

**Effects of Dietary Counseling and Physical Activities
on Overweight and Obesity among Adolescents
Visiting a Tertiary Care Hospital, Dhaka**



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By

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Institute of Nutrition and Food Science (INFS)

UNIVERSITY OF DHAKA

Dedicated to

My Beloved Parent's

Mohammad Ali Asgar

& Kamrunnisa

My Spouse **Sabrina Makbul**

and My Son **Aayad Rizwan**

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DECLARATION

I hereby declare that the research work entitled **“Effects of Dietary Counseling and Physical Activities on Overweight and Obesity among Adolescents Visiting in a Tertiary Care Hospital, Dhaka”** has been carried out under the Faculty of Biological Sciences, Institute of Nutrition and Food Science, University of Dhaka in fulfillment of the requirement for the degree of Doctor of Philosophy. I have composed this thesis on the basis of original research findings along with references from published literature. This thesis has not been submitted to any other institution for any other degree. I also certify that there is no plagiarized content in this thesis.

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CERTIFICATE OF THE SUPERVISOR

This is to certify that the thesis entitled “**Effects of Dietary Counseling and Physical Activities on Overweight and Obesity among Adolescents Visiting in a Tertiary Care Hospital, Dhaka**” is submitted by Mohammed Rizwanul Ahsan in partial fulfillment of the requirement for the degree of Doctor of Philosophy (PhD) under the Faculty of Biological Science, Institute of Nutrition and Food Science, University of Dhaka, Dhaka-1000, Bangladesh, and was carried out under the guidance of Professor Dr Khaleda Islam, Director, Institute of Nutrition and Food Science (INFS), University of Dhaka, Dhaka-1000.

To the best of my knowledge, this is an original research record, and the researcher duly acknowledges the other researcher materials and sources used in this work. To the best of my knowledge, no part of the work has been submitted for another degree or qualification at any other institute. It can be submitted to the examination committee for final evaluation and viva voce. To the best of our knowledge, all the given information is true.

Professor Dr. Khaleda Islam

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Abstract

Background: Adolescent overweight and obesity are rapidly increasing in low- and middle-income countries, including Bangladesh, due to urbanization, lifestyle transitions, and changing dietary patterns. Increased consumption of energy-dense, processed foods, reduced physical activity, and growing screen dependency have significantly contributed to this trend. These conditions are associated with an early onset of noncommunicable diseases (NCDs), such as diabetes, cardiovascular diseases, and psychological disorders. Despite the recognized importance of lifestyle modification, limited evidence exists in Bangladesh regarding the effectiveness of combined dietary counseling and physical activity interventions among adolescents. Therefore, this study aimed to assess the impact of integrated lifestyle interventions on nutritional status, dietary behavior, physical activity, and psychological well-being among adolescents attending a tertiary care hospital in Dhaka.

Methodology: A mixed-methods study design was employed, incorporating both quantitative and qualitative approaches. The study was conducted at the adolescent outpatient department of Bangladesh Shishu Hospital and Institute, Dhaka. The quantitative component followed a pre-post nonrandomized experimental design involving adolescents with overweight or obesity ($\text{BMI} \geq 25 \text{ kg/m}^2$, Asian cut-off). Data were collected at baseline and after intervention through face-to-face interviews using a pretested semi-structured questionnaire, along with anthropometric measurements and laboratory assessments.

Dietary intake was assessed using a 24-hour recall and food frequency questionnaire (FFQ), while physical activity was measured using a modified Global Physical Activity Questionnaire (GPAQ). Psychological status was evaluated using the Strengths and

Difficulties Questionnaire (SDQ). The intervention included individualized dietary counseling, structured diet plans, promotion of regular physical activity and psychological support. Participants were followed for up to 15 months with periodic monitoring.

The qualitative component included case studies and focus group discussions (FGDs) with adolescents and parents to explore behavioral, environmental, and psychosocial factors influencing obesity. Quantitative data were analyzed using SPSS (version 26), applying descriptive statistics and inferential tests such as paired t-tests and chi-square tests. Qualitative data were analyzed using thematic analysis.

Results: A total of 226 adolescents participated in the study, of whom 57.5% were male and 42.5% were female, with a mean age of 13.25 years. The majority (75.2%) were aged 10–14 years, and most participants belonged to urban (92.9%), nuclear family settings (88.9%) with good socioeconomic status (76.1%).

Baseline dietary assessment revealed high consumption of carbohydrates and fats, with frequent intake of rice, fast foods, and low consumption of fruits, vegetables, and dairy products. Average daily intake included high carbohydrate (18.72 servings) and fat (11.68 servings) consumption, while fruit (0.51 servings) and milk intake (0.32 servings) were inadequate. Mean caloric intake before intervention was 2461.57 kcal, indicating excess energy consumption.

Physical activity levels were low at baseline, with 71.7% of participants categorized as having low activity and none engaging in vigorous activity. Following intervention, there was a significant improvement in activity levels, with 46.5% achieving high physical activity. Mean MET scores increased significantly from 2.47 to 6.32 ($p < 0.001$).

Psychological outcomes also improved significantly. The mean SDQ score decreased from 26.19 at baseline to 16.25 at follow-up ($p < 0.001$), indicating reduced emotional and behavioral difficulties.

Anthropometric outcomes showed a progressive and statistically significant reduction in BMI across follow-up visits ($p < 0.001$). At baseline, 64.2% of participants were overweight and 35.8% were obese. After intervention, 70.8% achieved normal BMI, while only 9.7% remained overweight and 19.5% remained obese.

Qualitative findings supported these results. Adolescents reported unhealthy dietary habits, high screen time, and experiences of bullying prior to intervention. Parents demonstrated limited awareness and often encouraged unhealthy eating behaviors. Post-intervention, both adolescents and parents reported improved dietary practices, increased physical activity, reduced screen dependency, and enhanced psychological well-being. Case studies further illustrated substantial individual improvements in weight, mental health, and social functioning.

Conclusion: The study demonstrates that integrated interventions combining dietary counseling, physical activity, and psychological support are highly effective in improving both physical and mental health outcomes among adolescents with obesity. Adolescent obesity is a multifactorial condition requiring a holistic, family-centered approach. Early intervention and increased parental awareness are essential for sustainable lifestyle modification and long-term prevention of obesity-related complications.

Content

Chapter No.	Title	Page No.
	Abstract	vii
	Contents	x-xi
	List of the Tables	xii
	List of the Figures	xiv
	Abbreviations	xv
Chapter 1	Introduction	1-21
1.1	Background	2
1.2	Childhood Obesity	4
1.3	Physiology of Energy Regulation and Obesity	4
1.4	Etiology and Risk Factors	6
1.5	Physical activity (PA)	8
1.6	Global Physical Activity Questionnaire (GPAQ)	11
1.7	Health Effects of Childhood Obesity	12
1.8	Childhood Obesity: Effects on Psychological Aspects	13
1.9	Psychological Consequences of Obesity	15
1.10	Behavioral Strengths and Difficulties	16
1.11	Dietary Approach	17
1.12	Hypothesis	20
1.13	Objectives	20
1.13.1	General Objective	20
1.13.2	Specific objectives	20
1.14	Rationale of the study	21

Chapter 2	Literature Review	22-28
2.1	Background	23
2.2	Diet Therapy	24
2.3	Physical Activity	26
Chapter 3	Methodology	29-41
3.1	Study Design	30
3.2	Study Period	32
3.3	Study Location	32
3.4	Study Population	32
3.5.1	Inclusion Criteria	32
3.5.2	Exclusion Criteria	32
3.6	Sampling Method	32
3.7	Sample Size Determination	33
3.8	Data Collection Technique	33
3.9	Data Collection Instrument	37
3.10	Conceptual Framework	39
3.11	Ethical Considerations	40
3.12	Data Analysis Plan	40
Chapter 4	Results	42-82
	Part-1: Quantitative Survey Data Analysis and Monitoring Findings	43
	Part-2: Qualitative Findings based on Case Study and FGD	76
Chapter 5	Discussion	83-95
Chapter 6	Conclusions, Limitations and Recommendations	96-99
	References	100-121
	Appendices	122-159

List of Tables

Table No.	Title of Table	Page No.
1	Distribution of the respondents by age	43
2	Distribution of the respondents by gender	44
3	Distribution of the respondents by socio-demographic Variables	45
4	Distribution of the respondents according to consumption of beef	47
5	Distribution of the respondents according to consumption of chicken	49
6	Distribution of the respondents according to consumption of egg	51
7	Distribution of the respondents according to consumption of bread	53
8	Distribution of the respondents according to consumption of nuts	55
9	Distribution of the respondents according to consumption of fruits	57
10	Distribution of the respondents according to consumption of fast-food Item	59
11	Consumption of calorie, Carbohydrate, Protein and Fat before intervention	61
12	Paired sample t-test of physical activity level by METs (Metabolic Equivalent Tasks) before and after intervention	63
13	Paired sample t-test of total score of Strengths and Difficulties Questionnaire (SDQ) at 1st visit and at last visit	65
14	Respondent's average BMI according to follow up visit in accordance to age group in mean $\pm$ SD	66
15	Distribution of study subjects by the age of respondents at 1 st visit according to BMI	67

Table No.	Title of Table	Page No.
16	Distribution of study subjects by the age of respondents at 2 nd visit according to BMI	68
17	Distribution of study subjects by the age of respondents at 3 rd visit according to BMI	69
18	Distribution of study subjects by the age of respondents at 4 th visit according to BMI	70
19	Distribution of study subjects by the age of respondents at 5 th visit according to BMI	71
20	BMI changes in between 1 st to 5 th visit in Paired Samples t-test in paired group after intervention of dietary counseling and physical activity	72
21	Distribution of the respondents by BMI in all visits	74

List of Figures

Figure No.	Title of Figures	Page No.
1	Distribution of the respondents by socio-economic status	46
2	Distribution of study population according to consumption of mutton	48
3	Distribution of the respondents according to consumption of fish	50
4	Distribution of the respondents according to consumption of rice	52
5	Distribution of the respondent's consumption pattern of pulse & legumes	54
6	Distribution of the respondent's consumption pattern of vegetables	56
7	Distribution of the respondent's consumption of milk and milk products	58
8	Distribution of the respondents according to recall servings of food	60
9	Respondent's physical activities before and after intervention	62
10	Distribution of the respondents by statistics of SDQ total score at 1 st visit and SDQ total score at last visit	64
11	Distribution of the respondents by BMI in all visits	75

Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
AM	Acute Malnutrition
APPLES	Active Program Promoting Lifestyle Education in School
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CHT	Chattogram Hill Tracts
COVID-19	Coronavirus Disease 2019
CVD	Cardiovascular Disease
FFQ	Food Frequency Questionnaire
FGD	Focus Group Discussion
GABA	Gamma-Aminobutyric Acid
GPAQ	Global Physical Activity Questionnaire
HDL	High-Density Lipoprotein
LDL	Low-Density Lipoprotein
LH	Lateral Hypothalamus
LMICs	Low- and Middle-Income Countries
MET	Metabolic Equivalent of Task
MVPA	Moderate to Vigorous Physical Activity
NCDs	Non-Communicable Diseases
OPD	Outpatient Department
PA	Physical Activity
SD	Standard Deviation
SDGs	Sustainable Development Goals
SDQ	Strengths and Difficulties Questionnaire

SPSS	Statistical Package for the Social Sciences
ST	Screen Time
STEPS	STEPwise Approach to Chronic Disease Risk Factor Surveillance
UHC	Universal Health Coverage
UNICEF	United Nations Children’s Fund
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

More than half of all teenagers live in Asia, where 344 million teenagers in South Asia and 296 million in East Asia and the Pacific region (UNICEF Data 2017). By helping to lower health costs; increase productivity; and stop the passing on of ill health, poverty, and discrimination across generations, healthy teenagers also stimulate economic growth. Ten social and economic returns are projected for every dollar invested in adolescent health (Sheehan P, *et al.* Lancet 2017 and Susanna Lehtimäki, *et al.* 2019). Every year worldwide, there are approximately 1.2 million teenage deaths. However, most teenage health problems are treatable or preventable (Patton, GC, *et al.* Lancet 2016). Commonly established in adolescence, an estimated 70% of preventable deaths from noncommunicative diseases (NCDs) in adults have been linked to health risks and behavior, including tobacco, alcohol and illicit drug use; physical inactivity; and poor-quality diets (Lazzeri G, *et al.* 2018; Huang DY, *et al.* 2012; Health for the World's Adolescents. 2014 and The science of adolescent risk-taking. 2011), reinforcing social and health inequities during adolescence and later in life (Kuruvilla S., *et al.* 2018).

Because processed foods are more readily available and marketed, as well as because physical activity levels are declining, overweight and obesity in adolescence are rapidly increasing in many low- and middle-income nations (NCD Risk Factor Collaboration, Lancet 2017; Plan International, UNICEF, NCD Child, *et al.* 2017 and Woo J, *et al.* 2007). Adolescents' behaviors can play a positive role in their health and development behaviors such as healthy eating and adequate physical activity (Health for the World's Adolescents. 2014).

Adequate physical activity is important for preventing overweight and obesity, diabetes and cardiovascular disease (Freedman, DS, *et al.* 1999) and promoting adolescents'

emotional health (Young-Hyman, *et al.* 2001). Guidelines recommend at least 60 minutes of moderate or vigorous physical activity per day for adolescents (Sinha, R, *et al.* 2002). A lifestyle characterized by a lack of physical activity and excessive inactivity (particularly television viewing) might cause obesity in adolescents (Atkin, L-M, *et al.* 2000). The type of dietary fat could be more important than total fat consumption in the cause of obesity-related morbidities.

The adverse effects of saturated fat on the risk of cardiovascular disease are well documented (Litin, L 1993). The intake of partially hydrogenated (trans) fat, which is commonly found in commercial bakery products and fast foods (Hu., FB, *et al.* 1997), increases the risk for both cardiovascular disease (Salmeron, J, *et al.* 2001) and type 2 diabetes (Sinha, R, *et al.* 2002) in adults. In contrast, unsaturated fats from vegetable and marine sources decrease the risk of these diseases (Salmeron, J, *et al.* 2001; Subar, AF, *et al.* 1998 and Teachman, BA, *et al.* 2001).

