Public schools n= 158 N (%)	Private schools n= 135 N (%)
Pulses		
Daily	133 (84.2%)	84 (62.2%)
Alternative	25 (15.8%)	51 (37.8%)
Vegetarian/ non-vegetarian (n= 266)		
Vegetarian	17 (10.8%)	10 (7.4%)
Non-vegetarian	141 (89.2%)	125 (92.6%)
Frequency of eating meat (n=266)		
Daily	17 (12.1%)	20 (16%)
Alternative	10 (7.1%)	22 (17.6%)
Twice a week	114 (80.9%)	83 (66.4%)
Frequency of eating eggs (n=276)		
Daily	25 (16.9%)	35 (27.3%)
Alternative	30 (20.3%)	47 (36.7%)
Once a week	50 (33.8%)	29 (22.7%)
Twice a week	43 (29.1%)	17 (13.3%)
Frequency of intake of fish (n=276)		
Once a week	36 (24.3%)	26 (20.3%)
Twice a month	112 (75.7%)	102 (79.7%)
Frequency of drinking milk and intake of milk product (n=293)		
Daily	118 (74.7%)	117 (86.7%)
Alternative	40 (25.3%)	18 (13.3%)
Intake of seasonal vegetables in a week		
< 5 days	107 (67.7%)	93 (68.9%)
> 5 days	51 (32.3%)	42 (31.1%)
Mean $\pm$ SD = 4.6 $\pm$ 1.72		
Consumption of vitamin A rich vegetables and fruits		
Always	41 (25.9%)	86 (63.7%)
3 times per week	117 (74.1%)	49 (36.3%)
Mean $\pm$ SD = 2.6 $\pm$ 0.72		
Intake of another fruits/ week		
< 3 days	118 (74.7%)	76 (56.3%)
> 3 days	40 (25.3%)	59 (43.7%)
Mean $\pm$ SD = 3.35 $\pm$ 1.7		
Serving of fruits/ day		
< 2 servings	136 (86.1%)	84 (62.2%)
> 2 servings	22 (13.9%)	51 (37.8%)
Mean $\pm$ SD= 2.11 $\pm$ 0.89		
Frequency of intake of nuts (n=293)		
Daily	14 (8.9%)	31 (23%)
Sometimes	144 (91.1%)	104 (77%)
Consumption of processed /fast food		
Daily	137 (86.7%)	81 (60%)
Sometimes	21 (13.3%)	54 (40%)
Drinking carbonated soft drinks in past 7 days		

Dietary pattern	Public schools n= 158 N (%)	Private schools n= 135 N (%)
1-3 times	148 (93.2%)	130 (96.8%)
4-6 times	10 (6.3%)	5 (3.7%)
Mean $\pm$ SD = 1.79 $\pm$ 0.51		
Frequency of eating food at restaurant		
Alternative	35 (22.2%)	15 (11.1%)
Sometimes	78 (49.4%)	108 (80%)
Never	45 (28.5%)	12 (8.9%)
Frequency of having food from outside at home		
Alternative	26 (16.5%)	21 (15.6%)
Sometimes	74 (46.8%)	93 (68.9%)
Never	58 (36.7%)	21 (15.6%)
Frequency of drinking water		
1-4 glasses	98 (62%)	71 (52.6%)
5-6 glasses	60 (38%)	64 (47.4%)
Mean $\pm$ SD = 2.38 $\pm$ 0.96		

4.1.13 24-hour recall diet of public and private schools among adolescents

The mean and standard deviation of the 24-hour recall diet for both public and private schools in the Kathmandu Metropolitan area were displayed in the table below. As students from private schools tend to eat more calories per day, they tend to be more overweight (22.20%) and obese (6.70%). Furthermore, the mean and standard deviation of fat, protein and carbohydrate intake were found higher in private school's students than compared to RDA of ICMR 2020. On the other hand, private school's students had slightly higher mean and SD of total energy (2015.69 $\pm$ 664.85) gram than that of public schools but was comparatively less according to RDA of ICMR 2020.

Table 8: Mean and SD of 24-hour dietary recall

Macro-nutrients (gram)	Public schools Mean $\pm$ SD	Private schools Mean $\pm$ SD
Protein	65.63 $\pm$ 34.30	72.25 $\pm$ 30.77
Fats	48.66 $\pm$ 28.69	64.05 $\pm$ 34.02
Carbohydrate	267 $\pm$ 79.79	287.53 $\pm$ 88.01
Total energy	1770.64 $\pm$ 619.20	2015.69 $\pm$ 664.85

4.1.14 Age-wise distribution of macro-nutrients according to 24-hour dietary recall

The given table represented the mean and standard deviation of the variables of 24-hour recall diet including processed/fast food according to age group of 13-18 years of adolescents of both private and public schools of KMC.

The age group of 13-15 years tend to eat more protein, fats and carbohydrate compared to 16-18 years. This would be the reason for the higher percentage (19.4%) being overweight compared to 10.4% in the age group of 16-18 years.

Table 9: Age-wise distribution of macro-nutrients according to 24-hour dietary recall

Variables	Age of the respondents	Mean $\pm$ SD
Protein	13-15	71.49 $\pm$ 33.51
	16-18	60.86 $\pm$ 29.41
Fats	13-15	57.96 $\pm$ 32.93
	16-18	49.97 $\pm$ 29.12
Carbohydrate	13-15	282.18 $\pm$ 82.78
	16-18	262.97 $\pm$ 87.16
Total energy	13-15	1936.39 $\pm$ 641.14
	16-18	1745.10 $\pm$ 662.48
Processed/fast food	13-15	575.80 $\pm$ 474.54
	16-18	552.86 $\pm$ 484.03

4.1.15 24-hour dietary recall among adolescents of public and private schools

The findings below displayed about the 24- hour dietary recall pattern among the total adolescents (n=293) of both private and public schools of Kathmandu Metropolitan City. The factors included the consumption of processed or fast food, total energy/calories, and macronutrients (protein, fats, carbohydrates) by teenagers attending both public and private schools.

According to the study, the percentage of students in private schools who consumed enough or adequate protein was more (85.2%) compared to less than two third (62%) in public schools. Comparatively, teenagers attending public schools consumed more than one third (38%) inadequate protein than adolescents attending private schools. Also, the intake of adequate fats was more than three quarters (77.8%) in private school students while 58.2% of them in public schools do so. Likewise, intake of inadequate fats was high 41.8%

in public school's adolescents than in private schools. Moreover, in carbohydrate, almost all (100%) of the private school respondents had the adequate amount of carbohydrate paralleled to public school respondents 94.3%. Similarly, adolescents attending public schools consumed inadequate energy/calories over 86.5% than adolescents attending public schools 77%. While less than one third (23%) of private-schools adolescents had adequate energy/calories than compared to public school adolescents 13.9% respectively.

However, almost (97.8%) students attending in private schools consumed almost processed and fast food than those attending public schools 91.1%. Only 2.2% of private school adolescents didn't consume fast/processed food than compared to public school adolescents 8.9%. However, compared to students in public schools, the mean and standard deviation of fast-food intake in grams was higher 688.34 ± 521.81 among adolescents attending private schools and lowered among public school students 467.06 ± 407.65 gram.

Table 10: 24-hour dietary recall among adolescents of public and private schools

Variables	Public schools N (%)	Private schools N (%)
Protein		
Adequate	98 (62%)	115 (85.2%)
Inadequate	60 (38%)	20 (14.8%)
Fats		
Adequate	92 (58.2%)	105 (77.8%)
Inadequate	66 (41.8%)	30 (22.2%)
Carbohydrate		
Adequate	149 (94.3%)	135 (100%)
Inadequate	9 (5.7%)	-
Total energy		
Adequate	22 (13.9%)	31 (23%)
Inadequate	136 (86.1%)	104 (77%)
Processed/fast food		
Yes	144 (91.1%)	132 (97.8%)
No	13 (8.9%)	3 (2.2%)
Mean $\pm$ SD	467.06 $\pm$ 407.65	688.34 $\pm$ 521.81

4.1.16 Minimum dietary diversity among adolescents of public and private schools

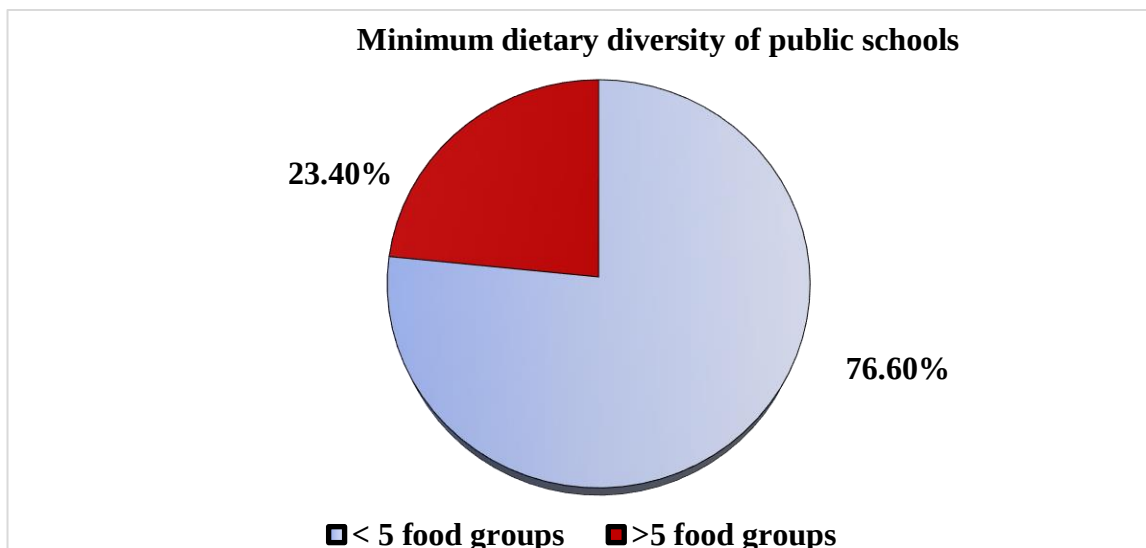


Figure 6: Minimum dietary diversity among adolescents of public schools

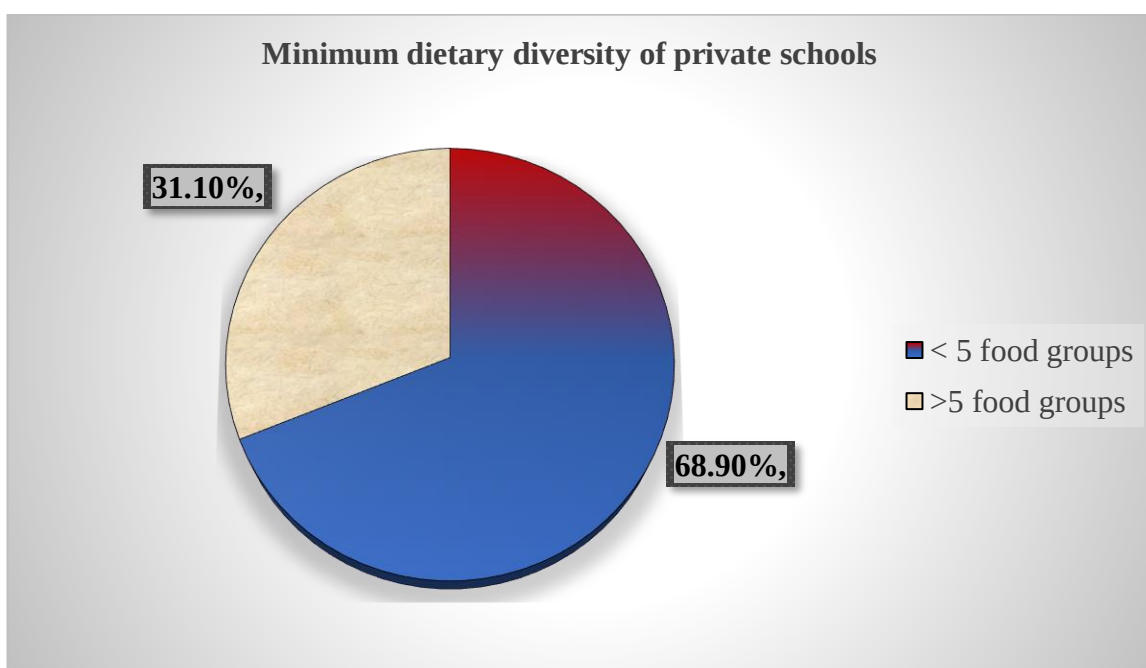


Figure 7: Minimum dietary diversity among adolescents of private schools

The given pie chart showed the minimum dietary diversity among adolescents of public and private schools. Five food groups included cereals and pulses, milk and milk products, meat and meat products, vitamin A rich fruits and vegetables, fats (oils and nuts). It illustrated

that more than half (56.5%) of adolescent students of public schools consumed less than five food groups while 43.5% of private school adolescents intake more than five food groups. Furthermore, more than half (53.2%) of private school adolescents consumed more than five food groups comparatively to public school students 46.8%.