Recent global estimates further highlight that adolescent health is now central to achieving the Sustainable Development Goals (SDGs), particularly those related to health, education, and economic productivity. Emerging evidence from 2020–2024 suggests that the burden of non-communicable diseases (NCDs) linked to adolescent lifestyle behaviors is increasing more rapidly in low- and middle-income countries (LMICs), including Bangladesh. Additionally, rapid urbanization, digitalization, and nutrition transition have intensified exposure to obesogenic environments, thereby accelerating unhealthy dietary patterns and sedentary lifestyles among adolescents. These transitions underscore the urgent need for integrated behavioral interventions targeting diet and physical activity in this age group.

1.2 Childhood Obesity

Defining obesity calls for an adequate cutoff range and a suitable assessment of body fat (Obesity Rates & Trends Overview). Body mass index (BMI) was calculated as weight in kg divided by height in meters squared, rounded to one decimal place, and childhood and adolescent obesity were classified as overweight with a BMI between the 85th and 95th percentiles of the 2000 Centers for Disease Control and Prevention (CDC) growth charts and a BMI greater than or equal to the age- and sex-specific 95th percentiles (Ogden CL, *et al.* 2010). This limits the maximum BMI that is attainable at a given sex and age (Freedman DS, *et al.* 2017 and Woo JG, *et al.* 2009); thus, the use of the BMI percentile based on the age/sex of the CDC growth charts for very high BMIs results in estimates that differ greatly from those that are observed (Flegal KM, *et al.* 2013 and Flegal KM, Wei R, *et al.* 2009). These constraints have led to the definition of severe obesity as a BMI $\geq 120\%$ of the 95th percentile instead of a percentile higher than the 95th percentile (Kelly AS, *et al.* 2013).

More recent frameworks emphasize the limitations of BMI alone and advocate for complementary measures such as waist-to-height ratio and body composition analysis for better risk stratification. Furthermore, updated international guidelines recommend using region-specific growth references due to ethnic variability in body fat distribution. In South Asian populations, including Bangladesh, adolescents tend to have higher cardiometabolic risks at lower BMI thresholds, highlighting the need for context-specific classification and intervention strategies.

1.3 Physiology of Energy Regulation and Obesity

Obesity is considered a chronic multifactorial disease and is typified by an excessive accumulation of adipose tissue, usually resulting from either poor energy expenditure or excessive food intake. Genetic, psychological, behavioral, dietary, environmental,

and hormonal elements can all cause obesity (Meneguetti BT, *et al.* 2019). Those who are susceptible genetically have obesity; the mechanism of this could be partially explained by interactions between brain reward and homeostatic circuits, inflammatory signaling, accumulation of lipid metabolites, or another mechanism impairing hypothalamic neurons (Guyenet SJ, *et al.* 2012). The physiology of normal energy control is tightly neurohormonal. Through neuroendocrine connections in the central nervous system, circulating peripheral hormones, including leptin and insulin, signal specialized neurons of the hypothalamus reflecting body fat stores and generate appropriate responses to preserve the stability of these stores, thus controlling neurohormonal balance in the central nervous system. The center of the control of hunger and satiety resides in the hypothalamus. Some of them are aimed at the action of endogenous peptides such as peptide YY, neuropeptide Y (Wu Y, *et al.* 2019), ghrelin, and pancreatic polypeptide. (Kaiya H, *et al.* 2016). When the physiology of energy control is affected by environmental and genetic factors, obesity in sensitive individuals may occur. Strong data indicate that most obesity cases are linked to central resistance to both leptin and insulin activities (Cornejo MP, *et al.* 2016 and Van de Sande-Lee S, *et al.* 2014). Obesity also depends on environmental modulators equally in importance. Changes in the circadian clock are linked to temporal variations in food behavior and greater weight gain (Engin A, *et al.* 2017). Stress meddles cognitive functions such as self-regulation and executive ability. Second, stress can influence behavior by causing overconsumption of meals heavy in calories, fat, or sugar; by lowering physical activity; and by reducing sleep duration. Third, stress initiates physiological changes in the hypothalamic–pituitary–adrenal axis, brain reward processing, and possibly the gut flora. Finally, stress can induce the synthesis of peptides, including leptin, ghrelin, and neuropeptide Y, as well as biochemical

hormones (Kaiya H, *et al.* 2016). Although the contributions of neuronal subpopulations in the LH are not fully known, the lateral hypothalamus (LH) is crucial for controlling eating and reward-related activities (Schiffino FL, *et al.* 2019). Additionally, the LH is linked to other facets of body weight control, including physical exercise and thermogenesis (de Vrind VA, *et al.* 2019). In the LH, γ -aminobutyric acid (GABA) neurons predominate among the heterogeneous assemblies of neuronal cell types (de Vrind VA, *et al.* 2019). LH GABA neurons are known to affect several behaviors crucial for body weight control, thereby changing energy expenditure (de Vrind VA, *et al.* 2019).

Recent advances in obesity research have also emphasized the role of the gut microbiome in energy metabolism and adiposity regulation. Dysbiosis has been linked with increased energy harvest, inflammation, and insulin resistance. Moreover, epigenetic modifications influenced by early-life nutrition and environmental exposures are now recognized as key contributors to obesity susceptibility. These findings suggest that obesity is not merely a result of behavioral imbalance but a complex interaction of biological, environmental, and developmental factors.

1.4 Etiology and Risk Factors

In childhood and adolescence, excess body fat poses a serious health issue. The explosive rise in juvenile obesity portends major health risks to adults. Obesity starts in childhood and transcends adult life; hence, treatment becomes more challenging. Among the best ways to stop the epidemic is knowing the risk factors and possible causes of pediatric obesity (Ogden CL, *et al.* 2014).

The Morbidity and Mortality Weekly Report published in 2011 indicates that acknowledgment of the notion that energy imbalance is only one of several causes of juvenile obesity and that there is no single cause at all (CDC grand rounds: childhood

obesity in the United States 2011). Many young people find their intake to differ from their expenditure (Schwarz SM, *et al.* 2019). Children who are obese, for example, eat almost 1000 more calories than their bodies need to be able to operate normally and engage in consistent physical activities. There will be an extra 57 pounds of needless weight over ten years. If nothing is done, childhood obesity will continue to increase with excessive calorie consumption and inactive lives. Including daily physical activity, improved sleep patterns, and dietary adjustments will assist in lowering excess calories and address obesity-related issues in down road.

Moreover, extra fat builds up in children when the increase in caloric intake exceeds their overall energy consumption (Schwarz SM, *et al.* 2019). Moreover, young people of this generation participate in more than six hours of social media activities per day compared with those of the 1900s. This covers conventional TV and video games as well as blogging and Facebook activity not restricted only to these games. Currently, children can eat more food in a shorter period of time.

Cutler *et al.* reported that technological progress in food production and transportation often correlates with increasing food consumption. Technology has thus made it more feasible for companies to mass produce food and ship to consumers for ready consumption, hence optimizing scale efficiencies in food preparation. This shift has produced a notable drop in the time expenses of food production. Reduced time costs have resulted in increased food consumption and, eventually, weight gain (Cutler DM, *et al.* 2003). Eliminating the time cost of food preparation disproportionately increases consumption for hyperbolic discounters since a time delay is a particularly critical strategy for discouraging those people from consuming (Cutler DM, *et al.* 2003). With respect to food and convenience, society currently values instant gratification above the long-term objective of leading a long, healthy life. The availability of high-calorie, less

expensive food mixed with high advertising and the easy accessibility of these foods has greatly contributed to the increasing trend of obesity (Benjamin RM, *et al.* 2010). For example, between 1990 and 2007, McDonald's and Coca-Cola's prices dropped 5.44% and 34.89%, respectively; fruit and vegetable prices increased almost 17% between 1997 and 2003 (Friedlander SL, *et al.* 2003). Similarly, compared with 42% in the late 1960s, only 16% of children currently walk or bike to school. Nevertheless, distance, convenience, climate, poor walkways, and worry about crimes against young people could all help explain this discrepancy. Moreover, with elementary, middle, and high schools combined, only 13.8% of these institutions offer sufficient daily physical education sessions for at least 4 hours a week (Swallen KC, *et al.* 2005). Research investigations, including investigations of problems influencing children prenatally and youth, have revealed several other possible risk factors. Table 1 shows possible risk variables and confounding elements related to childhood obesity (Reilly JJ, Armstrong J, *et al.* 2005).

Contemporary literature also identifies social determinants of health such as socioeconomic status, parental education, urban living conditions, and food environment as critical drivers of adolescent obesity. The increasing influence of digital marketing and ultra-processed food consumption has further exacerbated unhealthy eating behaviors. Additionally, COVID-19-related lifestyle disruptions have been associated with increased sedentary behavior, screen time, and unhealthy dietary patterns among adolescents, potentially accelerating obesity trends globally.

1.5 Physical Activity (PA)

Maintaining health and well-being at both the individual and population levels depend mostly on physical activity (Lee I-M, *et al.* 2012; Das P, *et al.* 2012 and Hallal PC, *et al.* 2012). According to the WHO, physical activity recommendations could help

prevent at least 9% of premature deaths worldwide (Lee I-M, *et al.* 2012). Moreover, the projected worldwide economic cost to health care systems associated with nonadherence in 2013 was \$53 billion (Ding D, *et al.* 2016). To assess public health campaigns and policies (Macfarlane D, *et al.* 2010 and Cleland CL, *et al.* 2014) aimed at lowering the burden of noncommunicative illnesses (NCDs), the World Health Organization has thus pushed the development of PA surveillance systems (Bauman A., *et al.* 2005). One such tool approved by the WHO for its STEPwise Approach to Chronic Disease Risk.

Factor Surveillance (World Health Organization; 2005; Bonnita R, Summary; Geneva: World Health Organization; 2001; World Health Organization; 2004 and Armstrong T, *et al.* 2006). Developed with particular regard for important physical activity domains in developing nations and with a length and complexity appropriate for inclusion in STEPS, the GPA was. Although the GPAQ has been extensively applied to track PA, its validity proof is scant. Nine nations, including Bangladesh, have participated in the most comprehensive research to date evaluating the validity of the GPAQ between 2003 and 2005. Since then, however, the STEPwise program has published revised estimates, and proof for the veracity of the latest version is still scarce. Moreover, only four of these eight countries including Bangladesh were not one; six of them employed pedometers, a criterion measure devoid of sensitivity to activity intensity, and rural populations were included in their sample. For urban Bangladesh, the criterion validity and reliability of the GPAQ were found to be 0.06 and 0.31–0.72, respectively (Bull FC, *et al.* 2009). It is yet unknown whether the GPAQ is a suitable tool for evaluating the situation of PAs among rural populations given that there are significant variations in the patterns and frequency of PAs between rural and urban populations (Moniruzzaman M, *et al.* 2016; Anjana RM, *et al.* 2014; Assah F, *et al.* 2015 and Padrão

P, *et al.* 2012). This study used the global physical activity questionnaire (GPAQ) Version 2 of the GPAQ (Bull FC, *et al.* 2009) in the Bengali language.

A total of 16 questions, including one question on sedentary behavior (Global Physical Activity Questionnaire (GPAQ) Analysis Guide), GPAQ-2, gather information on the "usual/typical" week frequency (days) and duration (minutes/h) of moderate- and vigorous-intensity PA in three domains: 1) at work; 2) during transportation; and 3) at leisure (i.e., recreational activities). We produced the following indicators *via* the GPAQ scoring system: total MVPA MET-min and domain-specific MVPA MET-min that is, work, transportation, and leisure. The intensity of PA is often determined via METs or metabolic equivalent tasks. Using GPAQ-2, moderate-intensity activities during work, commuting, and recreation are assigned a value of 4 METs; strong-intensity activities are assigned a value of 8 METs when an individual's overall energy expenditure is computed. The total MVPA MET-min score was computed as the sum of all MET-min/week from MVPA accomplished in work, transportation, and recreation.

High recreational screen time (ST), often measured as the amount of time spent on screen-based pursuits such television (TV), playing video games, and using a computer or other electronic device (e.g., tablets or smartphones), has been linked with a range of psychosocial difficulties in teenagers (Page AS, *et al.* 2010 and Hamer M, *et al.* 2009). High ST, for example, is positively linked to depressed and anxiety symptoms; nervousness; poor cognitive performance; and behavior problems, including aggression, attention deficit and hyperactivity disorders; sleep difficulties; social isolation; and self-harm in adolescents (Page AS, *et al.* 2010 and Hamer M, *et al.* 2009). Conversely, in longitudinal (Sund AM, *et al.* 2011) and intervention (White K, *et al.* 2009) investigations, regular physical activity (PA) involvement has historically

been adversely linked with adolescent psychosocial problems. Regular PA can lower anxiety and depression symptoms; increase self-esteem, academic performance, life satisfaction and quality of sleep; increase mood; and help teenagers cope with stress (Sund AM, *et al.* 2011 and White K, *et al.* 2009). Although some studies have shown an independent association with high ST irrespective of PA participation, emerging evidence suggests that recommended levels of PA and low ST can operate synergistically to decrease the risk of psychological problems in children and adolescents (Hamer M, *et al.* 2009; Cao H, *et al.* 2011 and Matin N, *et al.* 2017). Like many other poor nations, high STs and inadequate PAs are widespread among Bangladeshi teenagers; 79% have high STs (Khan A, *et al.* 2016), and 34% do not fulfill PA requirements (Khan A, Burton N, *et al.* 2017). According to a recent study on Bangladeshi teenagers, low PA was linked to symptoms of depression in only teenagers with high ST (Khan A, *et al.* Ment Health Phys Act 2017).

Recent global surveillance data indicate that more than 80% of adolescents worldwide do not meet the recommended physical activity levels, with even higher prevalence in South Asia. Emerging research also highlights the importance of reducing sedentary behavior independently of physical activity levels, as prolonged sitting has distinct metabolic risks. School-based and community-based interventions, including active transport and structured exercise programs, are increasingly recommended as cost-effective strategies for improving adolescent health outcomes in LMIC settings.

1.6 Global Physical Activity Questionnaire (GPAQ)

Regular physical activity is well known as a vital lifestyle practice for the development and maintenance of individual and population health and well-being (U.S. Department of Health and Human Services, 1996 and World Health Organization. Preventing Chronic Diseases, 2005). With significant economic implications, high degrees of

inactivity globally significantly contribute to the worldwide burden of disease (Bull FC, *et al.* World Health Organization 2005 and Pratt M, *et al.* 2000). A fundamental component of a public health response to present issues on levels of physical inactivity and obesity is tracking population levels of physical activity via a standardized approach (Levi F, *et al.* 2002 and World Health Organization, Global Strategy on Diet 2004). All nations should, according to the WHO Global Strategy for Diet, Physical Activity and Health: Monitoring diet and physical activity (World Health Organization, Global Strategy on Diet 2004). Developed under WHO direction in 2002 as part of the WHO stepwise approach to Chronic Disease Risk Factor Surveillance (STEPS), the Global Physical Activity Questionnaire (GPAQ), particularly in poor nations, has been extensively adopted as a practical method for monitoring important risk factors for noncommunicable illnesses (Armstrong T, *et al.* 2003).

Recent validation studies have attempted to refine GPAQ by integrating wearable device comparisons, such as accelerometers, to improve accuracy. Despite certain limitations, GPAQ remains a practical and widely used surveillance tool in resource-constrained settings. There is growing emphasis on adapting GPAQ culturally and linguistically to enhance its reliability in diverse populations, including rural and peri-urban communities in Bangladesh.

1.7 Health Effects of Childhood Obesity

Childhood obesity is known to have a significant effect on both physical and psychological health. Sahoo *et al.* stated that “childhood obesity can profoundly affect children’s physical health, social and emotional well-being, as well as self-esteem.” They associated poor academic performance and a lower quality of life experienced by the child with childhood obesity. They also reported that “metabolic, cardiovascular, orthopedic, neurological, hepatic, pulmonary, and menstrual disorders, among others,

are consequences of childhood obesity” (Sahoo K, *et al.* 2015). There are many health consequences of childhood obesity, and three of the more common ones are sleep apnea, diabetes, and cardiovascular diseases (Sahoo K, *et al.* 2015).

Recent systematic reviews (2020–2024) further confirm that childhood obesity is strongly associated with early onset of metabolic syndrome, type 2 diabetes, and hypertension. Additionally, evidence suggests that obesity during adolescence significantly increases the risk of premature mortality in adulthood. These findings reinforce the importance of early prevention and intervention strategies targeting this age group.

1.8 Childhood Obesity: Effect on Psychological Aspects

“Psycho-social factors, particularly within the family, often play a significant role in the onset and maintenance of obesity. Once established, obesity has a decisive influence on a child’s physical and mental health. Research on the psychosocial aspects of obesity has grown extensively over the years, from purely theoretical articles to cross-sectional, comparative studies of people with and without obesity to longitudinal analysis of the temporal sequencing of obesity and psychopathology” (Fabricatore, *et al.* 2004). Some previous studies have reported associations between childhood obesity and some forms of psychopathology, such as depressive symptoms (Erickson SJ, *et al.* 2000), attention deficit/hyperactivity disorder (Waring ME, *et al.* 2008) and low self-esteem (Wang F, *et al.* 2008). However, the findings are still mixed with respect to the psychosocial functioning of the clinical obese sample and the population-based sample. According to Janssen I, *et al.* 2004 and Strauss RS, *et al.* (2003): “Obesity also has significant negative impact on the emotional development of the child. Overweight children are more likely to be victims of discrimination, social isolation and bullying. The instances of verbal bullying (name calling, teasing), physical bullying (hitting, pushing) and

relational bullying (withdrawing friendship) of these children can easily be observed within the close premises of schools and home". These experiences often lead to the development of poor body image and low self-esteem in obese children (Goldfield GS, *et al.* 2010 and Mond J, *et al.* 2011). Psychopathology and childhood obesity A number of cross-sectional, case-control and prospective studies have reported the associations between increased body mass index (BMI) and psychopathology. The findings vary in terms of the population being studied. Compared with nonclinical samples, clinical samples of obese children consistently report more behavioral problems and are at greater risk of developing psychopathology (Sarkar P, *et al.* 2010; Braet C, *et al.* 1997 and Britz B, *et al.* 2000). Depression was the most frequently and consistently reported diagnosis (Goldfield GS, *et al.* 2010; Britz B, *et al.* 2000; Erermis S, *et al.* 2004 and Taner Y, *et al.* 2009), followed by anxiety disorders (Britz B, *et al.* 2000; Vila G, *et al.* 2004 and Isnard P, *et al.* 2003), eating disorders or episodes of binge eating (Britz B, *et al.* 2000; Isnard P, *et al.* 2003; Puder JJ, *et al.* 2010 and Sonnevile KR, *et al.* 2012) and attention deficit hyperactivity disorder (ADHD) (Erermis S, *et al.* 2004 and Agranat-Meged AN, *et al.* 2005). The cause-effect analysis of this relationship revealed the presence of obesity before the onset of psychiatric disorders on the basis of the retrospective recall of most obese cases (Britz B, *et al.* 2000); however, depression may act as a risk factor for the development and persistence of obesity, specifically in adolescents (Puder JJ, *et al.* 2010 and Mustillo S, *et al.* 2003). The literature could not identify any direct causal link between obesity and depression in adolescents; however, indirect pathways and experiences such as stressful life events, peer victimization and weight-based teasing may be contributing factors for the development of depression in adolescents (Nemiary D, *et al.* 2012). Few studies have reported sex differences in obese children and adolescents in relation to depression and anxiety, with obese girls being at

greater risk of developing depression and anxiety (social anxiety) with increasing weight (Anderson SE, *et al.* 2006 and Phillips BA, *et al.* 2012).

More recent studies have highlighted the bidirectional relationship between obesity and mental health disorders, where psychological distress can both contribute to and result from obesity. Social media exposure and body image dissatisfaction have emerged as modern risk factors influencing adolescent mental health. These psychosocial dynamics are particularly relevant in urban settings where peer comparison and digital influence are strong.

1.9 Psychological Consequences of Obesity

The physiological effects of childhood and adolescent obesity have been the main focus of several investigations. Obesity has been determined to be a negligible risk for psychopathology, which has led to disputes in other studies about the relationship between obesity and psychiatric diseases. However, Britz *et al.* comparative investigation revealed that children who were obese had significant incidences of eating disorders, somatoform, anxiety, and mood problems. Additionally, the study revealed that the majority of mental illnesses started after obesity. Sixty percent of women and 35% of men in this sizable population-based study admitted to binge eating and confessed to having little control over their nutrition (Britz B. *et al.* 2000). A study by Goldfield *et al.* involved 1,400 teenagers in grades 7–12 who were obese, overweight, or normal weight. Each group was defined on the basis of BMI, as established by the International Obesity Task Force. A questionnaire about moods, eating habits, and body images was completed by each participant. Compared with adolescents of normal weight, those who were obese reported much higher levels of body dissatisfaction, social isolation, depression symptoms, anhedonia, and low self-esteem (Goldfield GS, *et al.* 2010). Rather than being used to encourage weight loss, the stigmatization of

obese persons is pervasive and harmful. Stigma exacerbates obesity and adds to obstacles to healthy behavior change by promoting behaviors such binge eating, social isolation, avoiding health care services, reducing physical exercise, and increasing weight (Pont SJ, *et al.* 2017). In many nations, the bullying of young people on the basis of their weight is regarded as a prevalent and severe issue (Puhl RM, *et al.* 2016). Weight stigma was found to be significantly associated with all measures of disordered eating, as well as with weight bias internalization and psychological distress, according to statistical analyses conducted by O'Brien *et al.* to test whether the relationship between weight stigma experiences and disordered eating behaviors—that is, emotional eating, uncontrolled eating, and loss-of-control eating—is mediated by these factors among 634 undergraduate university students (O'Brien KS, *et al.* 2016).

Emerging evidence also emphasizes the role of weight stigma as a major public health concern, contributing to chronic stress, disordered eating, and avoidance of healthcare services. Interventions addressing obesity are increasingly recommended to incorporate psychological counseling and stigma reduction strategies to ensure holistic management.

1.10 Behavioral Strengths and Difficulties

The Strengths and Difficulties Questionnaire (SDQ) was used to evaluate behavioral strengths and challenges (Goodman R 1997; Woerner W, *et al.* 2004 and Goodman R 1999). Numerous investigations have demonstrated the exceptional validity and reliability of the SDQ. The specificity (94%) and sensitivity (90%) of the SDQ are also good. The subscale scores, overall difficulty scores, and internal consistency of the SDQ are all very high (Mullick, M. S. and R. Goodman, 2001). Bangladesh has validated this tool (Goodman, R. *et al.* 2000; Mullick *et al.* 2005). It consists of 25 questions with three possible answers: not true, partly true, and definitely true.

Emotional symptoms, conduct issues, hyperactivity, peer issues, and prosocial behavior are the five areas in which it is assessed. Higher scores indicate greater behavioral strength (in the case of prosocial behavior) or difficulty (in all other circumstances). Each domain score varied from 0 to 10. With cutoff values for the total and each domain, the total problem score derived from the first four domains is used to identify the level of problems: normal, borderline, and abnormal. The abnormal proportion is estimated to be 10% in the general population (Mullick *et al.*, 2005).

Recent applications of the SDQ in LMICs have demonstrated its usefulness in identifying early behavioral and emotional problems associated with obesity. Integrating behavioral assessment tools into routine adolescent health services is now recommended to support early detection and intervention.

1.11 Dietary Approach

Diet should be considered the most suitable nutrition strategy for long-term weight reduction, and the promotion of metabolic and mental health is shifting to healthy food choices (Koliaki, C, *et al.* 2018 and Wirnitzer, K.C. 2020), which include mostly whole food plant-based sources (Baroni, L, *et al.* 2018 and Wirnitzer, K.C. 2020). Nutritional approaches aimed at childhood obesity are not limited to restricted energy intake but rather reflect the most appropriate nutrition strategy for long-term weight reduction and the promotion of metabolic and mental health. This dietary pattern limits added sugars, refined grains, sweetened beverages, fast food, calorie-dense snacks, and high-fat processed foods and includes fruits, vegetables, nuts, and whole grains along with a well-structured meal frequency (Kaisari, P 2013). Reduced caloric intake and an increase in postprandial energy expenditure via a greater thermal response help explain the weight-related benefits of plant-based diets (Barnard, N, *et al.* 2019 and Greger, M, *et al.* 2020). Furthermore, linked with further weight-related benefits are whole

food plant-based diets, which cause favorable changes in cardiometabolic and digestive health (Tran, E, *et al.* 2020; Sabaté, J, *et al.* 2010). Increasing the nutritional literacy of children and their parents (with respect to agriculture, food industries, food safety, cooking, and theoretical knowledge of energy balance, nutrition, and diets) could help to further promote sustainable changes that support better dietary patterns (Bailey, C.J., *et al.* 2019). Although these are broad ideas and suggestions, no one diet should be advised or prescribed as the healthiest diet for every obese child (Koliaki, C, *et al.* 2018). Factors such as hunger, thermogenesis, energy homeostasis, and gut bacteria, among others, determine the ideal macronutrient balance (Dey, M, *et al.* 2020). Moreover, a perfect diet for treating obese and overweight individuals should be safe, effective, nutritionally sufficient, culturally appropriate, and reasonably priced (Koliaki, C, *et al.* 2018). However, most nutritional plans aimed at childhood obesity are still based on a "one-size-fits-all" model, which does not consider interindividual variability (Franzago, M *et al.* 2020), which often results in a lower adherence rate to dietary changes (Gibson, A.A, *et al.* 2017). One potential area of study in the treatment of obesity is personalized nutritional methods (Bray, M.S., *et al.* 2016). Clinical and observational studies largely in the field of nutrition have thus far provided data supporting tailored approaches to control obesity. In several studies (Kim, J, *et al.* 2019; Swan, W.I., *et al.* 2017 and Thompson, K.L *et al.* 2015), this multistep methodology was developed to organize tailored nutritional treatment aimed at pediatric obesity.

Like other developing countries, Bangladesh has a significant adolescent population. It is home to 36 million adolescents, accounting for 22% of the population. However, adolescent-friendly services are not yet a familiar concept. Bangladesh demographic and health survey (2014) revealed that the prevalence of overweight and obesity among

adolescents has increased, which indicates that Bangladesh has to address the double burden of undernutrition/malnutrition and overweight/obesity among adolescents.

Recent dietary guidelines increasingly emphasize sustainable and culturally appropriate eating patterns rather than restrictive diets. The concept of “precision nutrition” is gaining attention, where individualized dietary interventions are tailored based on genetic, metabolic, and lifestyle factors. Additionally, school-based nutrition education and parental involvement have been shown to significantly improve adherence to healthy dietary behaviors among adolescents.

Recent national surveys and studies (2020–2024) indicate a steady rise in adolescent overweight and obesity in urban Bangladesh, driven by rapid lifestyle transitions, increased consumption of fast foods, and declining physical activity. This dual burden of malnutrition coexistence of undernutrition and obesity poses a major challenge to the healthcare system. Therefore, evidence-based interventions focusing on dietary counseling and physical activity are crucial to mitigate this growing public health concern.

1.12 Hypothesis

Dietary counseling and physical activities, such as body mass index (BMI), overweight and obesity, have better effects on adolescents' health.

1.13 Objectives

1.13.1 General Objective

To examine the effects of dietary counseling and physical activities among adolescents visiting a tertiary care hospital, Dhaka.

1.13.2 Specific Objectives

- To determine the body mass index of the adolescents.
- To assess their lipid profile, blood glucose and thyroid hormone levels were measured.
- To examine the relationships of dietary counseling and physical activity (PA) patterns with body mass index (BMI) among adolescents.
- To explore the sociodemographic profile of the adolescents.