4.1.17 Association of overweight/obesity with socio-demographic characteristics of public and private schools

The table below showed an association of overweight/ obesity with socio-demographic characteristics among adolescents of public and private schools. Higher percentage of students of 13-15 years age (18.4%), females (18.9%), grade 8 (23%), dalit (20.8%), extended family (19.6%) and family income of more than 1,00,000 per month (26.7%) tend to be overweight/obese. Yet the socio-demographic factors such as age, sex, grade, ethnicity, family type, father's and mother's education, income were not found to be associated with overweight/obesity among public schools.

Contrary to the public schools, higher percentage of student of age 16-18 years (29.4%), male (30.3%), grade 9 (33.3%), janajati (36.1%) from private schools tend to be overweight/obese. The effect of family type and family earning were similar to that of public schools. Furthermore, the socio-demographic factors were not found to be associated with overweight/obesity among private schools. Thus, both public and private schools showed similar trend.

Table 11: Socio-demographic characteristics of public schools

Socio-demographic characteristics	Public schools		p-value
	Underweight/normal	Overweight/obese	
	N (%)	N (%)	
Age			
13-15	80 (81.6%)	18 (18.4%)	0.263
16-18	53 (88.3%)	7 (11.7%)	
Sex			
Male	73 (86.9%)	11 (13.1%)	0.317
Female	60 (81.1%)	14 (18.9%)	
Grade			
8	47 (77%)	14 (23%)	0.052
9	86 (88.7%)	11 (11.3%)	
Ethnicity			
Brahmin/chhetri	12 (100%)	-	0.352
Dalit	42 (79.2%)	11 (20.8%)	

Socio-demographic characteristics	Public schools		p-value
	Underweight/normal	Overweight/obese	
	N (%)	N (%)	
Janajati	23 (85.2%)	4 (14.8%)	
Madheshi/muslim	56 (84.8%)	10 (15.2%)	
Family type			
Nuclear/single	88 (86.3%)	14 (13.7%)	0.330
Extended/joint	45 (80.4%)	11 (19.6%)	
Father's education			
Illiterate	60 (89.6%)	7 (10.4%)	0.466
Primary level	25 (80.6%)	6 (19.4%)	
Secondary level	19 (79.2%)	5 (20.8%)	
More than sec/higher sec	29 (80.6%)	7 (19.4%)	
Mother's education			
Illiterate	64 (88.9%)	8 (11.1%)	0.438
Primary level	23 (76.7%)	7 (23.3%)	
Secondary level	21 (80.8%)	5 (19.2%)	
More than sec/higher sec	25 (83.3%)	5 (16.7%)	
Family monthly income (Rs)			
10000-50000	111 (86.7%)	17 (13.3%)	0.071
50001-150000	22 (73.3%)	8 (26.7%)	

*Significant $p < 0.05$

Table 12: Socio-demographic characteristics of private schools

Variables	Private schools		p-value
	Underweight/normal	Overweight/obese	
	N (%)	N (%)	
Age			
13-15	84 (71.2%)	34 (28.8%)	0.959
16-18	12 (70.6%)	5 (29.4%)	
Sex			
Male	53 (69.7%)	23 (30.3%)	0.689
Female	43 (72.9%)	16 (27.1%)	
Grade			
8	52 (75.4%)	17 (24.6%)	0.265
9	44 (66.7%)	22 (33.3%)	
Ethnicity			
Brahmin/chhetri	33 (78.6%)	9 (21.4%)	0.369
Dalit	4 (66.7%)	2 (33.3%)	
Janajati	39 (63.9%)	22 (36.1%)	
Madheshi/muslim	20 (76.9%)	6 (23.1%)	
Family type			
Nuclear/single	57 (72.2%)	22 (27.8%)	0.751
Extended/joint	39 (69.6%)	17 (30.4%)	
Father's education			

Variables	Private schools		p-value
	Underweight/normal	Overweight/obese	
	N (%)	N (%)	
Illiterate	7 (70%)	3 (30%)	0.571
Primary level	13 (68.4%)	6 (31.6%)	
Secondary level	34 (79.1%)	9 (20.9%)	
More than sec/higher sec	42 (66.7%)	21 (33.3%)	
Mother's education			
Illiterate	12 (80%)	3 (20%)	0.237
Primary level	22 (75.9%)	7 (24.1%)	
Secondary level	33 (76.7%)	10 (23.3%)	
More than sec/higher sec	29 (60.4%)	19 (39.6%)	
Family monthly income (Rs)			
10000-50000	19 (79.2%)	5 (20.8%)	0.337
50001-150000	77 (69.4%)	34 (30.6%)	

* Significant ($p < 0.05$)

4.1.18 Association of overweight/obesity with life style characteristics of public and private schools

The table below illustrated the relationship between lifestyle factors and overweight/obese in teenagers attending public schools and private schools. In life style factors of public schools, 16% of teenagers attending public schools were overweight or obese who engaged in at least 60 minutes of physical activity for all 7 days. 18.6% of individuals who worked out over the course of the seven days were found to be overweight or obese. Participants who engaged in walking or cycling for longer durations 60-120 minutes had a higher prevalence of obesity or overweight 17.9% compared to those who engaged in such activities for shorter durations less than 30 minutes with a prevalence of 13.3%. In contrast to adolescents who participate in sports once a week 14.3%, 21.5% of adolescents who play sports twice a week were overweight or obese.

Apart from sports day at school ($p=0.016$) and exposure to screen time ($p=0.038$), other life style characteristics such as physically active for 60 minutes, physical exercise, time spending in walking/bicycling, physical education class, days of having physical education class, playing sports, helping parents, habit of smoking and drinking alcohol as well as eating food using mobile devices did not show any association towards overweight/obesity among the adolescents of public schools.

Contrary to public schools, all life style characteristics, all life style characteristics did not show any association towards overweight/obesity among adolescents of private schools.

Table 13: Association between life style characteristics of public schools

Life-style characteristics	Public schools		p-value
	Underweight/normal N (%)	Overweight/obese N (%)	
Physically active for 60 minutes			
1-3 days	60 (84.5%)	11 (15.5%)	0.918
All 7 days	73 (83.9%)	14 (16.1%)	
Physical exercise to strengthen muscle			
1-5 days	98 (85.2%)	17 (14.8%)	0.558
All 7 days	35 (81.4%)	8 (18.6%)	
Time spending by walking/bicycling			
< 30 minutes	52 (86.7%)	8 (13.3%)	0.791
30-60 minutes	49 (83.1%)	10 (16.9%)	
60-120 minutes	32 (82.1%)	7 (17.9%)	
Physical education class			
Yes	19 (76%)	6 (24%)	0.222
No	114 (85.7%)	19 (14.3%)	
Days of having physical education class			
Once a week	14 (70%)	6 (30%)	0.160
Twice a week	5 (100%)	-	
Sports day in school			
Yes	91 (79.8%)	23 (20.2%)	0.016*
No	42 (95.5%)	2 (4.5%)	
Playing sports			
Once a week	18 (85.7%)	3 (14.3%)	0.758
Twice a week	62 (78.5%)	17 (21.5%)	
All 7 days	11 (78.6%)	3 (21.4%)	
Helping parents			
Always	113 (83.1%)	23 (16.9%)	0.351
Sometimes	20 (90.9%)	2 (9.1%)	
Habit of smoking			
Yes	6 (100%)	-	0.279
No	127 (83.6%)	25 (16.4%)	
Drinking alcohol/beer/wine			
Yes	10 (83.3%)	2 (16.7%)	0.934
No	123 (84.2%)	23 (15.8%)	
Exposure to screen time			
< 1hour	39 (92.9%)	3 (7.1%)	0.038*
2-4 hours	82 (83.7%)	16 (16.3%)	
> 4 hours	12 (66.7%)	6 (33.3%)	
Eating food using mobile/other electronic devices			
Often	118 (84.9%)	21 (15.1%)	0.505
Always	15 (78.9%)	4 (21.1%)	

***Significant (p < 0.05)**

Table 14: Association of overweight/obese with lifestyle characteristics among adolescents

Life style characteristics	Private schools		p-value
	Underweight/normal N (%)	Overweight/obese N (%)	
Physically active for 60 minutes			
1-3 days	53 (67.1%)	26 (32.9%)	0.221
All 7 days	43 (76.8%)	13 (23.2%)	
Physical exercise to strengthen muscle			
1-5 days	76 (72.4%)	29 (27.6%)	0.543
All 7 days	20 (66.7%)	10 (33.3%)	
Time spending by walking/bicycling			
< 30 minutes	28 (63.6 %)	16 (36.4%)	0.352
30-60 minutes	49 (73.1%)	18 (26.9%)	
60-120 minutes	19 (79.2%)	5 (20.8%)	
Physical education class			
Yes	67 (69.1%)	30 (30.9%)	0.404
No	29 (76.3%)	9 (23.7%)	
Days of having physical education class			
Once a week	48 (75%)	16 (25%)	0.079
Twice a week	19 (57.6%)	14 (42.4%)	
Playing sports			
Once a week	28 (80%)	7 (20%)	0.285
Twice a week	46 (70.8%)	19 (29.2%)	
All 7 days	22 (62.9%)	13 (37.1%)	
Helping parents			
Always	69 (69.7%)	30 (30.3%)	0.548
Sometimes	27 (75%)	9 (25 %)	
Habit of smoking			
Yes	6 (75%)	2 (25%)	0.802
No	90 (70.9%)	37 (29.1%)	
Habit of drinking alcohol/beer/wine			
Yes	26 (72.2%)	10 (27.8%)	0.864
No	70 (70.7%)	29 (29.3%)	
Exposure to screen time			
< 1hour	18 (69.2%)	8 (30.8%)	0.370
2-4 hours	65 (69.1%)	29 (30.9%)	
>4 hours	13 (86.7%)	2 (13.3%)	
Eating food using mobile/other electronic devices			
Often	76 (71.7%)	30 (28.3%)	0.774
Always	20 (69%)	9 (31%)	

***Significant (p < 0.05)**

4.1.19 Association of overweight/obesity with dietary pattern of public and private schools

The table denoted an association of overweight/obesity with dietary pattern of public as well as private schools. Among adolescents of public schools, the only dietary pattern “intake of meat” showed a statistically significant association with overweight/obesity while no any association were found between the other variables of dietary intake.

On the other hand, overweight/obesity was statistically significant to only consumption of “fast food” among adolescents of private schools.