1.14 Rationale of the Study

Adolescents (aged 10–19 years) constitute approximately 1.2 billion people globally, representing nearly one-sixth of the world's population, with about 90% residing in low- and middle-income countries. This demographic group is critical for achieving the Sustainable Development Goals (SDGs), including Universal Health Coverage (UHC), particularly as the adolescent population is projected to grow through 2050. However, the rising prevalence of noncommunicable diseases (NCDs) is increasingly linked to modifiable behavioral risk factors established during adolescence, notably physical inactivity and unhealthy dietary practices.

In Bangladesh, rapid urbanization, lifestyle transitions, and increased access to energy-dense foods have contributed to a growing burden of overweight and obesity among adolescents. Recent data from Dhaka indicate that approximately 20% of adolescents and over half of young adults are overweight or obese, reflecting an alarming upward trend. Despite this emerging public health concern, there remains a significant gap in evidence regarding the effectiveness of behavioral interventions—particularly dietary counseling and physical activity promotion—among adolescents in the Bangladeshi context.

Moreover, limited research has been conducted in clinical settings, such as tertiary care hospitals, where adolescents at higher risk can be effectively targeted. Therefore, this study aims to assess the effects of dietary counseling and physical activity interventions among adolescents attending a tertiary care hospital in Dhaka. The findings are expected to contribute to evidence-based strategies for preventing the progression of adolescent obesity into adulthood and reducing associated comorbidities and premature mortality.

CHAPTER 2

LITERATURE REVIEW

2. Literature Review

2.1 Background

Nutrition and physical activity are universally recognized as fundamental determinants of optimal growth, development, and long-term health outcomes. As highlighted in the Dietary Guidelines for Americans (2015–2020) and Physical Activity Guidelines (2nd edition), behaviors established during childhood and adolescence significantly influence health trajectories into adulthood. This life-course perspective is increasingly supported by contemporary research, which emphasizes adolescence as a critical window for establishing lifelong health behaviors and preventing noncommunicable diseases (NCDs).

Recent global evidence indicates that unhealthy dietary patterns and insufficient physical activity are among the leading modifiable risk factors contributing to the global burden of disease. According to the World Health Organization (WHO, 2022), physical inactivity and unhealthy diets are responsible for a substantial proportion of obesity, cardiovascular diseases, type 2 diabetes, and certain cancers. Importantly, these behaviors often originate during adolescence and persist into adulthood, thereby reinforcing the intergenerational cycle of poor health outcomes.

In low-and middle-income countries (LMICs), including Bangladesh, rapid urbanization, economic development, and globalization have accelerated a “nutrition transition.” This transition is characterized by increased consumption of energy-dense, nutrient-poor foods alongside declining levels of physical activity. Adolescents are particularly vulnerable to these changes due to increased autonomy, exposure to marketing, and lifestyle shifts influenced by digital technologies. Recent studies (Popkin *et al.*, 2020; UNICEF, 2021) highlight that adolescent in LMICs are increasingly

exposed to obesogenic environments that promote unhealthy eating behaviors and sedentary lifestyles.

Furthermore, the COVID-19 pandemic has exacerbated these challenges by increasing screen time, reducing opportunities for physical activity, and altering dietary habits among adolescents worldwide. Emerging evidence (2021–2024) suggests a significant rise in weight gain and unhealthy behaviors during and after pandemic-related restrictions, particularly among urban youth populations.

Therefore, promoting healthy dietary practices and physical activity during adolescence is not only essential for immediate health benefits but also serves as a critical strategy for reducing the long-term burden of NCDs and achieving global public health goals, including the Sustainable Development Goals (SDGs).

2.2 Diet Therapy

The global rise in adolescent obesity has been widely attributed to complex interactions between genetic predisposition and environmental influences, including dietary patterns and lifestyle behaviors. Earlier studies (Popkin, 2001; Misra and Vikram, 2004) highlighted the susceptibility of Indo-Asian populations to central obesity and metabolic syndrome. However, recent literature underscores that environmental and behavioral factors particularly diet, play a dominant role in the manifestation of these risks.

The ongoing nutrition transition has led to increased consumption of ultra-processed foods, sugary beverages, fast foods, and high-fat snacks among adolescents. These dietary patterns are often characterized by high energy density, excessive sugar, salt, and unhealthy fats, and low intake of essential micronutrients. According to recent

global reports (FAO, WHO, 2021), ultra-processed food consumption has significantly increased in LMICs, contributing to rising obesity rates among adolescents.

Longitudinal studies continue to confirm that childhood obesity strongly tracks into adulthood, with estimates ranging from 50% to 80% (Styne, 2001). More recent cohort studies (Simmonds *et al.*, 2016; Llewellyn *et al.*, 2018) further validate these findings, demonstrating that early-life obesity significantly increases the risk of adult obesity, type 2 diabetes, cardiovascular diseases, and premature mortality. Importantly, the metabolic consequences of obesity such as insulin resistance, dyslipidemia, and chronic inflammation are now increasingly observed at younger ages.

Emerging research has also highlighted the role of dietary patterns rather than individual nutrients. Diets high in refined carbohydrates and added sugars have been associated with increased adiposity and metabolic dysfunction, while diets rich in fruits, vegetables, whole grains, and healthy fats are protective. Recent systematic reviews (2020–2023) indicate that adherence to healthy dietary patterns, such as the Mediterranean diet or plant-based diets, is associated with improved metabolic health and reduced obesity risk among adolescents.

School-based interventions have been widely implemented to improve dietary behaviors among children and adolescents. Earlier studies (Luepker *et al.*, 1996; Sallis *et al.*, 1993) demonstrated modest improvements in knowledge and behavior. More recent interventions (2020–2024) have incorporated multi-component approaches, including nutrition education, environmental modifications, parental involvement, and policy changes. These integrated interventions have shown greater effectiveness in improving dietary intake and reducing obesity risk.

Evidence suggests that interventions targeting adolescents, particularly in middle and high school settings, are more effective than those targeting younger children. This may

be due to increased cognitive maturity, decision-making capacity, and peer influence among adolescents. Studies such as Singha *et al.* (2010) and Rao *et al.* (2007) demonstrated significant improvements in nutrition knowledge and behavior following targeted interventions. Recent studies further support the importance of peer-led and participatory approaches in promoting sustainable behavior change.

In addition, digital health interventions including mobile applications, social media campaigns, and online education platforms are emerging as innovative tools for improving adolescent dietary behaviors. These approaches leverage adolescents' familiarity with technology and have shown promising results in recent trials.

Despite these advancements, challenges remain in translating knowledge into sustained behavior change. Socioeconomic disparities, cultural preferences, food availability, and marketing influences continue to shape dietary choices among adolescents. In Bangladesh, the increasing availability of fast food and street food, coupled with limited nutrition awareness, poses significant challenges for promoting healthy diets.

2.3 Physical Activity

Physical activity is a critical component of energy balance and plays a vital role in preventing obesity and associated health risks. Regular physical activity during childhood and adolescence has been shown to improve cardiovascular fitness, bone health, mental well-being, and academic performance. However, global trends indicate a concerning decline in physical activity levels among adolescents.

Physical inactivity has been identified as a major contributor to obesity and cardiovascular risk factors, independent of body weight. Studies (Andersen *et al.*, 2006; Brage *et al.*, 2004) have demonstrated strong associations between low physical activity levels and increased risk of metabolic syndrome, hypertension, and insulin resistance.

More recent evidence (WHO, 2020) indicates that over 80% of adolescents worldwide do not meet the recommended 60 minutes of moderate-to-vigorous physical activity per day.

School-based interventions have been widely used to promote physical activity among children and adolescents. While these interventions have successfully increased awareness and participation, their impact on obesity outcomes has been limited. Factors such as insufficient duration and intensity of physical activity, academic pressures, and lack of infrastructure have been cited as barriers to effectiveness.

Recent studies emphasize the need for comprehensive approaches that extend beyond the school environment. After-school programs, community-based initiatives, and family involvement are increasingly recognized as important strategies for promoting physical activity. However, evidence from after-school interventions has been mixed, with challenges including low participation rates and sustainability issues.

Sedentary behavior, particularly screen time, has emerged as a significant risk factor for obesity and poor health outcomes. Adolescents today spend a substantial amount of time on electronic devices, including smartphones, computers, and television. High levels of sedentary behavior have been associated with increased adiposity, poor mental health, and reduced physical fitness.

Recent research highlights that reducing sedentary behavior is as important as increasing physical activity. Interventions that combine both strategies promoting active lifestyles while limiting screen time have shown greater effectiveness in improving health outcomes.

In addition, the built environment plays a crucial role in influencing physical activity levels. Access to safe recreational spaces, walkable neighborhoods, and active transportation options can significantly enhance physical activity among adolescents.

In many LMICs, including Bangladesh, limited infrastructure and safety concerns pose barriers to active lifestyles. The use of standardized tools such as BMI for assessing obesity remains widespread due to its simplicity and practicality. However, its limitations in accurately reflecting body composition, particularly in children and adolescents, have been widely acknowledged. Recent research advocates for the use of complementary measures, including waist circumference and body fat percentage, to improve risk assessment.

Importantly, evidence consistently shows that combined interventions integrating both dietary modification and physical activity are more effective in reducing obesity than single-component interventions. Studies (Bleich *et al.*, 2018; Friedrich *et al.*, 2012) have demonstrated greater improvements in BMI and metabolic outcomes when both diet and physical activity are addressed simultaneously.

In recent years, there has been growing interest in personalized and context-specific interventions. Tailoring physical activity programs to individual preferences, cultural contexts, and environmental conditions can enhance participation and adherence. For adolescents, incorporating enjoyable and socially engaging activities such as sports, dance, and group exercise has been shown to improve outcomes.

Overall, promoting physical activity among adolescents requires a multi-level approach involving schools, families, communities, and policy interventions. Addressing barriers and creating supportive environments are essential for achieving sustainable behavior change and reducing the burden of obesity.

CHAPTER -3

METHODOLOGY

3.1 Study Design

This study employed a mixed-methods research design, integrating both quantitative and qualitative approaches to comprehensively assess the effects of dietary counseling and physical activity on overweight and obesity among adolescents attending a tertiary care hospital in Dhaka. The use of a mixed-methods approach allowed for a more robust understanding of the research problem by combining numerical measurement with in-depth contextual insights.

3.1.1 Quantitative Component

The quantitative component of the study followed a descriptive and analytical cross-sectional design. Data were collected using a semi-structured questionnaire, which enabled the systematic collection of standardized information while allowing limited flexibility to capture additional relevant responses. The questionnaire included sections on:

- Socio-demographic characteristics (age, sex, education, family background)
- Dietary habits (meal frequency, food choices, consumption of fast food and sugary beverages)
- Physical activity patterns (frequency, duration, and type of activities)
- Sedentary behaviors (screen time, sitting duration)
- Anthropometric measurements (height, weight, BMI)

The semi-structured format ensured consistency across participants while allowing probing where necessary to improve data accuracy. This component aimed to quantify the prevalence of overweight and obesity, identify associated behavioral factors, and measure changes following dietary counseling and physical activity interventions.

3.1.2 Qualitative Component

To complement the quantitative findings, a qualitative approach was incorporated to explore perceptions, experiences, and contextual factors influencing adolescent behavior. This component provided deeper insights into attitudes, beliefs, and barriers related to diet and physical activity.

3.1.2.1 Case Study of Adolescents

A series of case studies were conducted among selected adolescents to obtain an in-depth understanding of individual experiences regarding dietary practices, physical activity, and lifestyle behaviors. Each case study involved:

- Detailed interviews with adolescents
- Exploration of personal, familial, and environmental influences
- Assessment of behavioral changes following counseling interventions

The case study approach allowed for a holistic examination of individual variability, highlighting real-life challenges and facilitators of behavior change that may not be captured through structured questionnaires.

3.1.2.2 Focus Group Discussions (FGDs)

Focus Group Discussions (FGDs) were conducted with groups of adolescents to explore shared experiences, social norms, and collective perceptions related to diet, physical activity, and body image. Each FGD:

- Included 8–10 participants with similar age groups
- Was guided by a semi-structured discussion guide
- Explored topics such as eating habits, peer influence, physical activity preferences, and perceived barriers

FGDs facilitated interactive discussions, allowing participants to express opinions, challenge ideas, and build on each other's responses. This method was particularly useful in understanding the influence of peer dynamics and cultural context on adolescent behavior.

3.2 Study Period

From 5th January 2022 to 5th April 2023.

3.3 Study Location

The study will be carried out at Bangladesh Shishu Hospital and Institute (ex- Dhaka shishu (children) hospital), established in 1972 and situated in Sher-e-Bangla Nagar Dhaka. It is a 650-bed hospital that includes almost all facilities. It has an adolescent unit with both indoor and outdoor facilities. Data were collected from the outpatient department of the adolescent unit of Dhaka Shishu (children) Hospital.

3.4 Study Population

The study population consisted of all adolescents who came to the OPD of Bangladesh Shishu Hospital & Institute (Ex- Dhaka Shishu Hospital).

3.5.1 Inclusion Criteria

- Adolescents aged between 10 and 19 years were included.
- Adolescents who were willing to participate.

3.5.2 Exclusion Criteria

- Adolescents who were mentally retarded.
- Having any other serious pathological condition.

3.6 Sampling Method

A nonprobability purposive sampling technique was employed to select the sample.

3.7 Sample Size Determination

“The sample size was determined by considering the study on Obesity and overweight in Bangladeshi children and adolescents: a scoping review, where the prevalence of childhood obesity was found to be approximately 18%” (Rahman. S., Islam. T., Dewan S Alam. Obesity and overweight in Bangladeshi children and adolescents: a scoping review, BMC Public Health, 2014). To determine the minimum required sample size, the following formula was used:

$$n = \frac{z^2pq}{d^2}$$
$$= \frac{(1.96)^2 \times (0.18) \times (0.82)}{(0.05)^2} = 226$$

where n = required sample size

z = 95% confidence level for this study

p = prevalence of childhood obesity is approximately

= 18% = 0.18

q = 1- p = 1 – 0.18 = 0.82

d = desired decision level

Considering a 10% nonresponse rate and rounding, the sample size was 249, and after the evaluation of data quality, the total collected sample was 226.

3.8 Data Collection Technique

Data were collected using a pre-post intervention approach, allowing assessment of changes in nutritional status, dietary behavior, physical activity, psychological condition, and biochemical parameters among adolescents following dietary counseling and physical activity interventions. Data collection was conducted at two time points:

baseline (before intervention) and endline (after intervention). A combination of face-to-face interviews, clinical assessments, and laboratory investigations was employed to ensure comprehensive and accurate data collection.

3.8.1 Socioeconomic Information

Socioeconomic data were collected through face-to-face interviews using a structured section of the questionnaire. Information included:

- Age, sex, and educational status of adolescents
- Parental education and occupation
- Household income and family size
- Residential characteristics (urban/semi-urban)

This information helped identify social determinants influencing dietary behavior, physical activity, and obesity risk.

3.8.2 Nutritional Status Assessment

Nutritional status was assessed through anthropometric measurements conducted following standard procedures:

- **Body weight** measured using a calibrated digital weighing scale (to the nearest 0.1 kg)
- **Height** measured using a stadiometer (to the nearest 0.1 cm)
- **Body Mass Index (BMI)** calculated as weight (kg)/height (m²)
- BMI-for-age percentiles/z-scores used to classify overweight and obesity

3.8.3 Dietary Information

Dietary data were collected using:

- **24-hour dietary recall method** to assess recent food intake
- **Food Frequency Questionnaire (FFQ)** to evaluate habitual dietary patterns

Information included:

- Meal frequency and timing
- Consumption of fast foods, sugary beverages, fruits, and vegetables
- Snacking behavior and eating outside home

Standard household measures (cups, spoons, portion charts) were used to improve accuracy of portion size estimation.

3.8.4 Physical Activity and Sedentary Behavior

Physical activity data were collected using a modified Global Physical Activity Questionnaire (GPAQ) adapted to the local context. Information included:

- Frequency, duration, and intensity of physical activity
- Domains: school/work, transport, and leisure-time activity
- Sedentary behavior (daily screen time, sitting duration)

Physical activity levels were expressed in MET-minutes/week.

3.8.5 Psychological Status Assessment

Psychological status was assessed using a validated behavioral screening tool, such as the Strengths and Difficulties Questionnaire (SDQ). This included:

- Emotional symptoms
- Conduct problems
- Hyperactivity/inattention
- Peer relationship problems
- Prosocial behavior

The tool was administered through interviews to ensure comprehension and accuracy.

3.8.6 Biochemical Assessment

Biochemical data were obtained through blood sample collection and laboratory analysis. Key parameters included:

- Fasting blood glucose
- Lipid profile (total cholesterol, LDL, HDL, triglycerides)

Blood samples were collected by trained personnel following standard aseptic procedures. Laboratory analyses were conducted in a certified diagnostic laboratory to ensure reliability and validity of results.

3.8.7 Intervention Monitoring

During the intervention period:

- Dietary counseling sessions were provided regularly
- Physical activity recommendations were monitored
- Compliance and behavioral changes were tracked through follow-up visits

Post-intervention data collection followed the same procedures as baseline to ensure comparability.

3.9 Data Collection Instruments

Multiple standardized and validated instruments were used to ensure accuracy, reliability, and consistency of data.

3.9.1 Semi-Structured Questionnaire

A pretested semi-structured questionnaire was used as the primary data collection tool.

It consisted of the following sections:

- Socio-demographic information
- Dietary habits and food consumption patterns
- Physical activity and sedentary behavior
- Psychological assessment items

The questionnaire was developed in English and translated into Bangla, then back-translated to ensure consistency. A pilot test was conducted to refine clarity, relevance, and cultural appropriateness.

3.9.2 Anthropometric Measurement Instruments

Standardized instruments were used for physical measurements:

- Digital weighing scale (calibrated daily)
- Portable stadiometer
- Measuring tape for waist circumference

All measurements were taken following WHO standardized protocols to minimize measurement error.

3.9.3 Dietary Assessment Tools

- 24-hour recall form
- Food Frequency Questionnaire (FFQ)
- Portion size estimation aids (household utensils, food models, charts)

These tools ensured both short-term and habitual dietary intake assessment.

3.9.4 Physical Activity Assessment Tool

- Modified Global Physical Activity Questionnaire (GPAQ)
- Structured recording sheet for MET calculations

The tool was adapted for cultural relevance and validated in similar populations.

3.9.5 Psychological Assessment Instrument

- Strengths and Difficulties Questionnaire (SDQ)

This validated instrument ensured reliable assessment of behavioral and emotional status among adolescents.

3.9.6 Laboratory Instruments

- Standard venipuncture equipment (syringes, vacutainers)
- Automated biochemical analyzers for blood tests
- Quality-controlled laboratory reagents

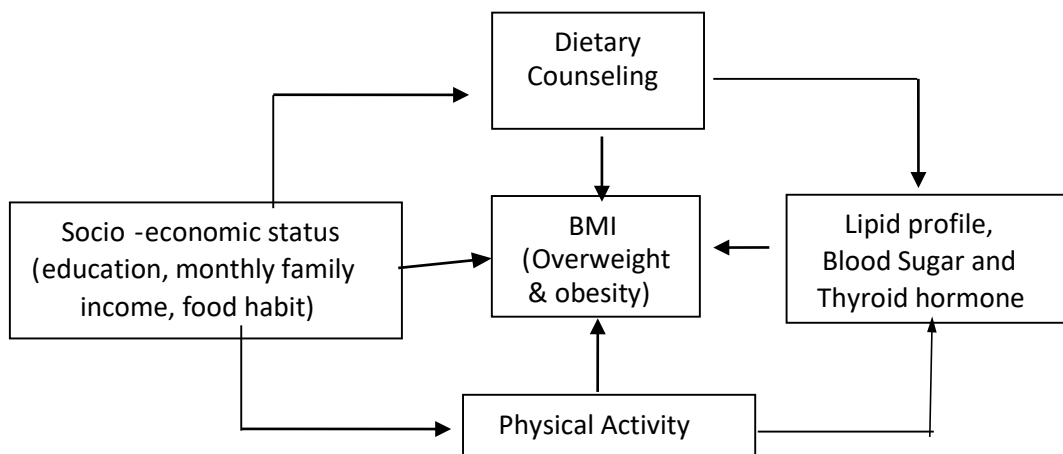
All laboratory procedures followed standard operating protocols to ensure accuracy.

3.9.7 Data Quality Control Measures

To ensure data validity and reliability:

- Data collectors were trained prior to fieldwork
- Instruments were pretested and standardized
- Regular supervision and cross-checking were performed
- Calibration of equipment was done daily
- Double data entry and validation were conducted

3.10 Conceptual Framework



Explanation of the Conceptual Framework

The conceptual frame given above shows how dependent variables are influenced by independent variables and confounding and intervening variables. Here, dietary counseling and physical activity act as independent variables that influence the BMI of adolescents. Moreover, socioeconomic status may act as a confounding or intervening variable that influences both the dependent and independent variables.

3.11 Ethical Considerations

- Written informed consent was obtained from each participant.
- Confidentiality was maintained.
- The subjects were free to withdraw from the study at any time if they wanted.
- The subjects were informed about the nature of the study.
- Information obtained during the study work was not used for any purpose other than the study.

3.12 Data Analysis Plan

Data were entered, cleaned, and analyzed using statistical software SPSS. Version 26. Both descriptive and inferential statistics were applied to assess the effects of dietary counseling and physical activity interventions among adolescents.

Descriptive statistics were used to summarize baseline characteristics of participants. Continuous variables (age, BMI, biochemical parameters) were presented as mean $\pm$ standard deviation (SD) or median (interquartile range) where appropriate, while categorical variables (sex, nutritional status categories, physical activity levels) were expressed as frequencies and percentages.

To evaluate changes before and after the intervention, paired sample t-tests (for normally distributed variables) or Wilcoxon signed-rank tests (for non-normally distributed variables) were used. For categorical outcomes, the McNemar test or chi-square test was applied as appropriate. Changes in BMI, dietary behaviors, physical activity levels (MET-min/week), and biochemical indicators were specifically analyzed.

Multivariate analysis, such as linear regression or logistic regression, was performed to identify factors associated with changes in overweight and obesity status while controlling for potential confounders (e.g., age, sex, socioeconomic status). Statistical significance was set at $p < 0.05$ with a 95% confidence interval.

Qualitative data obtained from case studies and focus group discussions (FGDs) were analyzed using thematic analysis. Transcripts were coded, categorized, and organized into themes reflecting perceptions, behaviors, and barriers related to diet and physical activity.

Finally, findings from both quantitative and qualitative analyses were triangulated to provide a comprehensive understanding of the intervention effects.

CHAPTER -4

RESULTS

4. Results

Both the quantitative and qualitative methods were applied for this interventional study with the aimed to comprehensively assess the effects of dietary counseling and physical activity on overweight and obesity among adolescents attending a tertiary care hospital in Dhaka city, Bangladesh. Therefore, the results section was highlighted in two parts i.e., quantitative survey data analysis and monitoring part and qualitative analysis based on some case studies and certain focus group discussion.

Part-1: Quantitative Survey Data Analysis and Monitoring Findings

Table 1: Distribution of the respondents by age

Age in Years	Frequency	Percentage (%)
10-14 years	170	75.2
15-17years	36	15.9
18-19 years	20	8.8
Total	226	100.0

Mean $\pm$ SD = 13.27 $\pm$ 2.34

Table-1 represents the distribution of the respondents by their age. 170 respondents (75.20%) were in the 10-14 age range, 36 people (15.9%) were in the 15-17 age range, and 8.8% were in the 18-19 age range. With a mean age of 13.27 $\pm$ 2.34 years, the majority of respondents (75.2%) were between the ages of 10 and 14, followed by those between the ages of 15 and 17 (15.9%) and 18 and 19 (8.8%). The study's primary focus is on early adolescents, indicating that interventions targeted at younger age groups may result in more long-lasting and successful behavioral changes.

Table 2: Distribution of the respondents by gender

Gender	Frequency	Percent
Boy	130	57.5
Girl	96	42.5
Total	226	100.0

Table-2 displays the gender breakdown of the study participants (N = 226). Among the total sample, 130 respondents (or 57.5% of the total) identified as boy. Conversely, 96 girls (or 42.5% of the total) make up the sample. There were somewhat more male than female who took part in the study.

Table 3: Distribution of the respondents by sociodemographic variables

Variables	Frequency	Percentage
Subject's Education		
Primary	56	24.8
Junior Secondary	138	61.1
Secondary	12	5.3
Higher Secondary	20	8.8
Parent's Monthly Income		
15000-20000	23	10.2
20001-40000	20	8.8
>40000	183	81.0
Guardian's Education		
Primary	58	25.7
Secondary	155	68.6
Tertiary	13	5.8
Family type		
Nuclear	201	88.9
Joint	25	11.1
Living Area		
Urban	210	92.9
Rural	16	7.1

Table-3 shows that 138 (61.1%) of the respondents were in junior secondary education, 56 (24.8%) were in primary education, 20 (8.8%) were in higher secondary education, and 12 (5.3%) were in secondary education. According to the data, 81.0% of parents earn more than forty thousand taka per month, 10.2% earn between fifteen and twenty thousand taka per month, and 8.8% earn less than forty thousand taka per month.

A total of 25.7% of the guardians had secondary education, 25.7% had primary education, and 5.8% had tertiary education. This table indicates that 201 (88.9%) of the respondents lived in a nuclear family, whereas 25 (11.1%) lived in a joint family. According to this table, 210 (92.9%) families reside in an urban area, and 16 (7.1%) reside in a rural area.

The majority of participants were enrolled in junior secondary education (61.1%), were from high-income families (81%), resided in urban areas (92.9%), and originated from nuclear families (88.9%). Furthermore, 76.1% possessed a high socioeconomic position. The sample reflects an urban, relatively affluent demographic, which may account for increased exposure to sedentary behaviors and energy-dense diets—primary factors in overweight and obesity.

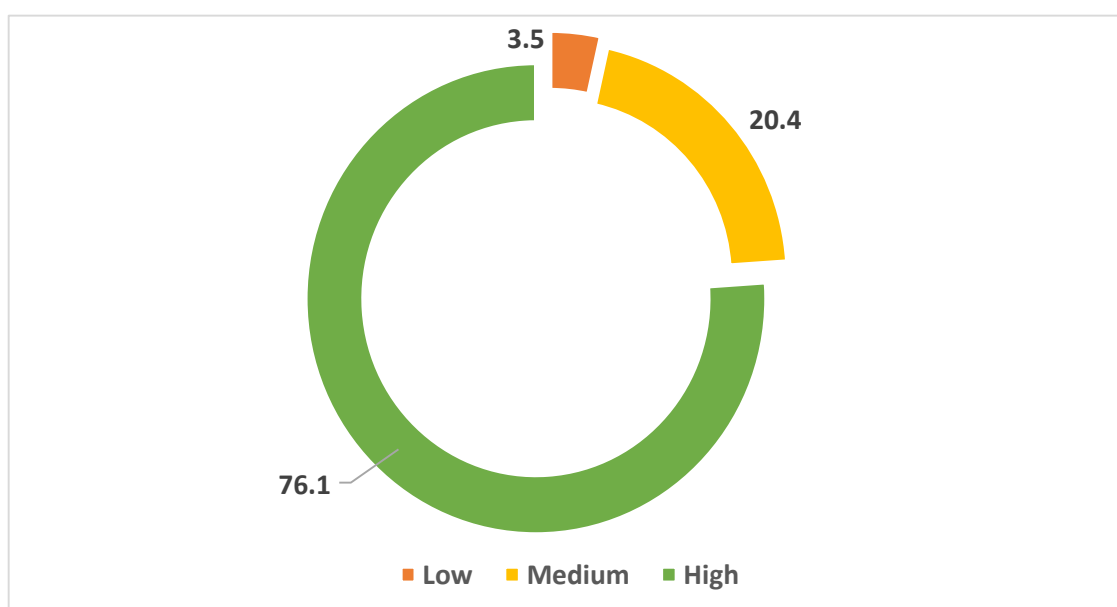


Figure 1: Distribution of the respondents by socioeconomic status

Figure 1 shows that 172 (76.1%) respondents had good socioeconomic status, 46 (20.4%) respondents had medium socioeconomic status, and 8 (3.5%) respondents had low socioeconomic status. (Ref: World Health Organization. The Asia Pacific Perspective-Redefining Obesity and Its treatment. Geneva WHO, 2000)

Table 4: Distribution of the respondents according to consumption of beef

Beef Item	Frequency	Percent
More than once per day	2	.9
Once per day	3	1.3
3-6 times per week	33	14.6
Once or twice per week	106	46.9
Once per month or less	38	16.8
Never	44	19.5
Total	226	100.0

The data presented in the table above reveals that out of the 106 individuals who reported consuming beef once or twice per week, 38 (16.8%) and 33 (14.6%) eaten beef once per month or less and three to six times per week, respectively. Three of the respondents, or 1.3%, had eaten beef at least once each day, while two of the respondents, or 0.9%, had eaten more than once per day. The remaining 19.5% of the respondents had not had any beef at all.