Table 15: Association of overweight/obesity with dietary pattern in public schools

Dietary pattern	Public schools		p-value
	Underweight/normal N (%)	Overweight/obese N (%)	
Intake of pulses			
Daily	114 (85.7%)	19 (14.3%)	0.222
Alternative	19 (76%)	9 (24%)	
Veg/non-veg			
Vegetarian	15 (88.2%)	2 (11.8%)	0.627
Non-Veg	118 (83.7%)	23 (16.3%)	
If non-veg, intake of meat			
Daily	11 (40.7%)	16 (59.3%)	<0.001**
Alternative	45 (90%)	5 (10%)	
Twice a week	62 (96.9%)	2 (3.1%)	
Intake of eggs			
Daily	18 (72%)	7 (28%)	1.27
Alternative	26 (86.7%)	4 (13.3%)	
Once a week	41 (82%)	9 (18%)	
Twice a week	40 (93%)	3 (7%)	
Intake of fish			
Once a week	32 (88.9%)	4 (11.1%)	0.399
Twice a month	93 (83%)	19 (17%)	
Intake of milk and milk products			
Daily	99 (83.9%)	19 (16.1%)	0.869
Alternative	34 (85%)	6 (15%)	
Intake of seasonal vegetables in a week			
< 5 days	88 (82.2%)	19 (17.8%)	0.335
> 5 days	45 (88.2%)	6 (11.8%)	
Intake of other vitamin A rich fruits and vegetables			
Always	33 (80.5%)	8 (19.5%)	0.452
At least 3 times/week	100 (85.5%)	17 (14.5%)	
Days of eating other fruits			

Dietary pattern	Public schools		p-value
	Underweight/normal N (%)	Overweight/obese N (%)	
< 3 days	99 (83.9%)	19 (16.1%)	0.869
> 3 days	34 (85%)	6 (15%)	
Serving of fruits on a day			
< 2 servings	113 (83.1%)	23 (16.9%)	0.351
> 2 servings	20 (90.9%)	2 (9.1%)	
Intake of nuts			
Daily	11 (78.6%)	3 (21.4%)	0.547
Sometimes	122 (84.7%)	22 (15.3%)	
Processed/fast food			
Daily	115 (83.9%)	22 (16.1%)	0.836
Sometimes	18 (85.7%)	3 (14.3%)	
Carbonated drinks within 7 days			
1-3 times	124 (83.8%)	24 (16.2%)	0.602
4-6 times	9 (90%)	1 (10%)	
Food at restaurant			
Alternative	31 (88.6%)	4 (11.4%)	0.170
Sometimes	68 (87.2%)	10 (12.8%)	
Never	34 (75.6%)	11 (24.4%)	
Food from outside at home			
Alternative	21 (80.8%)	5 (19.2%)	0.265
Sometimes	66 (89.2%)	8 (10.8%)	
Never	46 (79.3%)	12 (20.7%)	
Drinking water			
1-4 glasses	83 (62.4%)	15 (60%)	0.82
5-6 glasses	50 (37.6%)	10 (40%)	

*Significant (p < 0.05) ** (p <0.001)

Table 16: Association of overweight/obesity with dietary pattern in private schools

Dietary pattern	Private schools		p-value
	Underweight/normal	Overweight/obese	
	N (%)	N (%)	
Intake of pulses			
Daily	59 (70.2%)	25 (29.8%)	0.774
Alternative	37 (72.5%)	14 (27.5%)	
Veg/non-veg			
Vegetarian	6 (60%)	4 (40%)	0.420
Non-Vegetarian	90 (72%)	35 (28%)	
If non-veg, intake of meat			
Daily	17 (85%)	3 (15%)	0.191
Alternative	36 (75%)	12 (25%)	
Twice a week	37 (64.9%)	20 (35.1%)	
Intake of eggs			
Daily	22 (62.9%)	13 (37.1%)	0.477
Alternative	35 (74.5%)	12 (25.5%)	

Dietary pattern	Private schools		p-value
	Underweight/normal	Overweight/obese	
	N (%)	N (%)	
Once a week	21 (72.4%)	8 (27.6%)	
Twice a week	14 (82.4%)	3 (17.6%)	
Intake of fish			
Once a week	18 (69.2%)	8 (30.8%)	0.737
Twice a month	74 (72.5%)	28 (27.5%)	
Milk consumption			
Daily	83 (70.9%)	34 (29.1%)	0.911
Alternative	13 (72.2%)	5 (27.8%)	
Intake of seasonal vegetables			
< 5 days	152 (76%)	48 (24%)	0.190
> 5 days	77 (82.8%)	16 (17.2%)	
Intake of other vitamin A rich fruits and vegetables			
Always	62 (72.1%)	24 (27.9%)	0.739
At least 3 days /week	34 (69.4%)	15 (30.6%)	
Days of eating other fruits			
< 3 days	56 (73.7%)	20 (26.3%)	0.454
> 3 days	40 (67.8%)	19 (32.2%)	
Serving of fruits in a day			
< 2 servings	60 (71.4%)	24 (28.6%)	0.917
> 2 servings	36 (70.6%)	15 (29.4%)	
Intake of nuts			
Daily	19 (61.3%)	12 (38.7%)	0.169
Sometimes	77 (74%)	27 (26%)	
Fast food			
Daily	63 (77.8%)	18 (22.2%)	0.036*
Sometimes	33 (61.1%)	21 (38.9%)	
Carbonated drinks			
1-3 times	91 (70%)	39 (30%)	0.146
4-6 times	5 (100%)	-	
Food at restaurant			
Alternative	11 (73.3%)	4 (26.7%)	0.926
Sometimes	76 (70.4%)	32 (29.6%)	
Never	9 (75%)	3 (25%)	
Food from outside at home			
Alternative	13 (61.9%)	8 (38.1%)	0.557
Sometimes	67 (72%)	26 (28%)	
Never	16 (76.2%)	5 (23.8%)	
Drinking water			
1-4 glasses	51 (71.8%)	20 (28.2%)	0.846
5-6 glasses	45 (70.3%)	19 (29.7%)	

***Significant (p < 0.05)**

4.1.20 Association of overweight/obese with 24-hour dietary recall of public and private schools

The table below described an association of overweight/obesity with 24-hour dietary recall among adolescents of public schools. Adequate protein intake was found to be associated with overweight/obesity among adolescents of both public ($p=0.021$) and private ($p=0.021$) schools. Although total energy intake was found to be associated to overweight/obesity among students of public schools ($p=0.015$), it was not the matter among adolescents of private schools.

Whereas, the other variables like minimum dietary diversified food and intake of fast food were not associated with overweight/obese among adolescents of both schools.

Table 17: Association of overweight/obese with 24-hour dietary recall of public school's students

Variables	Public schools		p-value
	Underweight/normal N (%)	Overweight/obese N (%)	
Protein			
Adequate	69 (71.1%)	28 (28.9%)	0.021*
Inadequate	30 (90.9%)	3 (9.1%)	
Fats			
Adequate	66 (72.5%)	25 (27.5%)	0.138
Inadequate	33 (84.6%)	6 (15.4%)	
Carbohydrate			
Adequate	95 (75.4%)	31 (24.6%)	0.256
Inadequate	4 (100%)	-	
Total energy			
Adequate	13 (56.5%)	10 (43.5%)	0.015*
Inadequate	86 (80.4%)	21(19.6%)	
Minimum dietary diversity			
< 5 food groups	104 (78.2%)	17 (68%)	0.269
> 5 food groups	29 (21.8%)	8 (32%)	
Fast food			
Yes	94 (75.2%)	31 (24.8%)	0.202
No	5 (100%)	-	

***Significant at $p < 0.05$**

Table 18: Association of overweight/obese with macronutrients of private schools

Variables	Private schools		p-value
	Underweight/Normal N (%)	Overweight/Obese N (%)	
Protein			
Adequate	77 (67%)	38 (33%)	0.011*
Inadequate	19 (95%)	1 (5%)	
Fats			
Adequate	74 (70.5%)	31 (29.5%)	0.761
Inadequate	22 (73.3%)	8 (26.7%)	
Total energy			
Adequate	18 (58.1%)	13 (41.9%)	0.068
Inadequate	78 (75%)	26 (25%)	
Minimum dietary diversity			
< 5 food groups	67 (69.8%)	26 (66.7%)	0.722
> 5 food groups	29 (30.2%)	13 (33.3%)	
Fast food			
Yes	94 (96.9%)	38 (28.8%)	0.864
No	2 (66.7%)	1 (33.3%)	

***Significant at $p < 0.05$**

4.1.21 Binary logistic regression of public and private schools with overweight/obesity

The table below showed that there was an association of nutritional status with private and public schools. It demonstrated that private school adolescents were significantly associated ($p= 0.008$) which was **2.16 times** (OR=2.161, 95% CI 1.226-3.809) more likely to be overweight/obese than public school adolescents. There were a significant relationship between overweight/obese among adolescent students of public and private schools (p value 0008).

Table 19: Binary logistic regression of public and private schools with overweight/obesity

Type of school	Nutritional category		p-value	Odd's Ratio	COR (95% CI)
	Underweight/normal N (%)	Overweight/obese N (%)			
Public	133 (84.2%)	25 (15.8%)	0.008	1	1.226-3.809
Private	96 (71.1%)	39 (28.9%)		2.161	

4.1.22 Binary logistic regression of socio-demographic characteristics of public and private schools

The provided table displayed the results of binary logistic regression for the sociodemographic traits of overweight and obese adolescents attending public and private schools. The socio-demographic variables like father's education, mother's education and family monthly income were statistically significantly associated with overweight/obesity.

Regarding respondents whose father's education was more than secondary/higher secondary education level were 2.16 times (**COR=2.164**, 95% CI 1.19-5.854; **p=0.017**) more likely to be obese/overweight with reference to those whose fathers were illiterate. About respondents whose mother's education was more than secondary/higher secondary level were 3 times more (**COR=3.071**, 95% CI 1.388-6.795; **p=0.006**) likely to be overweight/obese with reference to those whose mothers were illiterate. Similarly, participants mothers with primary level education were 2.1 times more (**COR=2.15**, 95% CI 0.899-5.138, **p=0.085**) likely to be overweight/obese than those respondents' mothers who had secondary level education. Thus, the level of education of mother's and father's education both showed inverse relation with their children being overweight/obese i.e. (**p=0.006** and **p=0.017**). Family monthly income was also strongly associated with overweight/obesity of public and private school students. Regarding family monthly income, respondents' family monthly income with more than fifty thousand to one lakh fifty thousand was 2.5 folds more likely to be overweight/obese with reference to those who had less than fifty thousand (**COR=2.51**, 95% CI 1.406-4.470; **p=0.002**) respectively.

Whereas, the other factors like age (**p=0.122**), sex (**p=0.788**), grade (**p=0.459**), Ethnicity (**p=9.473**), family type (**p=0.304**) were not associated with overweight/obesity. The odds of age groups 13-15 years were almost equally likely (**COR=1.71**, 95% CI 0.861-3.425) to be overweight/obese with reference to age groups 16-18 years. Besides, the odds of female were equally likely (**COR=1.079**, 95% CI 0.619-1.882; **p=0.788**) to be overweight/obese than that of male. The odds of grade 9 was equally likely to be obese/overweight (**COR=1.234**, 95% CI 0.708-2.150; **p=0.459**) with reference to grade 8 students. Further, under ethnicity, with reference to brahmin/chhetri, janajati were 16% less likely to be obese/overweight (**COR=0.833**, 95% CI 0.159-4.379). Further, the odds of nuclear family

were almost equally likely to be overweight/obese with reference to joint family (COR=1.34, 95% CI 0.765-2.356; p=0.304) respectively.

Table 20: Binary logistic regression of socio-demographic characteristics of public and private schools

Socio-demographic characteristics	Nutritional category			p-value
	Underweight/ normal N (%)	Overweight/ obese N (%)	COR (95% CI)	
Age of the respondent				
13-15	164 (75.9%)	52 (24.1%)	1.71 (0.861-3.425)	0.122
16-18	65 (84.4%)	12 (15.6%)	1	
Sex				
Male	126 (78.8%)	34 (21.3%)	1	0.788
Female	103 (77.4%)	30 (22.6%)	1.079 (0.619-1.882)	
Grade				
8	99 (76.2%)	31 (23.8%)	1.234 (0.708-2.150)	0.459
9	130 (79.8%)	33 (20.2%)	1	
Ethnicity				
Brahmin/chhetri	45 (83.3%)	9 (16.7%)	1	0.088
Dalit	46 (78%)	13 (22%)	2.097 (0.897-4.904)	
Janajati	62 (70.5%)	26 (29.5%)	0.833 (0.159-4.379)	
Madheshi/muslim	76 (82.6%)	16 (17.4%)	1.094 (0.436-2.745)	
Family type				
Nuclear	145 (80.1%)	36 (19.9%)	1.34 (0.765-2.356)	0.304
Joint/extended	84 (75%)	28 (25%)	1	
Father's education				
Illiterate	67 (87%)	10 (13%)	1	0.114
Primary level	38 (76%)	12 (24%)	2.116 (0.836-5.56)	
Secondary level	53 (79.1%)	14 (20.9%)	1.770 (0.728-4.301)	
More than Sec/higher sec	71 (71.7%)	28 (28.3%)	2.64 (1.19-5.854)	
Mother's education				
Illiterate	76 (87.4%)	11 (12.6%)	1	0.085
Primary level	45 (76.3%)	14 (23.7%)	2.15 (0.899-5.138)	
Secondary level	54 (78.3%)	15 (21.7%)	1.92 (0.818-5.502)	
More than Sec/higher sec	54 (69.2%)	24 (30.8%)	3.071 (1.388-6.795)	
Family monthly income (Rs)				
10,000-50,000	130 (85.5%)	22 (14.5%)	1	0.002*
50,001-150,000	99 (70.2%)	42 (29.8%)	2.51 (1.406-4.470)	

*Significant p < 0.05

4.1.23 Binary logistic regression of life style characteristics of public and private school's students

The binary logistic regression of overweight/obesity with lifestyle factors in public and private school is displayed in the study's findings table. In case of lifestyle variables, the factors like physical education and sports day in schools was statistically significant with overweight/obesity. Adolescents who had physical education in their school were 2.14 times more likely to obese/overweight with reference to those students who didn't have physical education (COR=2.14, 95% CI 1.219-3.749; $p=0.007$). Correspondingly, adolescents who had sports day in school were 6.9 times (COR=6.96, 95% CI 1.638-29.602; $p=0.009$) more likely to be overweight/obese with reference to those students who didn't have the same. This showed a significant correlation between sports day program with overweight/obese.