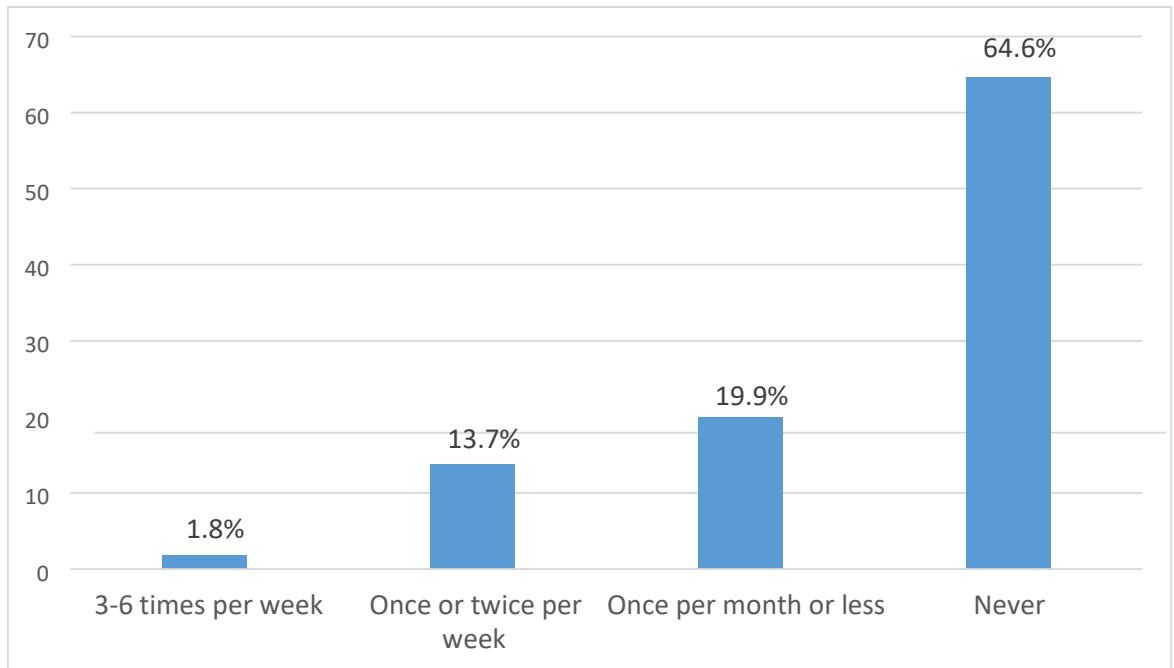


Figure 2: Distribution of the respondents according to consumption of mutton

Figure-2 represents that 146 (64.6%) of the respondents do not take mutton at all, and 45 (19.9%) of them take mutton once per month or less. Thirty-one (13.7%) of the respondents consumed mutton once or twice per week, and only 4 (1.8%) of them consumed mutton 3-6 times per week.

Table 5: Distribution of the respondents according to consumption of chicken

Chicken Item	Frequency	Percent
More Than Once Per Day	18	8.0
Once Per Day	18	8.0
3-6 Times Per week	128	56.6
Once or Twice per week	55	24.3
Once per month or less	7	3.1
Total	226	100.0

Table 5 presents the distribution of respondents according to their frequency of chicken consumption (N = 226). Most of the people who answered said they ate chicken three to six times a week, which is 128 people (56.6%). This shows that most of the people who answered regularly eat chicken.

A significant number of respondents, 55 individuals (24.3%), indicated that they consume chicken once or twice weekly, signifying moderate consumption. Daily eating was less common; 18 people (8.0%) ate chicken once a day, and the same number (8.0%) ate it more than once a day.

Only a small number of people, 7 (3.1%), said they ate chicken once a month or less. This suggests that infrequent consumption is not common in this group. The results show that chicken is a common source of protein, with most people eating it several times a week.

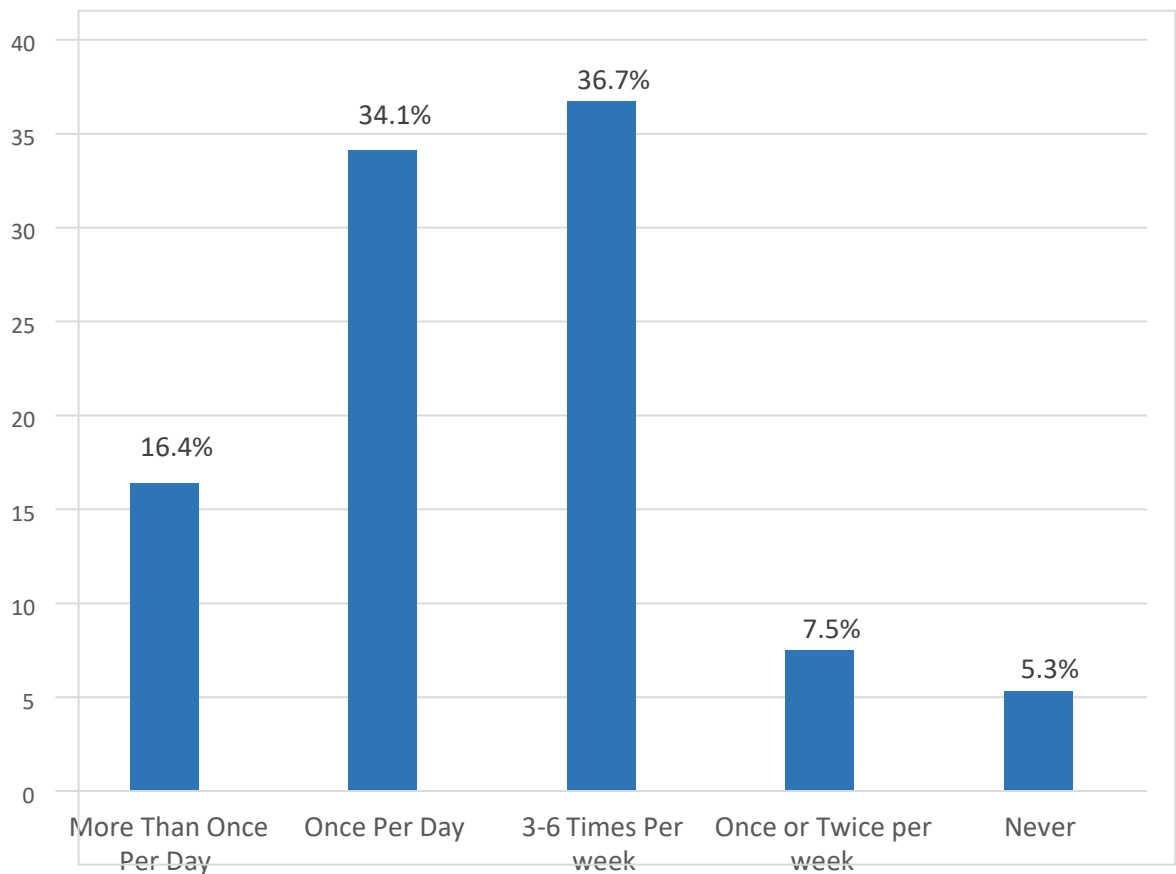


Figure 3: Distribution of the respondents according to consumption of fish

Figure 3 illustrates the distribution of respondents according to their percentage of fish consumption (N = 226). It was shown that approximately 83 (36.7%) of the respondents consumed fish 3-6 times per week, and 77 (34.1%) of the respondents consumed fish once per day. Thirty-seven (16.4%) and 17 (7.5%) of them consumed fish more than once per day or once or twice per week, respectively, and 12 (5.3%) never consumed fish.

Table 6: Distribution of the respondents according to consumption of egg

Eggs Item	Frequency	Percent
More Than Once Per Day	21	9.3
Once Per Day	133	58.8
3-6 Times Per week	33	14.6
Once or Twice per week	31	13.7
Once per month or less	8	3.5
Total	226	100.0

Table 6 presents the distribution of respondents according to their frequency of egg consumption (N = 226). Most of the people who took part (133, or 58.8%) said they ate eggs once a day. This shows that eggs are a common part of most people's daily diets. A smaller number of respondents, 21 (9.3%), said they ate eggs more than once a day, which shows that they ate a lot of them. Meanwhile, 33 people (14.6%) ate eggs 3–6 times a week, and 31 people (13.7%) said they ate them once or twice a week. This suggests that these groups ate eggs in moderate amounts.

Only a small number of participants, 8 people (3.5%), said they ate eggs once a month or less. This shows that eating eggs infrequently is not common. In general, the results show that most of the people who answered the survey eat eggs often and in large amounts.

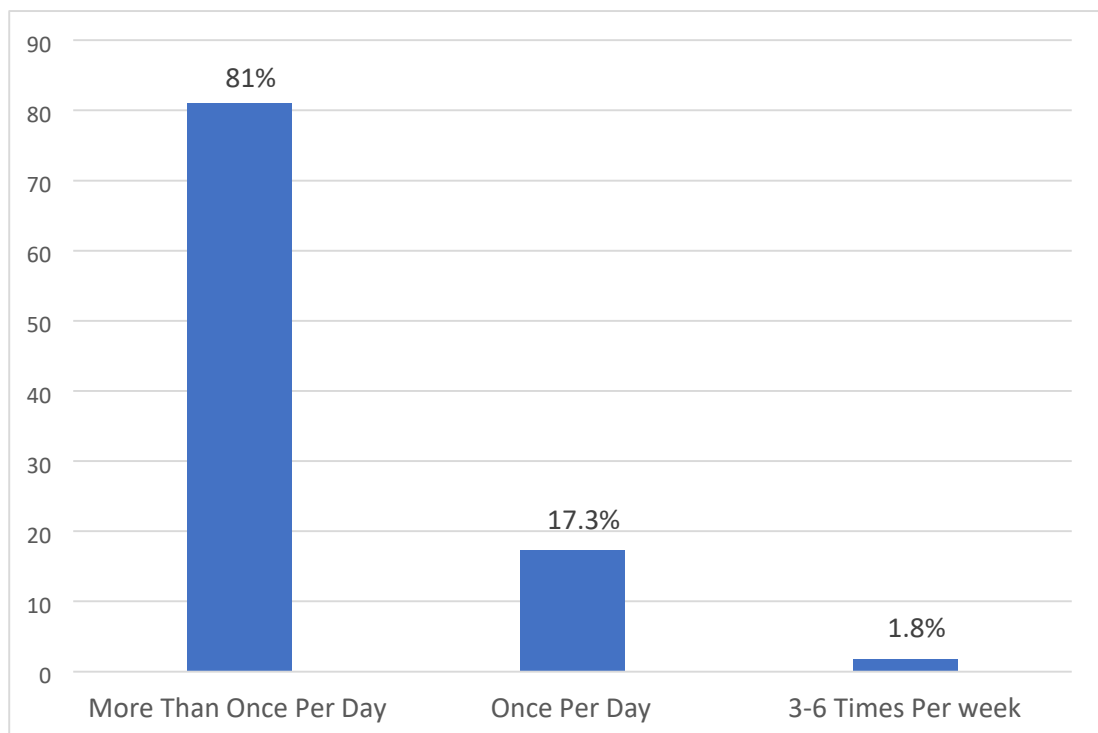


Figure 4: Distribution of the respondents according to consumption of rice

According to the data presented in figure 4, the majority of the respondents, amounting to nearly 183 (81%) of them, ingested rice on a daily basis. A total of 39 patients, or 17.3 percent, ingested rice on a daily basis. It is remarkable that four of the respondents, or 1.8%, ingested rice three to six times each week.

Table 7: Distribution of the respondents according to consumption of bread

Bread Item	Frequency	Percent
More Than Once Per Day	27	11.9
Once Per Day	130	57.5
3-6 Times Per week	10	4.4
Once or twice per week	14	6.2
Once per month or less	19	8.4
Never	26	11.5
Total	226	100.0

The table shows that 26 (11.5%) of the respondents did not consume bread at all. A total of 130 (57.5%) of the respondents brewed once per day. The other 27 (11.9%) and 19 (8.4%) of the respondents consumed bread more than once per day and once per month or less, respectively.