Moreover, students who were physically active for 1-3 days among were 1.4 folds more (COR=1.407, 95% CI 0.804-2.462; $p=0.231$) likely to be overweight/obese with reference to those who were active for all seven days. Besides, those who had physical exercise for all seven days were almost equally likely (COR=1.24, 95% CI 0.664-2.309; $p=0.502$) to be overweight/obese with reference to those students who had physical exercise for 1-5 days. Regarding cycling/walking, those who spend more than 30-60 minutes in cycling or walking were equally likely (COR=1.275, 95% CI 0.586-2.773; $p=0.540$) to be overweight/obese with reference to those who spend less than 30 minutes in it. In case of days of physical education class, adolescents who had physical education class once a week was 9.5% less (COR=0.608, 95% CI, 0.268-1.380; $p=0.232$) likely to be obese/overweight with reference to those who had it twice a week.

Additionally, the odds of playing sports for all 7 days was 2.2 times (COR=2.23, 95% CI 0.900-5.525; $p=0.083$) more likely to be overweight/obese with reference to those who played it for once a week. In case of helping parents, the teenagers who helped their parents were equally likely (COR=1.244, 95% CI 0.603-2.567; $p=0.554$) to be overweight/obese with reference to those who helped their parents occasionally. As well as, adolescents who were exposed to screen time (watching tv, mobile, video games, other gadgets etc.) for more than four hours were 1.65 times more likely (COR=1.658, 95% CI 0.595-4.621; $p=0.333$) to be overweight/obesity with reference to those who were exposed to less than 1 hour. Besides, those who always used mobile devices during meals was 1.4 time more likely

(COR=1.413, 95% CI 0.696-2.866; p=0.338) to be overweight/obese with reference to those who used it often. In case of smoking, teenagers who never had the habit of smoking were 1.7 times more likely (COR=1.714, 95% CI 0.374-7.864; p=0.488) to be with reference to those who did smoking. In the same manner, those who had never habit of drinking alcohol, beer or wine were 21.8% likely to be overweight/obese (COR=0.808, 95% CI 0.393-1.663; p=0.563) with reference to those who had the habit of drinking alcohol, beer or wine.

Thus, there were no significant association found between the following factors: being physically active, exercising, going for walks or rides, attending physical education classes, participating in sports, lending a hand to parents, screen time, consuming food through electronic devices, smoking habit, and alcohol/beer/wine habit, respectively.

Table 21: Binary logistic regression of lifestyle characteristics of public and private schools

Life-style characteristics	Underweight/ normal N (%)	Overweight/ obese N (%)	COR (95% CI)	p-value
Physically active				
1-3 days	113 (75.3%)	37 (24.7%)	1.407 (0.804-2.462)	0.231
All 7 days	116 (81.1%)	27 (18.9%)	1	
Physical exercise				
1-5 days	174 (79.1%)	46 (20.9%)	1	
All 7 days	55 (75.3%)	18 (24.7%)	1.24 (0.664-2.309)	0.502
Time spends for cycling & walking				
< 30 min	80 (76.9%)	24 (23.1%)	1	0.822
> 30-60 min	98 (77.8%)	28 (22.2%)	1.275 (0.586-2.773)	0.540
60-120 min	51 (81%)	12 (19%)	1.214 (0.570-2.587)	0.615
Physical education class				
Yes	86 (70.5%)	36 (29.5%)	2.14 (1.219-3.749)	0.007*
No	143 (83.6%)	28 (16.4%)	1	
Days of having physical education class				
Once a week	62 (73.8%)	22 (61.1%)	0.608 (0.268-1.380)	0.232
Twice a week	24 (63.2%)	14 (36.8%)	1	
Sports day in school				
Yes	187 (75.1%)	62 (24.9%)	6.96 (1.638-29.602)	0.009*
No	42 (95.5%)	2 (4.5%)	1	
Playing sports				
Once a week	46 (82.1%)	10 (17.9%)	1	
Twice a week	108 (75%)	36 (25%)	1.53 (0.702-3.348)	0.283
All 7 days	33 (67.3%)	16 (32.7%)	2.23 (0.900-5.525)	0.083
Helping parents				
Always	182 (77.4%)	53 (22.6%)	1.244 (0.603- 2.567)	0.554

Sometimes	47 (81%)	11 (19%)		1
Screen time				
< 1 hour	57 (83.8%)	11 (16.2%)		1
2-4 hour	147 (76.6%)	45 (23.4%)	1.59 (0.767-3.281)	0.213
>4 hour	25 (75.8%)	8 (24.2%)	1.658 (0.595-4.621)	0.333
Eating food using mobile devices				
Often	194 (79.2%)	51 (20.8%)		1
Always	35 (72.9%)	13 (27.1%)	1.413 (0.696-2.866)	0.338
Habit of smoking				
Yes	12 (85.7%)	2 (14.3%)		1
No	217 (77.8%)	62 (22.2%)	1.714 (0.374-7.864)	0.488
Habit of drinking alcohol, beer, wine				
Yes	36 (75%)	12 (18.8%)		1
No	193 (78.8%)	52 (21.8%)	0.808 (0.393-1.663)	0.563

***Significant $p < 0.05$**

4.1.24 Binary logistic regression on dietary pattern among adolescent of public and private schools

The table below revealed binary logistic regression on dietary pattern among adolescents of public and private schools. It illustrated that there was a significant correlation between the factors of dietary pattern like intake of eggs, intake of nuts and intake of fast food.

Adolescents who consumed pulses alternatively were 1.4 times (COR=1.404, 95% CI 0.764-2.580; $p=0.274$) more likely to be overweight/obese than those who consumed it daily. In the same way, those adolescents who were vegetarian were equally likely (COR=1.025, 95% CI 0.395; $p=0.960$) to be overweight/obese with reference to non-vegetarian. Nevertheless, respondents who consumed meat daily were equally likely (COR=1.186, 95% CI 0.520-2.706; $p=0.685$) to be overweight/obese with reference to those who intake it alternatively. Likewise, respondents who consumed eggs daily were 4.5 folds (COR=4.5, 95% CI 1.65-12.22; **$p=0.003$**) more overweight/obese with reference to those who eat it twice a week. It showed a statistically significant association between intake of eggs daily with overweight/obesity. Additionally, those who eat eggs once a week were 2.4 times (COR=2.47, 95% CI 0.908-6.706) more likely to be overweight/obese compared to those who eat it alternatively. Respondents who consumed fish twice a month were equally likely to be overweight/obese with reference to those who consumed it once a week (COR=1.173, 95% CI 0.578-2.381; $p=0.659$). Further, those respondents who daily drink milk were also equally likely (COR=1.24, 95% CI 0.603-2.567; $p=0.554$) to be overweight/obese with reference to those who drank milk alternatively.

Adolescents eating seasonal vegetable for less than 5 days were 1.5 times more likely to be obese/overweight with reference to intake of it for more than five days (COR=1.52, 95% CI 0.810-2.850; $p=0.192$). Likewise, students who always had vitamin A rich fruits and vegetables was 1.4 times more likely (COR=1.41, 95% CI 0.809-2.460; $p=0.225$) to be overweight/obese with reference to those who consumed it at least 3 times per week. Moreover, respondents eating other fruits more than three days were equally (COR=1.34, 95% CI 0.757-2.382; $p=0.314$) expected to be overweight/obese with reference to those who had it for less than 3 days. Correspondingly, those respondents who had more than two servings of fruits per day was equally (COR=1.12, 95%CI 0.594-2.101; $p=0.730$) likely to be overweight/obese with reference to those who had less than two servings of fruit per day.

In addition, intake nuts daily was significantly associated with overweight/obesity among adolescent which was 2 times more (COR=2.031, 95% CI 1.014-4.065; **$p=0.045$**) likely to be overweight/obese with reference to those who take it occasionally. Further, participants who consumed processed or fast food sometimes were 2 times more (COR=2.094, CI 1.156-3.793; **$p=0.015$**) likely to be overweight/obese with reference to those who consumed it daily. This showed a statistically significant association with overweight/obesity.

In the same way, respondents who had food at restaurant occasionally were 1.5 times more likely (COR = 1.53, 95% CI 0.667-3.514; $p=0.565$) to be overweight/obese with reference to those who eat their food at restaurant. Besides, adolescents who alternatively had their food from outside at home was equally likely (COR =1.394, 95% CI 0.605-3.212; $p=0.565$) to be overweight/obese with reference to those who never had it. Additionally, adolescents who had 1-3 servings of carbonated drinks was 4.1 times more (COR= 4.102, 95% CI 0.529-31.806; $p=0.177$) likely to be overweight/obese with reference to those who had 4-6 servings. Finally, regarding drinking water, with reference to 1-4 glasses, adolescents who had five to six glasses of water per day was equally likely (COR= 1.17, 95% CI 0.660-2.042; $p=0.584$) to be overweight/obese.

Table 22: Binary logistic regression on dietary pattern of public and private schools

Dietary pattern	Underweight/ normal N (%)	Overweight/ obese N (%)	COR (95% CI)	p-value
Intake of pulses				
Daily	173 (79.7%)	44 (20.3%)	1	0.274
Alternative	56 (73.7%)	20 (26.3%)	1.404 (0.764-2.580)	
Veg/non-veg				
Vegetarian	21 (77.8%)	6 (22.2%)	1.025 (0.395-2.657)	0.960
Non-vegetarian	208 (78.2%)	58 (21.8%)	1	
Frequency of intake of meat				
Daily	28 (59.6%)	19 (40.4%)	1.186 (0.520-2.706)	0.685
Alternative	81 (82.7%)	17 (17.3%)	1.033 (0.418-2.554)	
Twice a week	99 (81.8%)	22 (18.2%)	1	
Frequency of intake of eggs				
Daily	40 (66.7%)	20 (33.3%)	4.5 (1.65-12.22)	0.003*
Alternative	61 (79.2%)	16 (20.8%)	2.361 (0.862-6.463)	
Once a week	62 (78.5%)	17 (21.5%)	2.47 (0.908-6.706)	0.077
Twice a week	54 (90%)	6 (10%)	1	
Frequency of intake of fish				
Once a week	50 (80.6%)	12 (19.4%)	1	0.659
Twice a month	167 (78%)	47 (22%)	1.173 (0.578-2.381)	
Frequency of drinking milk				
Daily	182 (77.4%)	53 (22.6%)	1.24 (0.603-2.567)	0.554
Alternative	47 (81%)	11 (19%)	1	
Days of eating seasonal vegetables & fruits				
<5 days	152 (76%)	48 (24%)	1.52 (0.810-2.850)	0.192
> 5 days	77 (82.8%)	16 (17.2%)	1	
Frequency of intake of vitamin A rich fruits & vegetables				
Always	95 (74.8%)	32 (25.2%)	1.41 (0.809-2.460)	0.225
At least 3 times/week	134 (80.7%)	32 (19.3%)	1	
Days of eating other fruits				
<3 days	155 (79.9%)	39 (20.1%)	1	0.314
>3 days	74 (74.7%)	25 (25.3%)	1.34 (0.757-2.382)	
Servings of fruits/day				
< 2 Servings	173 (78.6%)	47 (21.4%)	1	0.730
>2 Servings	56 (76.7%)	17 (23.3%)	1.12 (0.594-2.101)	
Intake of nuts				
Daily	30 (66.7%)	15 (33.3%)	2.031 (1.014-4.065)	0.045*
Sometimes	199 (80.2%)	49 (19.8%)	1	
Intake of fast food				
Daily	178 (81.7%)	40 (18.3%)	1	0.015*
Sometimes	51 (68%)	24 (32%)	2.094 (1.156-3.793)	
Frequency of eating food at restaurant				
Alternative	42 (84%)	8 (16%)	1	0.315
Sometimes	144 (77.4%)	42 (22.6%)	1.53 (0.667-3.514)	
Never	43 (75.4%)	14 (24.6%)	1.709 (0.650-4.496)	

Dietary pattern	Underweight/ normal N (%)	Overweight/ obese N (%)	COR (95% CI)	p-value
Frequency of intake of food from outside at home				
Alternative	34 (72.3%)	13 (27.7%)	1.394 (0.605-3.212)	0.565
Sometimes	133 (79.6%)	34 (20.4%)	0.932 (0.484-1.796)	0.435
Never	62 (78.5%)	17 (21.5%)	1	
Drinking carbonated drinks				
1-3 times/servings	215 (77.3%)	63 (22.7%)	4.102 (0.529-31.806)	0.177
4-6 times/servings	14 (93.3%%)	1 (6.7%)	1	
Drinking water				
1-4 glasses	134 (79.3%)	35 (20.7%)	1	
5-6 glasses	95 (76.6%)	29 (23.4%)	1.17 (0.669-2.042)	0.584

****Significant at $p < 0.05$**

4.1.25 Binary logistic regression between associated variables of 24-hour recall diet

The table below demonstrated binary logistic regression between associated variables of 24-hour recall diet with overweight/obese among adolescents of Kathmandu metropolitan City. In protein, adolescents who intake adequate protein were 5.7 times (COR=5.75, 95% CI 2.214-14.925; $p < 0.001$) more likely to be overweight/obese with reference to those adolescents who had inadequate protein intake. Similarly, those respondents who had adequate fats were 2.8 folds (OR=2.844, 95% CI 1.409-5.742; $p = 0.004$) more likely to be overweight/obese with reference to those who had inadequate fats. Adolescents who had adequate calorie intake were 3.7 times (COR=3.72, 95% CI 1.964-7.049; $p < 0.001$) more expected to be overweight/obese with reference to those who had inadequate calorie intake. On the other hand, those adolescents who had fast/ processed food were 2 times (COR=2.17, 95% CI 0.484-9.760; $p=0.311$) more likely to be overweight/obese with reference to those who did not have it.

Thus, a significant association were found between the variables like adequate protein, fats and total energy with overweight/obese among adolescents of public and private schools. Hence, the adequate protein intake was shown to have a significant effect on overweight/obesity trends among adolescents of both public and private schools from the results of this research.

Table 23: Binary logistic regression analysis of 24-hour dietary recall

Variables	Underweight/ Normal N (%)	Overweight/ Obese N (%)	COR (95 %CI)	p-value
Protein				
Adequate	155 (72.3%)	59 (27.7%)	5.75 (2.214-14.915)	< 0.001**
Inadequate	75 (93.8%)	5 (6.3%)	1	
Fats				
Adequate	144 (73.1%)	53 (26.9%)	2.844 (1.409-5.742)	0.004*
Inadequate	85 (88.5%)	11 (11.5%)	1	
Total energy				
Adequate	30 (56.6%)	23 (43.4%)	3.72 (1.964-7.049)	< 0.001**
Inadequate	199 (82.9%)	41 (17.1%)	1	
Fast food				
Yes	214 (77.5%)	62 (22.5%)	2.17 (0.484-9.760)	0.311
No	15 (88.2%)	2 (11.8%)	1	

***Significant at p < 0.05, ** Significant at p < 0.001**

4.1.26 Multiple regression analysis of overweight and obesity with associated factors

The given table below represented multiple regression analysis of overweight/obesity with associated factors. Regarding school type, the odds of private school's students were 53.7% less likely (AOR=0.463, 95% CI 0.173-1.237; p=0.124) to be overweight/obese than compared to public schools. However, since the 95% CI (0.173-1.237) includes 1, the result is not statistically significant, indicating that the observed association could be due to chance.

Adolescents whose fathers attained primary level education 26.5% less likely (AOR = 0.735, 95% CI 0.175-3.077) of experiencing overweight/obesity compared to those whose fathers had higher level of education. Further, the odds of adolescents whose mother's attained more than secondary/higher secondary level education was 5.7 folds (AOR=5.793, 95% CI 1.070-31.3577; **p = 0.041**) more likely to be overweight/obese than compared to those adolescents' mothers who were illiterate. This analysis showed that mother's education was statistically significantly associated with overweight/obesity which means

this variable has an independent effect on overweight/obesity while controlling for other variables. Likewise, adolescent's mothers who attained primary level education were 3 times (AOR=3.011, 95% CI 0.765-11.859) more likely to be overweight/obese in comparison with mother's who attained secondary level education. The odds of overweight/obesity among adolescent whose family monthly income was more than 50,000-1,50,000 was 2.2 times more likely to be overweight/obese with reference to those adolescents whose family monthly income was less than 50,000 (AOR=2.23, 95% CI 0.882-5.648). Adolescents who had physical education class were 1.6 times more likely (AOR=1.693, 95% CI 0.747-3.833) to be overweight/obese than those who didn't have physical education class. Similarly, adolescents who had sports day were found to be 2.9 times (AOR=2.932, 95% CI 0.585-14.706) more likely to be overweight/obese than those who didn't have sports day in school.

Correspondingly, those who had eggs once a week were 3.7 times (AOR=3.704, 95% CI 1.174-11.688; **p=0.026**) more likely to be overweight/obese than those who had it alternatively. This showed that intake of eggs once a week was statistically significant with overweight/obese. Moreover, adolescents who had daily intake of nuts were found equally likely (AOR=1.268, 95% CI 0.556-2.8809) to be obese/overweight than those who had it occasionally. Additionally, those who rarely had processed/fast food were 2.2 times more likely (AOR=2.212, 95% CI 1.020-4.793; **p=0.044**) to be overweight/obese than those who had it daily. Therefore, processed/fast food was significantly associated with overweight/obesity.

Under 24-hour recall diet, adolescent who had adequate protein was significantly associated with overweight/obesity which was 5.4 times (AOR=5.465, 95% CI 1.518-19.683; **p=0.009**) more likely to be overweight/obese than that of inadequate protein intake. Yet again, the odds of adequate fats were equally likely (AOR=1.152, 95% CI 0.432-3.073, **p=0.572**) to be overweight/obese with reference to inadequate fats. Finally, those respondents who had adequate calories which was 2.4 times (AOR=2.431, 95% CI 1.096-5.391; **p=0.029**) more likely to be overweight/obese with reference to those adolescents who had inadequate energy/calories respectively.

Table 24: Multiple regression analysis of overweight/obese with associated factors

Variable	Overweight/obese	
	Adjusted OR (95 %CI)	p-value
Type of school		
Public	1	
Private	0.463 (0.173-1.237)	0.124
Father's education		
Illiterate	1	
Primary level	0.735 (0.175-3.077)	0.673
Secondary level	0.218 (0.041-1.170)	0.076
More than secondary/higher secondary	0.176 (0.029-1.068)	0.059
Mother's education		
Illiterate	1	
Primary level	3.011 (0.765-11.859)	0.115
Secondary level	4.296 (0.915-20.176)	0.065
More than secondary/higher secondary	5.793 (1.070-31.357)	0.041*
Monthly income		
10,000-50,000	1	
50,001-150,000	2.232 (0.882-5.648)	0.090
Physical education class		
Yes	1.693 (0.747-3.833)	0.207
No	1	
Sports day in school		
Yes	2.932 (0.585-14.706)	0.191
No	1	
Frequency of intake of eggs		
Daily	5.015 (1.600-15.723)	0.006*
Alternative	2.881 (0.930-8.926)	0.067*
Once a week	3.704 (1.174-11.688)	0.026*
Twice a week	1	
Frequency of intake of nuts		
Daily	1.268 (0.556-2.889)	0.572
Sometimes	1	
Frequency of intake of fast/processed food		
Daily	1	
Sometimes	2.212 (1.020-4.793)	0.044*

***Significant p < 0.05**

Table 25: Multiple regression analysis of overweight/obesity with associated factors

Variable	Overweight/obese Adjusted OR (95 %CI)	p-value
Protein		
Adequate	5.465 (1.518-19.683)	0.009*
Inadequate	1	
Fats		
Adequate	1.152 (0.432-3.073)	0.778
Inadequate	1	
Total energy		
Adequate	2.431 (1.096-5.391)	0.029*
Inadequate	1	

***Significant p < 0.05**

4.2 Discussion

This study was designed to compare the nutritional status of adolescent studying in public and private schools in Kathmandu Metropolitan City. Adolescent mean height was 1.58m i.e. 158 cm and average weight was around 51kg. Among total 293 respondents, male was higher (56.3%) in private schools while female was higher in public schools (46.8%). The mean and standard deviations age of the study participants was 15.20 ± 0.98 in public schools and 14.42 ± 1.06 in private schools. In addition, 45.2% of the students in private schools were janajati, while 33.5% dalit students attended public schools. Similarly, 41.5% of students at private schools were from joint families, while over half (64.6%) of students attending public schools come from nuclear families.

In this research study, prevalence of severe thin was 2.4% followed by 14.7% of thin, less than two third (61.1%) were normal, 17.1% overweight and 4.8% obese which is consistent with the findings of the study prevailed in Duhok district, Iraq (32) which stated that the prevalence of severe thin 0.8% ,thin 5.4% ,10.8% obese and 17.4% overweight,. However, the findings of the current data were in contrast to data of NDHS which was 26% in adolescent girls and 41% among adolescent boys 15-19 years (30). Moreover, in this study severe thin was more common in public schools 2.5% than in private schools 2.2%, followed by thin, 17.7 % of students in public schools and 11.10% in private schools.

On other hand, it is in contrast to the study conducted in Delta State, Nigeria (17), where the occurrence of underweight in public and private school was 29% in both schools ($p < 0.030$). However, this finding is slightly higher than another study conducted in sub metropolitan city of Hetauda which outlined prevalence of overweight as 9.31% (33). Thus, the variation of underweight in various countries and other district of Nepal might be due to differences in the study setting of different schools, different age groups with different food habits of adolescents included in the study as well as the methodologies applied in the study purpose.

Additionally, this study found that, higher percentage of adolescents were overweight (22.2%) and obese (6.7%) in private schools compared to 12.7% overweight and 3.2% obese in public schools. It is compatible to a study conducted in Dharan, Nepal, where adolescents of private schools had a greater prevalence of overweight and obesity than adolescents

studying in public schools 13.7% and 5.8% vs 3.8% and 0.8% (Shakya, et al., 2023). Based on the current study, the prevalence of overweight was higher (18%) in females than in male 16%. Whereas, the prevalence of obesity was slightly more (5%) in male than in female 4.5%. On the other hand, this finding study were contradictory to another study conducted in China (34) which stated prevalence of overweight as male 17.4%, female 10.1% and obesity male 8.8%, female 3.1%. The findings of overweight/obesity were in contrast with NDHS data which was overweight as (boys vs girls, 5% vs 4%) and obesity as (boys vs girls 3% vs <1%). This might be due to disparities in study sites as habits are revolutionized in terms of dietary patterns, food habits, lifestyle, socio-economic conditions and physical inactivity.

In the study, the cutoff point of WHR, according to the WHO a moderate WHR is: 0.9 or less in men and 0.85 or less for women. So, the current study reported as 2.6% of boys had moderate WHR in private schools and 1.2% were found in public schools. While among girls 10.2% had high WHR was found (0.86 or higher). But there was no any association found with overweight/obesity which is supported by the study conducted in Poland (Zbigniew, et al., 2023). In contrast the study conducted in Gujrat India (Vasvadu, et al., 2020) revealed, 28% of adolescents were overweight, 23.9% were obese, and 47.9% were normal, according to WHR.