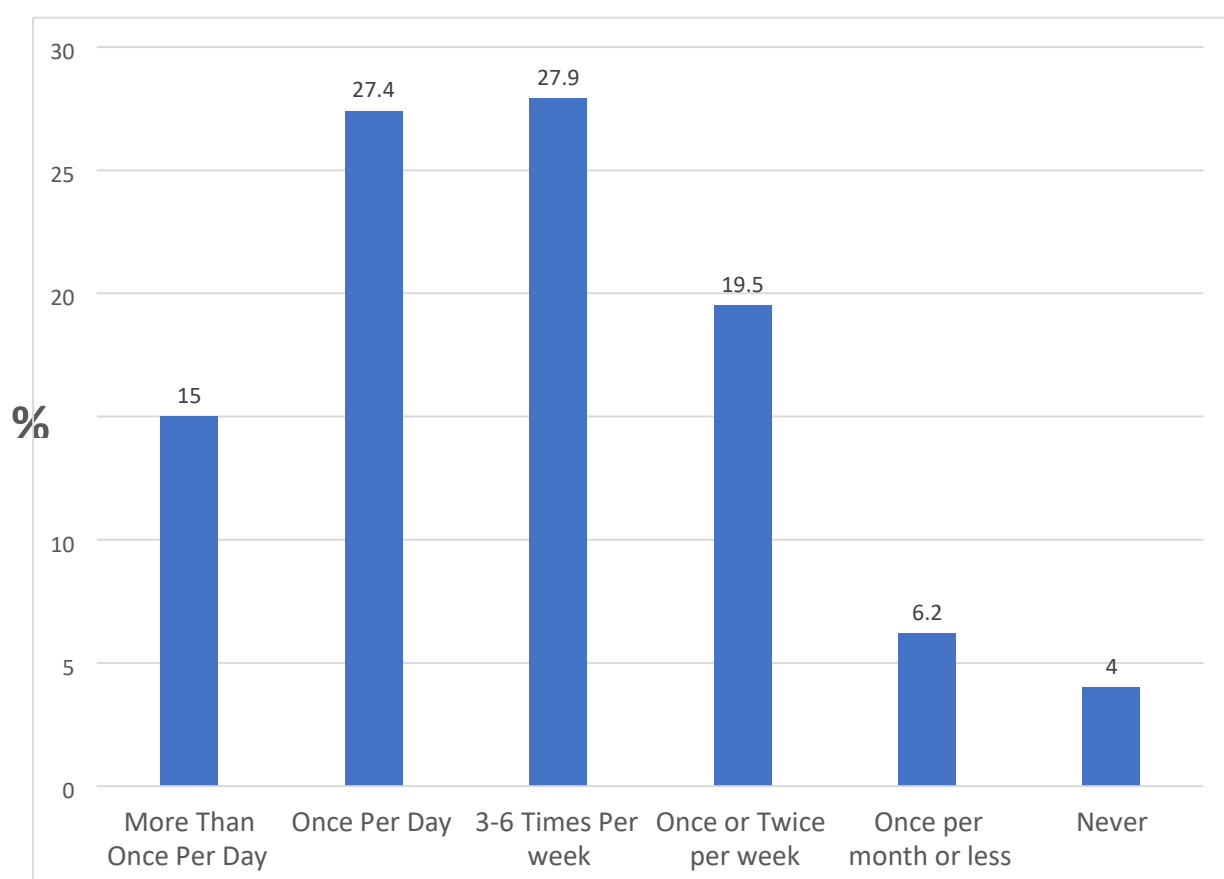


Figure 5: Distribution of the respondent's consumption pattern of pulse & legumes

Figure 5 shows that approximately 63 (27.9%) of the respondents took pulse and legumes 36 times per week. Sixty-two (27.4%) and 44 (19.5%) of the respondents took pulses and legumes once per day and once or twice per week, respectively.

Table 8: Distribution of the respondents according to their consumption of nuts

Nuts Item	Frequency	Percent
Once Per Day	41	18.1
3-6 Times Per week	29	12.8
Once or Twice per week	35	15.5
Once per month or less	49	21.7
Never	72	31.9
Total	226	100.0

Table 8 presents the distribution of respondents according to their different nuts consumption. The results show that a large number of participants, 72 (31.9%), said they never ate nuts. This was the largest group in the distribution.

Of the people who do eat nuts, 49 (21.7%) said they only eat them once a month or less. This suggests that a large part of the population doesn't eat them very often. Regular patterns of eating nuts were less common. Only 41 people (18.1%) ate nuts once a day, 29 people (12.8%) ate nuts 3–6 times a week, and 35 people (15.5%) ate nuts once or twice a week. The results show that nuts are not a common food for the people who answered the survey. A large number of them either rarely or never eat them.

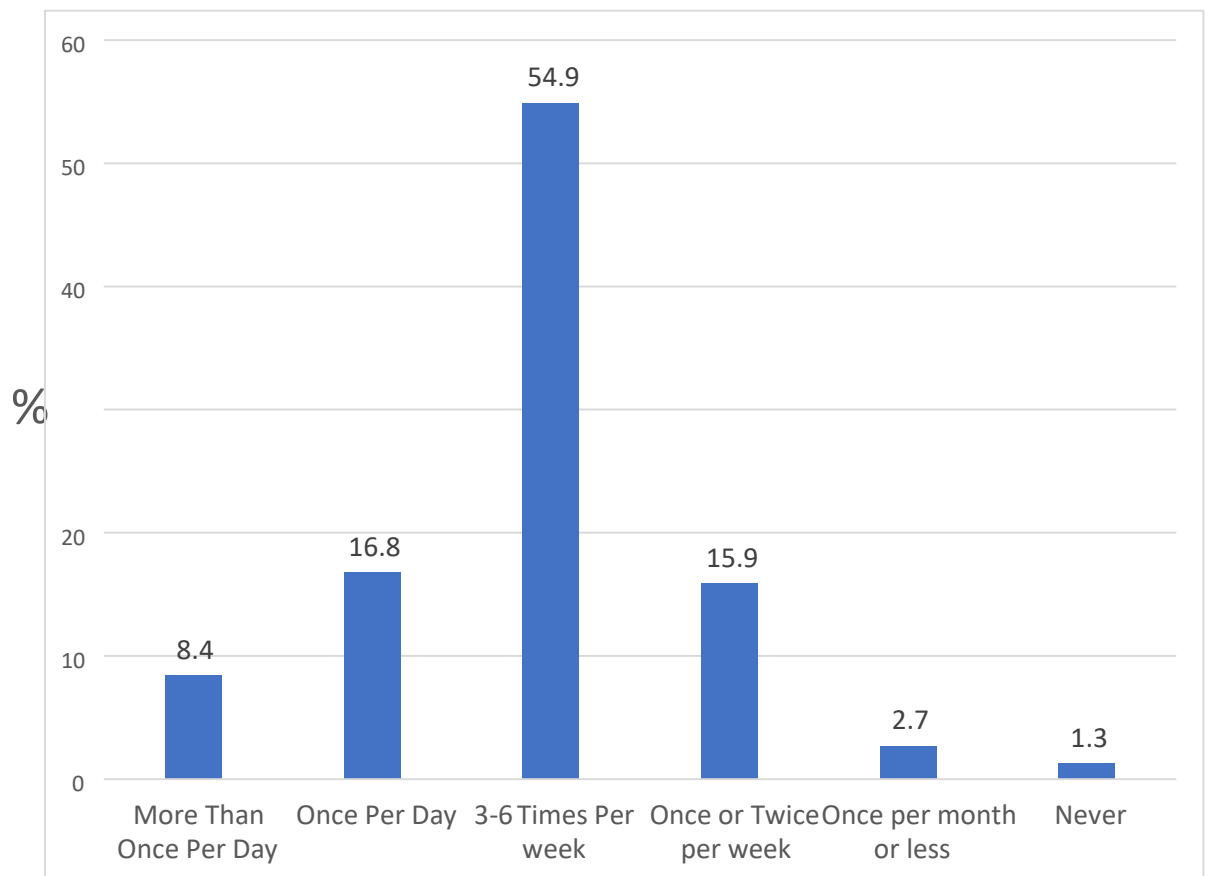


Figure 6: Distribution of the respondent's consumption pattern of vegetables

The figure 6 shows that most of the respondents (124, 54.9%) consumed vegetables 3--6 times per week, whereas 38 (16.8%) and 36 (15.9%) of the respondents consumed vegetables once per day and once or twice per week, respectively.

Table 9: Distribution of the respondents according to consumption of fruits

Fruits items	Frequency	Percent
Once Per Day	13	5.8
3-6 Times Per week	56	24.8
Once or Twice per week	133	58.8
Once per month or less	22	9.7
Never	2	0.9
Total	226	100.0

The above table 9 shows that approximately 133 (58.3%) of the respondents had fruits once or twice per week. A total of 56 (24.8%) and 22 (9.7%) of the respondents consumed fruits 3-6 times per week and once per month or less, respectively.

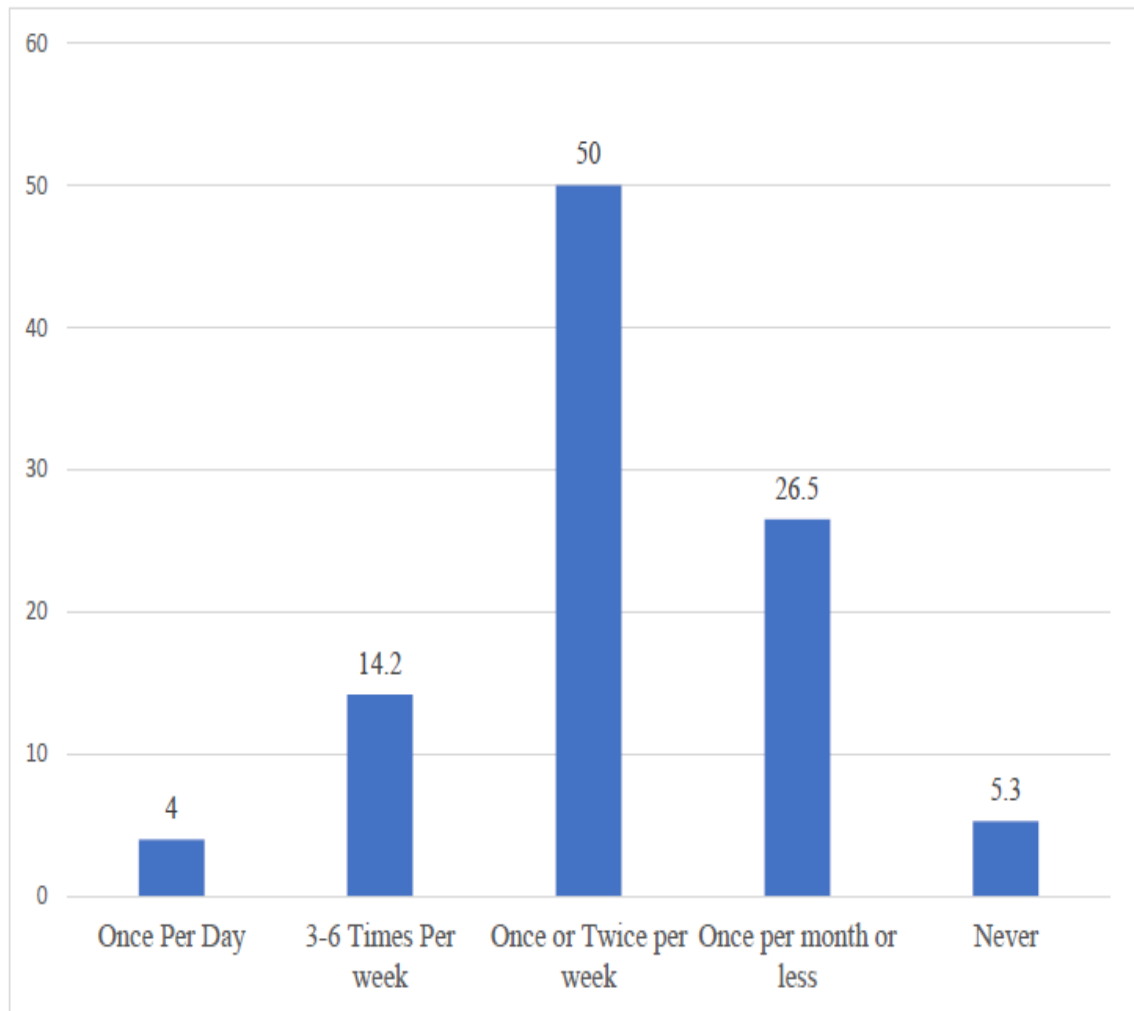


Figure 7: Distribution of the respondents according to their consumption of milk and milk products

The figure 7 shows that 113 (50%) of the respondents consumed milk and milk products once or twice per week. Sixty (26.5%) and 32 (14.2%) of the respondents consumed milk and milk products once per month or less and 3--6 times per week, respectively. Only 9 (4%) of the respondents consumed milk and milk products daily.

Table 10: Distribution of the respondents according to consumption of the fast-food item

Fast food Item	Frequency	Percent
More Than Once Per Day	45	19.9
Once Per Day	59	26.1
3-6 Times Per week	32	14.2
Once or Twice per week	54	23.9
Once per month or less	27	11.9
Never	9	4.0
Total	226	100.0

The table-10 shows that 59 (26.1%) of the respondents had fast food once per day. Fifty-four (23.9%) and 45 (19.9%) of the respondents ate fast food once or twice per week or more than once per day, respectively. The other 32 (14.2%) and 27 (11.9%) participants consumed fast food 3-6 times per week and once per month or less, respectively. Amazingly, only 9 (4%) of the respondents did not consume fast food at all.