Among total study participants, almost all 158 (100%) in the public and 135 (100%) in private schools had the daily intake of cereals and pulses. About 10.8% of the respondents in public schools and only 7.4% in public schools were vegetarian. Additionally, majority (92.6%) of them in private and 89% in private school's adolescents were non vegetarian. Whereas 16% of participants in private schools and 12.1% in public schools consumed meat every day. Majority (86.1%) of public-school adolescents eat less than 2 servings of fruits per day in comparison to private school adolescents 62.2%. In the same way, adolescents at private schools consumed over two servings of fruit daily 37.8% than public-schools adolescents 13.9%.

Association of public schools with overweight/obesity

This research study also highlights significant findings on overweight/obesity. Out of 158 respondents who attained public schools 18.4% of them between the ages of 13-15 years and females 18.9% were obese/overweight. In public schools, higher percentage of grade 8

students were obese/overweight 23% than grade 9 student where the p-value was 0.052. This may be due to attraction of intake of more fast food/ processed foods in school canteen rather than having home-based foods. It was relatively more than the study revealed in Kerala India, where 17.3 % were overweight and 8.7% obese in grade 10 students (Varghese, et al., 2019).

One notable association between lifestyle factors and overweight/obesity was discovered in students who participated in school sports. This group was 20.2% more likely to be overweight/obesity than students who didn't have sports day in school ($p=0.016$). This might be because, despite the possibility of a sports day program, they may not have participated in playing games.

In addition, other factors associated with overweight/obesity among adolescent was exposure to screen time for more than 4 hours ($p=0.038$), intake of meat ($p < 0.001$) at 95% CI which is similar to the study conducted Lebanon (35) that specified more exposure to smart phone screen time ($>2\text{hrs}$) was a significant increase in BMI ($p=0.048$). Furthermore, it is supported by the research conducted in Iran, (48) which stated intake of meat and poultry was highly associated with central obesity ($p < 0.001$). This might be due to generation of digital era and attraction towards fast foods than home based food.

Association with overweight/obesity of private schools

Among 135 respondents of private schools, at the age of 16-18 were marginally overweight by 29.4% and 28.8% of them were in the age of 13-15 years where 30.3% of them were male and 27 % female. Adolescents who was physically active only for one to three days were found more overweight/obese 32.9% than those active for all seven days. Adolescents who spend less than 30 minutes in walking/bicycling was 36.4% overweight/obese than those who did it for 1-2 hours. It might be due to use of more transportation facilities than walking or bicycling. Likewise, teenagers always using mobile devices while eating were 31% overweight/obese which is consistent with literature of (28) highlighted that adolescents consume more calories when using their cellphones.

An associated factor with overweight/obesity among adolescent in private schools was fast-food consumption with $p < 0.05$ at 95% CI which is consistent to study conducted by

(36) and (35). This might be due higher intake of overdose of calories, unhealthy food and high take of sugary items when they eat it occasionally.

The study also revealed that intake of seasonal vegetables for less than 5 days was 24% overweight/obese and intake of vitamin a fruits and vegetables for at least 3 days was 30.6% overweight/obese. Moreover, 19.2% of people who ate meals from outside at home instead were obese or overweight which is parallel to the research conducted by (37) stated that those eating food from outside at home were more than one third (38.1%) overweight/obese than those who never eat food from outside at home. It may be due to students in private schools might come from higher socio-economic backgrounds which influences their lifestyle and dietary habits which may leads to increase in overweight/obesity.

Private school students' dietary pattern may be different than public schools and even environmental factors might be the cause of overweight/obesity among adolescents of private schools. Students in private schools might come from higher socioeconomic backgrounds, which can influence dietary habits and lifestyle. Higher socioeconomic status is often associated with greater access to calorie-dense, processed foods, and a sedentary lifestyle, contributing to higher obesity rates (37).

Binary logistic regression of public and private schools

The present study focused on to assessed the factors associated with overweight/obesity among adolescents. It revealed that there was a significant association between type of schools and overweight/obesity. Adolescents attending private schools were 2.16 times more likely to be overweight or obese than those attending public schools (COR = 2.161, 95% CI 1.226-3.809; $p = 0.008$). This difference was statistically significant which is similar to the study of (38) where a higher prevalence of overweight/obesity in adolescents ($p < 0.001$) attending private schools compared to public schools. However, Age, sex, ethnicity and family type found no association with overweight/obesity.

An associated factors like mother's education, fathers' education, family monthly income, sports day in school, was found to be statistically significant with overweight/obese in bivariate analysis. The respondent's mother's with more than secondary/higher education level were 3 times more (COR=3.071, 95% CI 1.388-6.795) likely to be obese/overweight than mother's having no education which follows similar pattern in the study conducted in

South Africa (8). Likewise, respondent's fathers with secondary/higher education were 2.6 times (COR= 2.64, 95% CI 1.19-5.85; $p=0.017$) more likely to be overweight/obese than illiterate which is in consistent with the studies of (8) where there were no significant differences regarding father's education.

Further, family monthly income was 2.5 times more likely (COR=2.51, 95% CI 1.406-4.470) to be overweight with overweight/obesity which was also independently associated with obesity in South Africa and other SSA (Sub-Saharan African) countries (8) . This discrepancy might be due to variation in the age, objectives, variables and sample size.

Hence, family monthly income may also influences eating behaviours, eating pattern, life styles with increased level of overweight/obesity. Adolescents who had sports day in schools was 6.9 times (COR=6.96 95% CI 1.638-29.602; $p=0.009$) more likely to be overweight/obese than schools not having sports day. This might be due to lack of participation especially girls during the sports day program. And during my observation what I found was that every Friday was book free day in public schools, but on that day most of the students were absent as they don't have classes. While in private schools, only boys were active in playing sports mostly like outdoor games and girls were limited to indoor games only.

The existing study revealed that intake of eggs daily was 4.5 folds (COR=4.5, 95% CI 1.65-12.22; $p=0.003$) more likely to be overweight/obese with reference to those who take it twice a week. The other related study discovered egg consumption to be associated with decreased chance of MUO (metabolically unhealthy obesity) among Iranian overweight and obese adolescents (39). Although intake of eggs is associated with overweight/obese high-quality protein, minerals, vitamins, cholesterol, and both saturated and unsaturated fats can all be found in abundance in eggs which is beneficial for health (39).

Consumption of fast/processed food occasionally was significantly ($p=0.015$) associated which was 2 times (COR= 2.094, 95% CI 1.156-3.793) more likely to be overweight/ obese than who take it daily. Intake of vegetables and fruits for less than five days was equally likely (COR= 1.52, 95% CI 0.810-2.850) to be overweight/obese than those consumed it for more than five days which is comparable to the study findings of (4) Daily intake of nuts was 2 times (COR= 2.03, 95% CI 1.014-4.965; $p=0.045$) more likely to be overweight/obese than those who take it occasionally. It might be due to more amounts of nuts eaten per day.

Likewise, adolescents who had fast foods occasionally was 2 times (COR=2.094, 95% CI 1.156-3.793; $p=0.0015$) more likely to be overweight/obese than who take it daily which contradicts to the study conducted in Bangladesh, (53) found a noteworthy association between consuming fast food and having a greater prevalence of obesity $p<0.05$; 29.9% among fast food consumers compared to 9.1% among non-consumers. Additionally, adolescents who had 1-3 servings of carbonated drinks was 4.1 times more (COR= 4.102, 95% CI 0.529-31.806; $p=0.177$) likely to be overweight/obese with reference to those who had 4-6 servings. This might be due to influence of advertisement of carbonated drinks and peer influence.

24-hour dietary recall

In public schools, sufficient intake of protein 28.9% and total energy/calorie 43.5% was shown to be significantly associated ($p=0.021$) and ($p=0.015$) with overweight/obesity in this study. This could be driven on by a shift in eating habits, physical inactivity, fast food intake in schools, and lifestyle changes. In private schools a significant association ($p=0.011$) of adequate protein with overweight/obesity where 33% of them were obese/overweight than those intaking inadequate protein. This might be due to consumption of more processed meat and meat products rather than home based foods.

The bivariate analysis indicates a significant association between protein intake and obesity/overweight status. Specifically, individuals who consumed adequate protein were significantly more likely to be obese or overweight compared to those with inadequate protein consumption, with an (COR=5.75, 95% CI 2.214-14.915) and a p -value < 0.001 . This suggests that the likelihood of being obese or overweight is approximately 5.75 times higher in individuals with adequate protein intake compared to those with inadequate intake. High protein intake might be part of a diet that includes higher overall caloric intake, increase in muscle mass and increase in satiety and eating pattern which can contribute to weight gain and obesity.

Adolescents who consumed a substantial amount of fat were 2.8 times more likely to be overweight or obese compared to those who consumed inadequate fats, with an odds ratio (COR 2.844, 95% CI 1.409-5.742; $p=0.004$). This indicates a strong and significant relationship between higher fat intake and increased likelihood of being overweight or obese. In the same way, Adolescents who consumed an appropriate amount of total

calories/energy were 3.7 times more likely to be overweight/obese compared to those who consumed inadequate total energy, with an (COR=3.72, 95% CI: 1.964-7.049) and a p-value < 0.001. This also highlights a significant association between adequate energy intake and higher likelihood of being overweight or obese.

Respondents who consumed adequate protein were significantly more likely to be overweight/obese compared to those with inadequate protein intake, with (AOR= 5.465, 95% CI, 1.518-19.683; p=0.009). This indicates, even after adjusting for other variables, adequate protein intake is strongly associated with a higher likelihood of being overweight or obese. Moreover, adolescents who consumed adequate total energy were significantly more likely to be overweight or obese compared to those with inadequate energy intake, with an (AOR= 2.431, 95% CI: 1.096-5.391; p=0.029). This suggests that adequate energy intake, adjusted for other factors, is also associated with an increased likelihood of being overweight or obese. The study by (8) found that frequent snacking is associated with higher total energy intake and increased consumption of added and total sugars. This finding aligns with results, indicating that dietary habits contributing to higher energy intake can lead to overweight/obesity.

Those participants whose mothers attained more than secondary/higher secondary level education were significantly more likely to be overweight or obese compared to those whose mothers were illiterate, with an adjusted odds ratio (AOR=5.793, 95% CI: 1.070-31.3577) and a p-value of 0.041. This indicates that higher maternal education is strongly associated with a higher likelihood of adolescents being overweight or obese.

Teenagers who consumed eggs daily were significantly more likely to be overweight/obese compared to those who consumed eggs twice a week, with an (AOR =5.015, 95% CI: 1.600-15.723) and a p-value of 0.006. This suggests a strong association between daily egg consumption and increased likelihood of being overweight or obese. Where the current findings support with a study performed in South Africa, by (8), which showed a positive association between processed/fast food consumption and increased body fat among adolescents. This suggests that high-calorie, low-nutrient foods like sugary items, carbonated drinks, chocolates, and fast foods (e.g., burgers, chowmein, pizza, sausage, fried chicken, french fries) contribute significantly to weight gain.

Part V

Conclusions & recommendations

5.1 Conclusions

The results of this study, which was done among adolescents at KMC's public and private schools, showed that the prevalence of overweight and obesity is higher in private schools than in public schools, at 22% vs. 12.7%. Teenagers in private schools were shown to be substantially ($p=0.008$) more likely to be overweight or obese than those in public schools. Of the 293 participants, 2.4% were found to be extremely thin, followed by 14.7% who were thin, 61.1% were normal, 17.1% were overweight, and 4.8% who obese. Males were found to be more obese than females.

In binary logistic regression, father's education, mother's education, family income, sports day, physical education were found to be significantly associated with overweight/obesity. Moreover, less than 30 minutes of walking or cycling and more than four hours of screen time have been linked to lifestyle factors associated with being overweight or obese. Private school's adolescents consumed >5 food groups compared to that of public schools' adolescents. In multivariate analysis, dietary factors like nuts, processed/fast food, intake of eggs were associated with overweight/obesity in adolescents, the relationships can be complex and multifaceted. Under 24-hour recall diet, the significant associations between adequate protein and energy intake with overweight/obesity underscore the complexity of dietary influences on weight status. It's crucial to interpret these findings in the context of overall dietary patterns, lifestyle behaviors, and individual differences.

This study highlights the disparities in nutritional status between adolescents in public and private schools in KMC and underscores the need for comprehensive strategies to address these disparities. It emphasizes the importance of considering dietary factors in addressing overweight/obesity among adolescents. Overall, this study provides insights into the complex interplay of socio-demographic, physical activity, and dietary factors and 24-hour dietary recall influencing the nutritional status among adolescents and focuses the need for tailored interventions to address the issue of overweight and obesity in this population.

5.2 Recommendations

- Further research could explore additional factors contributing to weight disparities between private and public-school students of KMC.
- Every private-schools should have provisioned with a dietician for proper meal program for adolescent students.
- Designing school-based health and nutrition awareness programs is necessary in accordance with the results in order to support healthy weight status, lifestyle, food habits and dietary patterns.
- Conduct workshops and seminars for students and parents on the importance of a balanced diet in each ward of Kathmandu Metropolitan City.

Part VI

Summary

6.1 Summary

Adolescent obesity/overweight are worldwide health problems that are sporadically spread throughout the world and are probably caused by a dynamic network of causal relationships. This study aims to identify the prevalence and factors associated with nutritional status among adolescents of public and private schools of Kathmandu Metropolitan City. It was an analytical cross-sectional study. Among 293 participants under underweight, 2.4% of them were found severe thin followed by 14.7% of thin, 61.1% were normal while 17.1% were overweight and 4.8% them were obese. While comparing between both schools it showed that overweight students were greater in private schools 22% than in public schools 12.7%. Male was found slightly higher (5%) obese than female 4.5%. Furthermore, more than half (53.2%) of private school adolescents consumed more than five food groups comparatively to public school students 46.8%. Private school adolescent's girls had high WHR 10.2% than compared to public school adolescent's girls 4% respectively.

In public schools a significant association ($p < 0.05$) were found among students who had sports day in school and those who were exposed to screen for more than four hours. A significant association was found in the fast-food consumption ($p=0.036$) where 38.9% of them were more overweight who consumed it sometimes rather than who take it daily. There was also a significant association ($p < 0.001$) between intake of meat and overweight/obese who consumed it daily. Adolescents who spend less than 30 minutes in walking/bicycling was 36.4% overweight/obese than who did for one to 2 hours. A highly significant association was discovered between the consumption of fast food by adolescents with overweight or obese ($p=0.036$).

Private school adolescents were significantly associated which were 2.6 times ($COR=2.61$, 95% CI 1.226-3.809; $p=0.008$) more likely to be overweight/obese than public school adolescents. Study revealed that the factors like father's education ($COR=2.64$, 95% CI 1.19-5.854; $p=0.017$), mother's education ($COR=3.071$, 95% CI 1.388-6.795; $p=0.006$) and family monthly income ($COR=2.51$, 95% CI 1.406-4.470; $p=0.002$) were significantly associated with overweight/obesity. There was also a significant association which was 2.1

times more (COR=2.14, 95% CI 1.219-3.749; $p=0.007$) likely to be overweight/obesity who had physical education class once a week than that of having twice a week in both public and private schools. Correspondingly, adolescents who had sports day in school were 6.9 times (COR=6.96, 95% CI 1.638-29.602; $p=0.009$) more likely to be overweight/obese than those adolescents who didn't have the same. Intake of eggs daily was 4.5 folds (COR=4.5, 95% CI 1.65-12.22) more likely to be overweight/obese than those who intake it once a week. Hence, there was a significant association between intake of eggs and overweight/obesity.

Intake of nuts daily were significantly associated with overweight/obesity among adolescents with ($p=0.045$) and the odds were 2 times more (COR=2.031, CI 1.014-4.065) likely to be overweight/obese than linked with those had the same sometimes only. Correspondingly, the odds of consuming processed or fast food were significantly associated with overweight/obesity which were 2 times more likely (COR=2.094, CI 1.156-3.793; $p=0.015$) to be overweight/obese with reference of those eating it daily. There was a strong association between protein, fats and total calorie (energy). A significant association were also found between protein ($p < 0.001$), fats ($p=0.004$) and total energy ($p < 0.001$) with overweight/obese among adolescents of public and private schools.

After adjusted the odds of adolescents whose mother attained more than secondary/higher secondary level education were 5.7 folds more likely to be overweight/obese with reference to illiterate (AOR=5.793, 95% CI 1.070-31.3577; $p=0.041$). Adolescents who daily had eggs were significantly associated with overweight/obesity which were 5 folds (AOR=5.015, 95% CI 1.600-15.723; $p=0.006$) more likely to be overweight/obese than those who had twice a week. Likewise, fast food was also significantly associated ($p=0.044$) which was 2.2 times more (AOR=2.212, 95% CI 1.020-4.793) likely to be than those who had it daily. Under 24-hour recall diet, adolescent who had adequate protein (AOR=5.465, 95% CI 1.518-19.683; $p=0.009$), adequate total energy (AOR=2.431, 95% CI 1.096-5.391; $p=0.009$) more likely to be overweight/obese.

Hence, adolescents overweight/obesity must be addressed and managed by addressing general food habits and lifestyle variables.

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Annex-I

Assent to participate in a research subject

Factors Associated with Nutritional Status among Adolescents of Kathmandu Metropolitan City: A Comparative Study between Public and Private Schools

Namaste, my name is Ruby Manandhar, an independent researcher. I would like to carry out research entitled “**Factors Associated with Nutritional status among adolescents of Kathmandu Metropolitan City: A Comparative Study between Public and Private Schools**” in the selected schools of Kathmandu Metropolitan City. The participant of my study are the adolescent students of Public and Private schools. The number of participants is 286. The aim of my study is “to identify the prevalence and factors associated with nutritional status among the adolescents”. The information on regarding demographic characteristics, anthropometric measurements (height, weight, waist and hip circumference), Lifestyle characteristics and dietary pattern are kept in the questionnaire. You have the option whether or not participating in this study. You can refuse to participate in any part of the study or withdraw will involve no loss of benefits. You can discontinue participation at any time. You may choose not to answer any questions even if you choose to participate in the study. Without consequences of any sort, you are free to leave at any moment. Any inquiry you are unwilling to respond to may also be avoided.

The participation of your child is voluntary. The information you enter will be kept in strict confidence. Your information will be classified 1, 2, 3 based on what it contains. No information revealing you identify will be included in the research's published findings, and participants won't get any compensation. If you agree to participate in this study, please answer the provided questionnaire. Hoping for your positive response. Thank you.

I hereby give my consent to my boy/girl to participate for the above-mentioned study knowing that all the information provided by me will be treated with confidentiality by the researcher.

Signature of parents.....

Date:

Annex-II

अभिभावक स्वीकृति फारम

शीर्षक, “काठमाडौं महानगरपालिकाका किशोरकिशोरीहरूबीचको पोषण स्थितिसँग सम्बन्धित कारकहरू : सार्वजनिक र निजी विद्यालयहरूबीचको तुलनात्मक अध्ययन”

नमस्ते, मेरो नाम रुबी मानन्धर हो । म एक स्वतन्त्र अनुसन्धानकर्ता हुँ । म काठमाडौं महानगरपालिकाको छनोट गरिएका विद्यालयहरूमा “काठमाडौं महानगरपालिकाका किशोरकिशोरीहरूमा पोषणको स्थितिसँग सम्बन्धित कारकहरू: सार्वजनिक र निजी विद्यालयहरूबीचको तुलनात्मक अध्ययन” शीर्षकको अनुसन्धान गर्न चाहन्छु । मेरो अध्ययनको सहभागी सार्वजनिक र निजी विद्यालयका किशोर विद्यार्थीहरू हुन् । सहभागीहरूको संख्या दृढ हो । मेरो अध्ययनको उद्देश्य “किशोरीहरूमा पोषण स्थितिसँग सम्बन्धित प्रचलितता र कारकहरू पहिचान गर्नु” हो ।

जनसांख्यिकीय विशेषताहरू, एन्थ्रोपोमेट्रिक मापन (उचाइ, तौल, कम्मर र हिप परिधि), जीवनशैली विशेषताहरू र आहार ढाँचा सम्बन्धी जानकारी प्रश्नावलीमा राखिएका छन् । यस अध्ययनमा भाग लिने वा नगर्ने विकल्प तपाईंसँग छ । तपाईं को छोरा / छोरीले अध्ययनको कुनै पनि भागमा भाग लिन अस्वीकार गर्न सक्नुहुन्छ वा फिर्ता लिँदा कुनै फाइदाहरू गुमाउनु पर्दैन । तपाईं कुनै पनि समयमा सहभागिता बन्द गर्न सक्नुहुन्छ । तपाईंले कुनै पनि प्रश्नको उत्तर नदिने छनौट गर्न सक्नुहुन्छ यदि तपाईंले अध्ययनमा भाग लिने छनौट गर्नुभयो भने पनि । कुनै पनि प्रकारको नतिजा बिना, तपाईं कुनै पनि क्षण छोड्न स्वतन्त्र हुनुहुन्छ । तपाईंले जवाफ दिन नचाहनुभएको कुनै पनि सोधपुछ पनि बेवास्ता गर्न सकिन्छ ।

तपाईंको बच्चाको सहभागिता स्वैच्छिक हो । तपाईंले प्रविष्ट गर्नुभएको जानकारी कडा विश्वासमा राखिनेछ । तपाईंको जानकारी यसमा समावेश भएको आधारमा १, २, ३ मा वर्गीकृत गरिनेछ । तपाईंको छोरा / छोरीले पहिचान गर्नुभएको कुनै पनि जानकारी अनुसन्धानका प्रकाशित निष्कर्षहरूमा समावेश गरिने छैन, र सहभागीहरूले कुनै क्षतिपूर्ति पाउने छैनन् । यदि तपाईं आफ्नो छोरा / छोरी लाई यस अध्ययनमा भाग लिन सहमत हुनुहुन्छ भने, कृपया प्रदान गरिएको प्रश्नावलीको जवाफ दिनुहोस् ।

तपाईंको सकारात्मक प्रतिक्रियाको अपेक्षा गर्दछु । धन्यवाद ।

म यसद्वारा मेरो छोरा / छोरीलाई माथि उल्लेखित अध्ययनमा भाग लिनको लागि मेरो सहमति दिनुहोस् कि मैले उपलब्ध गराएको सबै जानकारी अनुसन्धानकर्ताले गोप्य रूपमा व्यवहार गर्नेछु ।

.....

अभिभावकको हस्ताक्षर

मिति:

कोड नं

Annex-III

Informed consent form

Namaste, my name is Ruby Manandhar, an independent researcher. I would like to carry out research entitled **“Factors Associated with Nutritional status among adolescents of Kathmandu Metropolitan City: A Comparative Study between Public and Private Schools”** in the selected schools of Kathmandu Metropolitan City. The participants of my study are the adolescent students of public and private schools. The number of participants is 286. The aim of my study is **“To identify the prevalence and factors associated with nutritional status among the adolescents”**.

The expected duration of the research study is 6 months period and the frequency of participants involvement will be one time only. Your participation is voluntary. You have the option whether or not participating in this study. You can refuse to participate in any part of the study or withdraw will involve no loss of benefits. You can discontinue participation at any time. You may choose not to answer any questions even if you choose to participate in the study. Without consequences of any sort, you are free to leave at any moment. Any inquiry you are unwilling to respond to may also be avoided.

The information you enter will be kept in strict confidence. Your information will be classified 1, 2, 3 based on what it contains. No information revealing you identify will be included in the research's published findings, and participants won't get any compensation. If you agree to participate in this study, please answer the provided questionnaire.

Hoping for your positive response. Thank you.

I hereby give my consent for the above-mentioned study knowing that all the information provided by me will be treated with confidentiality by the researcher.

.....

Date:

Signature of the participant

Also, I have agreed to share my pictures for the study purpose.

Annex-IV

Nepali Consent Form

सूचित सहमति फारम

नमस्ते, मेरो नाम रुवी मानन्धर हो । एक स्वन्त्र अनुसन्धानकर्ता हुँ । मेरो अध्ययनको एक भागको रूपमा, म “काठमाडौं महानगरपालिकाको किशोरकिशोरी विद्यार्थीहरूमा पोषण स्थितिसँग सम्बन्धित कारकहरूमा अनुसन्धान गरिरहेको छु” । मेरो अध्ययनको सहभागी काठमाडौं महानगरपालिकामा चयन गरिएका विद्यालयहरू अर्न्तगत सार्वजनिक र निजी विद्यालयका किशोर विद्यार्थीहरू हुन् । सहभागीहरूको संख्या २८६ हो । मेरो अध्ययनको उद्देश्य “किशोरीहरूमा पोषण स्थितिसँग सम्बन्धित कारकहरू पहिचान गर्नु” हो ।

अनुसन्धान अध्ययनको अपेक्षित अवधि ६ महिनाको अवधि हो र सहभागीहरूको संलग्नताको आवृत्ति एक पटक मात्र हुनेछ । तपाईंको सहभागिता स्वैच्छिक हो । यस अध्ययनमा भाग लिने वा नगर्ने विकल्प तपाईंसँग छ । तपाईंले कुनै पनि प्रश्नको उत्तर नदिने छनोट गर्न सक्नुहुन्छ यदि तपाईंले अध्ययनमा भाग लिने छनोट गर्नुभयो भने पनि कुनै पनि प्रकारको नतिजा बिना, तपाईं कुनै पनि क्षण छोड्न स्वतन्त्र हुनुहुन्छ । तपाईंले जवाफ दिन नचाहनुभएको कुनै पनि प्रश्नहरू छोड्न सकिन्छ ।

तपाईंले प्रविष्ट गर्नुभएको जानकारी कडा विश्वासमा राखिनेछ । तपाईंको जानकारी यसमा समावेश भएको आधारमा १, २, ३ मा वर्गीकृत गरिनेछ । तपाईंले पहिचान गर्नुभएको कुनै पनि जानकारी अनुसन्धानका प्रकाशित निष्कर्षहरूमा समावेश गरिने छैन, र सहभागीहरूले कुनै क्षतिपूर्ति पाउने छैनन् । यदि तपाईं यस अध्ययनमा भाग लिन सहमत हुनुहुन्छ भने, कृपया प्रदान गरिएको प्रश्नावलीको जवाफ दिनुहोस् । तपाईंको सकारात्मक प्रतिक्रियाको अपेक्षा गर्दछु । धन्यवाद ।

म यसद्वारा माथि उल्लेखित अध्ययनको लागि मेरो सहमति दिनुहोस् कि मैले उपलब्ध गराइएका सबै साथै, म मेरा तस्विरहरू साझा गर्न सहमत छु ।

सहभागीको हस्ताक्षर

Annex V

Questionnaire

Q. N	Questions	Responses	Skip Pattern “Go To”
1. General Information			
1.1	Date of Interview	DD/MM/YY.... /...../.....	
1.2	Form No		
1.3	School Name		
1.4	Signature of the respondent		
2. Demographic Information			
2.1	Age of respondents (DoB)	/...../.....(B.S.)/...../.....(A.D.) DD/MM/ YY Age.....Year.....Month	
2.2	Sex of respondent	Male Female Other	
2.3	Grade/Class		
2.4	School Type	1. Private (sansthaगत) 2. Public (sarbajanik)	
2.5	Ethnicity/Caste	1. Brahmin/Chhetri 2. Dalit 3. Janajati 4. Muslim 5. Madhesi 6. Others Specify	
2.6	Family Type	1. Nuclear 2. Joint/Extended	
2.7	Mother's Education	1. Illiterate 2. Informal Education 3. Less than primary education 4. Primary level 5. Lower Secondary (6-8) 6. Secondary (9-10) 7. Higher Secondary and above	
2.8	Father's Education	1. Illiterate 2. Informal Education 3. Less than primary education 4. Primary level 5. Lower Secondary (6-8) 6. Secondary (9-10) 7. Higher Secondary and above	

2.9	Family Monthly Income		
3. Anthropometric measurement			
3.1	Height	 cm	
3.2	Weight	 kg	
3.4	BMI	kg/m2	
3.5	Waist Circumference	 cm	
	Hip Circumference	 cm	
	Waist/Hip	 cm	
4. Lifestyle Characteristics			
4.1	During the past 7 days, how many days were you physically active for a total of at least 60 minutes per day?	1. 0 days 2. Once a week 3. Twice a week 4. Thrice a week 5. All 7 days	
4.2	During the past 7 days, on how many days did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups, or yoga?	1. 0 days 2. 1 day 3. 2 days 4. 3 days 5. 4 days 6. 5 days 7. 6 days 8. 7 days	
4.3	How much time do you spend walking or bicycling for travel on a typical day?	1. < 30 minutes 2. 30 to 60 minutes 3. 60 minutes to 120 minutes 4. never	
4.4	Do you have physical education class in your school?	1. Yes 2. No	If No, then go to 4.6
4.5	During this school year, how many days did you have physical education (PE) class each week?	1. 0 days 2. Once a week 3. Twice a week 4. More than twice 5. All 7 days	
4.6	Do you have sports day program in your school?	1. Yes 2. No	
4.7	How often do you play sports like football, basketball, swimming or other games?	1. 0 days 2. Once a week 3. Twice a week 4. All 7 days	
4.8	How often do you help your parents during household activities in your home?	1. Never 2. Always 3. Sometimes 4. Once in a week	
4.9	Do you ever smoke?	1. Yes 2. No	If No. then go to 4.11

4.10	During the past 30 days, how many days did you smoke cigarettes/hookah/chew tobacco?	1. < 30 days (a month) 2. All 30 days	
4.11	Do you ever drink alcohol like beer, wine or spirit?	1. Yes 2. No	If No, then go to 4.13
4.12	During the past 30 days, how many days did you have at least one drink containing alcohol including beer, wine?	1. Never (0 day) 2. < 30 days (a month) 3. All 30 days	
4.13	How often do you watch tv, playing video/mobile games or use any other electronic devices in a day?	1. <1hour 2. 1-2 hour 3. 3-4 hours 4. > 4 hours	
4.14	Do you eat your food while using or watching digital devices such as mobile phone?	1. Never 2. Sometimes 3. Often 4. Always	
5. Dietary Pattern			
5.1	In a typical week, how often do you eat cereals and pulses?	1. Daily 2. Alternately 3. Once a week 4. Twice a week 5. Once a month 6. Twice a month Others (Specify)	
5.2	Are you vegetarian/non vegetarian?	1. Vegan 2. Vegetarian 3. Non -vegetarian	If Veg then go to 5.5
5.3	If non vegetarian, how often do you eat meat?	1. Daily 2. Alternately 3. Once a week 4. Twice a week 5. Once a month 6. Twice a month Others (Specify)	
5.4	In a typical week, how many days do you eat egg and fish?	1. Daily 2. Alternately 3. Once a week 4. Twice a week 5. Once a month 6. Twice a month Others (Specify)	
5.5	How often do you drink milk and eat milk	1. Daily 2. Alternately 3. Once a week	

	products like cheese, paneer, ghee, butter etc?	4. Twice a week 5. Once a month Twice a month Others (Specify)	
5.6	In a typical week, how many days do you eat seasonal vegetables? (like cabbage, cauliflower, eggplant, broccoli etc)	1. Specify days.... 2. Don't know	
5.7	How often do you consume Vitamin A rich vegetables and fruits?	1. Never 2. Always 3. 1-3 times per week 4. More than 3 times per week	
5.8	In a typical week, on how many days do you eat other fruits?	1. Days.... 2. Don't know	
5.9	How many servings of fruits do you eat on one of those days?	1. Number of servings..... 2. Don't Know	
5.10	How often do you eat nuts and seed? (like Almond, chia seed, flax seed, Walnut)	1. Daily 2. Sometimes 3. Alternately 4. Once a week 5. Twice a week 6. Once a month 7. Twice a month 8. Never	
5.11	How often do you eat processed food? (such as chips, kurkure, sausage, lays, instant noodles)	1. Daily 2. Alternately 3. Once a week 4. Twice a week 5. Once a month 6. Twice a month 7. Never	
5.12	During the past 7 days, how many times did you drink a can, bottle, or glass of a carbonated soft drink. (Do not include diet soft drinks.)	1. I did not drink carbonated soft drinks during the past 7 days 2. 1 to 3 times during the past 7 days 3. 4 to 6 times during the past 7 days 4. 1 time per day 5. 2 times per day 6. 3 times per day 7. 4 or more times per day	
5.13	How often do you eat your food out of home? (Restaurant)	1. Daily 2. Alternately 3. Once a week 4. Twice a week	

		5. Once a month 6. Twice a month 7. Never	
5.14	How often do have your food from outside?	1. Daily 2. Alternately 3. Once a week 4. Twice a week 5. Once a month 6. Twice a month 7. Never	
5.15	How many glasses of water do you drink? (excluding other liquid like juice, dal etc)	1. 1-2 glass 2. 2-3 glasses 3. 3-4 glasses 4. 4-5 glasses 5. 6 or more than 6	

Annex VI

24-hour dietary recall form

Time	Quick List Name of Food	Description of the food or Drink	Type of foo/Brand Name	Quantity (Code)	Any Additions? (Oil, Salt, Sugar)	Any leftovers or second helpings
Midnight Time	a. b. c.					
Early Morning Time	a. b. c. d.					
3. Breakfast Time	a. b. c. d.					
4. Lunch Time	a. b. c. d.					
5. Afternoon Time	a. b. c. d.					
Midafternoon Time	a. b. c. d.					
Evening Time	a. b. c. d.					
Dinner Time	a. b. c. d.					
Bed-time Snacks	a. b.					

Annex-VII

Letters from schools



श्री जनकल्याण माध्यमिक विद्यालय

(SHREE JANAKALYAN SECONDARY SCHOOL)

पत्र संख्या: ४०
च.नं. ०८०१०८१



काठमाडौं-६, बौद्ध
फोन नं. ०१-४४९८२५३
स्थापना: २०१०

2080/10/22

To Whom It May Concern

This is to confirm that **Ms. Ruby Manandhar**, a student of Master of Sciences in Nutrition and Dietetics at CAFODAT, has surveyed students studying 8 and 9 grades in this school as part of a study on 'Factors associated with Nutritional Status among Adolescents of Kathmandu Metropolitan City. A comparative Study between Public and Private Schools'.

We wish her all the success in her research.

Sincerely yours,


.....
Manju Magrati
Principal



अरनिको आवासीय माध्यमिक विद्यालय ARNIKO SECONDARY BOARDING SCHOOL



Date: 2024-01-29

To Whom It May Concern:

This is to inform you that Ms. Ruby Manandhar, Masters student studying Masters in Nutrition and Dietetics at CAFODAT college, Kumaripati, has conducted her survey on **“Factors Associated with Nutritional Status among Adolescents of Kathmandu Metropolitan City: A Comparative Study between Public and Private Schools”** in our school.

The survey was conducted with a sample of students studying in grade 8 and 9.

We wish her all the success in her research.

Principal

“Children are our love, our hope and our tomorrow.”

Bhotebahal, Kathmandu, Nepal • Phone: 5353903 • arnikoschool@live.com



Holy Garden School

Ring Road, Balaju

ESTD:2033



Date: 1/25/2024

Ref.No.89/80/81

To Whom It May Concern

This is to inform you that Ms. Ruby Manandhar, independent researcher, has conducted her survey on **"Factors Associated with Nutritional Status among Adolescents of Kathmandu Metropolitan City: A Comparative Study between Public and Private Schools"** at Holy Garden School, ward no: 16.

The survey was conducted with a sample of students studying 8 and 9 grades.

We wish her all the success in her research.

Yours Sincerely,

Executive Vice-Principal
Dipesh Khatri Chhetry



☎: 4950-751, 4950751
Fax: +977-1-4950751

Post Box No: 1465 Ktm
E-mail:
holygardenschoolbalaju@gmail.com

Love All Serve All



ARUNIMA SHIKSHYA SADAN SEC. SCHOOL

Bauddha, Mahankal, Kathmandu -6

Estd. 1993

Tel: 01-5918199

01-5918420

P.O.Box :11598

Ref No.:

Date:.....

Date: 28/01/2024

To Whom It May Concern

This is to inform you that Ms. Ruby Manandhar, Masters student studying Masters in Nutrition and Dietetics at CAFODAT college, Kumaripati has conducted her survey on **“Factors Associated with Nutritional Status among Adolescents of Kathmandu Metropolitan City: A Comparative Study between Public and Private Schools”** at Arunima Shikshya Sadan Secondary School.

The survey was conducted with a sample of students studying in 8 and 9 grades.

We wish her all the success in her research.

Yours Sincerely

Principal

Shova Khanal



E-mail : arunimashishusadan@gmail.com

Annex- IX

Standardization of food