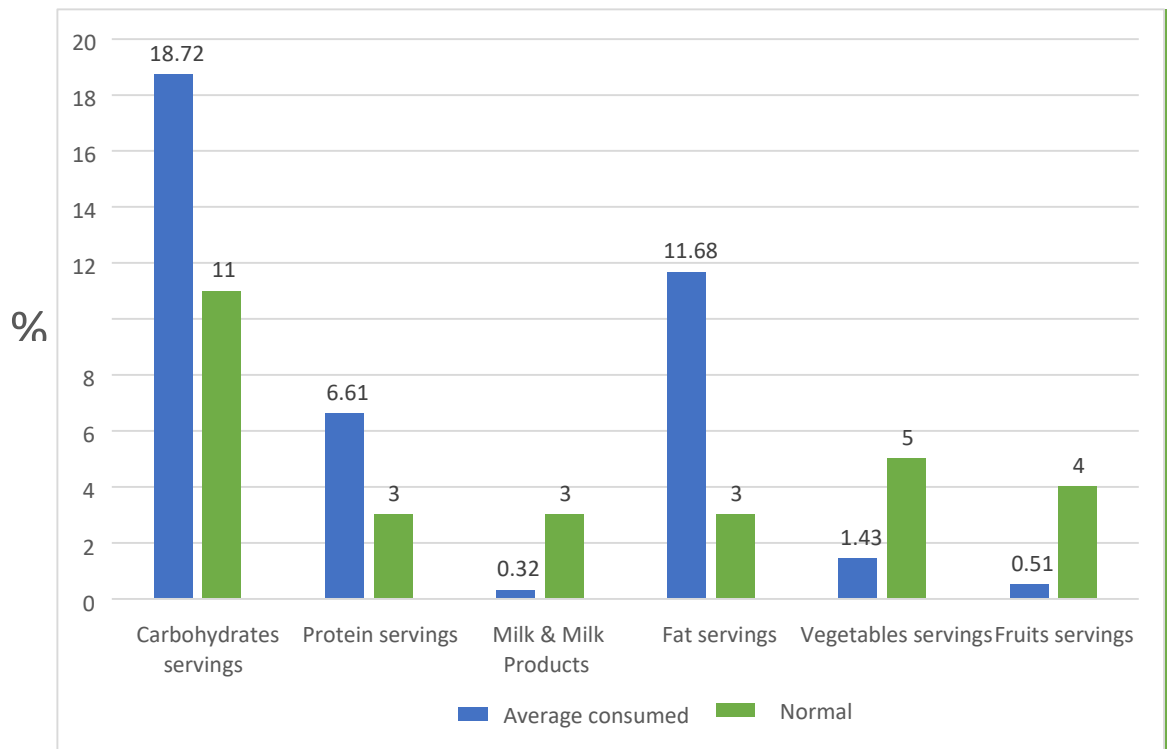


Figure 8: Distribution of the respondents according to their food recall

From the figure 8, it was observed that most of the respondents had consumed food as they recalled by servings on average. Carbohydrate servings were 18.72, which is high, with up to 11 servings; protein servings were 6.61, which is high, with up to 3 servings being normal; milk and milk product servings were 0.32, which is low, with up to 3 servings being normal; fat servings were 11.68, which is high, with up to 3 servings being normal; vegetable servings were 1.43, which is low, with up to 3 servings being normal; and fruit servings were 0.51, which is low, with up to 3 servings being normal.

**Table 11: Consumption of calories, carbohydrates, protein and fat in grams
before intervention**

Group Age	Calorie (kcal)	Carbohydrate (gram)	Protein (gram)	Fat (gram)
10-14 years (n=170)	2424.94	219.90	107.53	158.95
15-17 years (n=36)	2549.56	263.03	80.27	130.03
≥18 (n=170)	2614.55	232.19	98.81	161.14
Total (n=226)	2461.57	227.85	102.41	154.54

Table 11 illustrates the distribution of respondents by age group for their average intake of calories, carbs, protein, and fat prior to the intervention (N = 226).

In the cohort of responders aged 10–14 years (n = 170), the average daily consumption was 2424.94 kcal for energy, 219.90 g of carbohydrates, 107.53 g of protein, and 158.95 g of fat. Conversely, participants aged 15–17 years (n = 36) had rather diverse consumption amounts of nutrients. The published values demonstrate increased calorie intake in this age group, alongside variations in macronutrient distribution, especially in carbohydrate and fat consumption. The aggregate sample (N = 226) had a mean calorie consumption of 2461.57 kcal, along with 227.85 g of carbohydrates, 102.41 g of protein, and 154.54 g of fat.

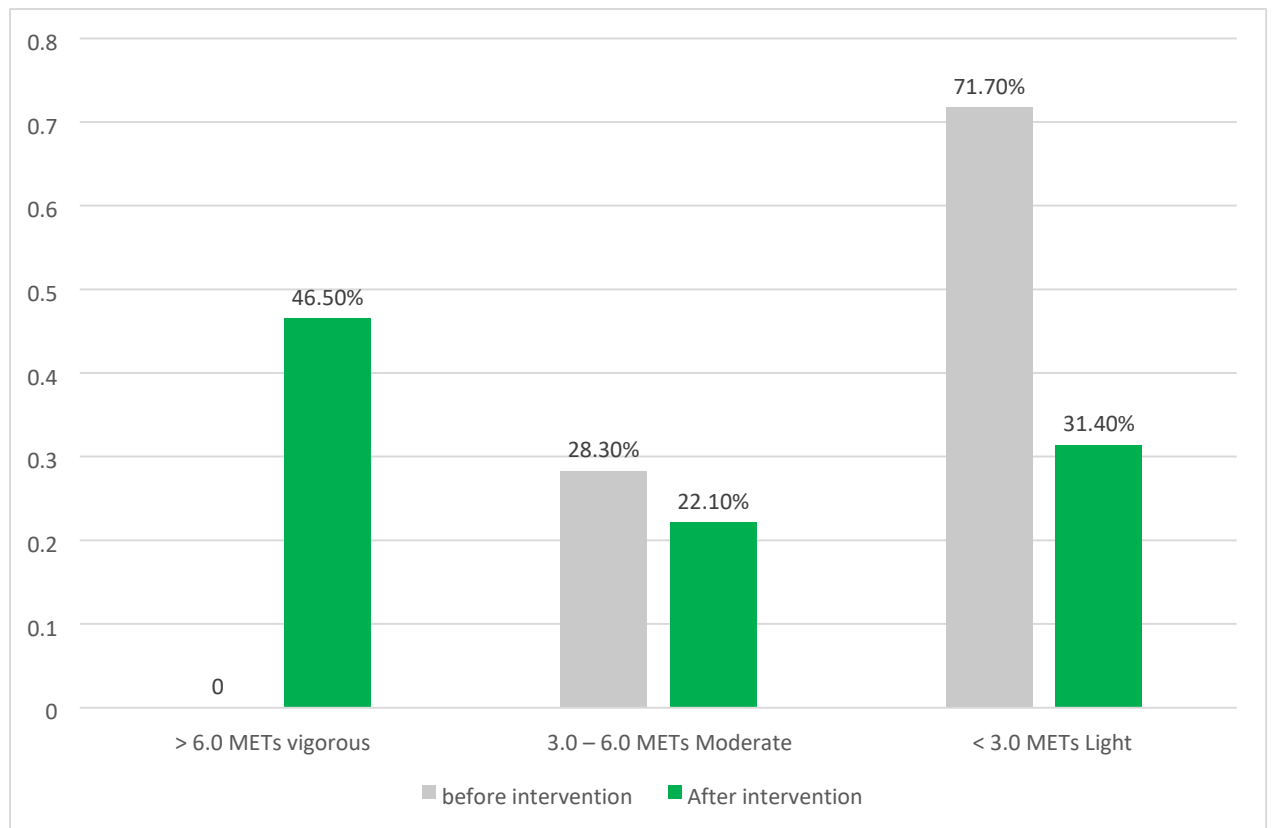


Figure 9: Respondent's physical activities before and after intervention

Figure 9 shows that, before the intervention, 162 (71.70%) of the respondents had low physical activity levels, 64 (28.30%) had moderate physical activity levels, and none had vigorous activity. After the intervention, 105 (46.50%) of the respondents had high physical activity levels, 71 (31.40%) had low physical activity levels, and 50 (22.10%) had moderate physical activity levels.

Table 12: Paired sample t-test of physical activity level by metabolic equivalent tasks (METs) before and after intervention

Paired Samples	Mean $\pm$ SD	t- value	p- value Sig. (2-tailed)
Physical activity after intervention	6.32 $\pm$ 3.52	19.03	0.000
Physical activity before intervention	2.47 $\pm$ 1.36		

Table 12 presents the comparison of respondents' physical activity levels, measured in metabolic equivalent tasks (METs), before and after the intervention using a paired *t*-test (*n* = 226). The mean physical activity level **after the intervention** was 6.32 $\pm$ 3.52 METs, which is substantially higher than the mean value **before the intervention**, recorded at 2.47 $\pm$ 1.36 METs. This indicates a marked increase in physical activity following the intervention. The paired *t*-test result shows a *t*-value of 19.03 with a corresponding *p*-value of 0.000 (*p* < 0.001), demonstrating that the observed difference is statistically highly significant.

Overall, the findings suggest that the intervention had a significant positive effect on improving the physical activity levels of the respondents.

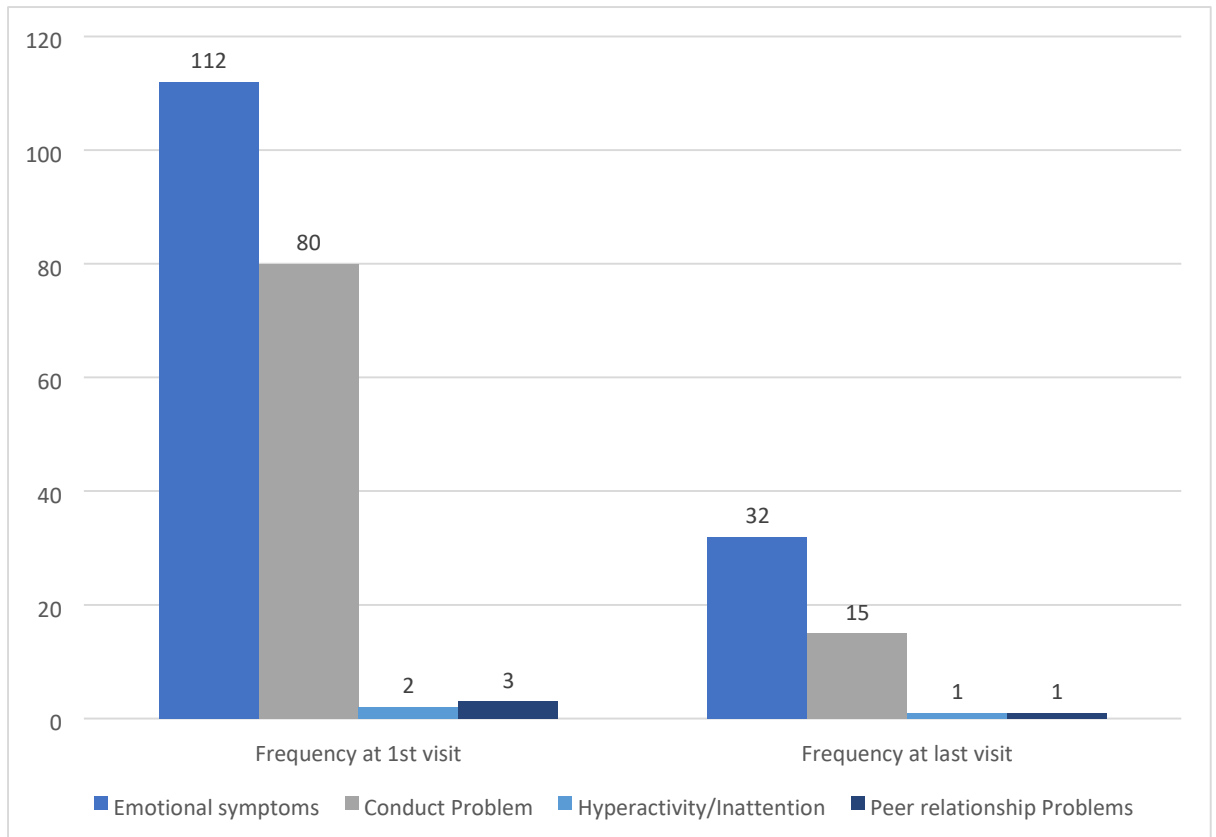


Figure 10: Distribution of the respondents by statistics of the SDQ total score at the 1st visit and the SDQ total score at the last visit

The figure 10 shows that 112 respondents had emotional symptoms at the 1st visit, whereas only 32 had emotional symptoms at the last visit according to the total SDQ score. Eighty respondents had conducted problems at the 1st visit, whereas only 15 had conducted problems at the last visit according to the statistics of SDQ total score. Two respondents reported hyperactivity/inattention at the 1st visit, while only 1 reported hyperactivity/inattention at the last visit according to the total SDQ score. Three respondents had peer relationship problems at the 1st visit, while only 1 had peer relationship problems at the last visit according to the total SDQ score.

Table 13: Paired sample t-test of total score of Strengths and Difficulties Questionnaire (SDQ) at the 1st visit and at the last visit

Paired Samples	Mean $\pm$ SD	t- value	p- value Sig. (2-tailed)
SDQ total score at 1 st visit	26.19 $\pm$ 3.45	45.33	0.000
SDQ total score at last visit	16.25 $\pm$ 2.36		

Significance, $p = <0.05$

The table shows a significant ($p= 0.000$) change in the total score of the Strengths and Difficulties Questionnaire (SDQ) between the 1st visit and the last visit, with a t value of 45.33. The mean total score of the Strengths and Difficulties Questionnaire (SDQ) at the 1st visit was 26.19, which decreased to 16.25 at the last visit.

Table 14: Respondents average BMI according to follow-up visit in accordance with age group in mean $\pm$ SD

Group Age (N=226)	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
10-14 years	25.22 $\pm$ 2.64	24.71 $\pm$ 2.69	24.26 $\pm$ 2.66	23.88 $\pm$ 2.66	23.54 $\pm$ 2.65
15-17years	27.21 $\pm$ 3.00	26.72 $\pm$ 3.10	26.32 $\pm$ 3.19	25.85 $\pm$ 3.21	25.51 $\pm$ 3.18
18-19 years	27.20 $\pm$ 4.14	26.68 $\pm$ 4.36	26.25 $\pm$ 4.36	25.95 $\pm$ 4.33	25.74 $\pm$ 4.24
Total	25.71 $\pm$ 2.97	25.20 $\pm$ 3.05	24.76 $\pm$ 3.05	24.38 $\pm$ 3.05	24.05 $\pm$ 3.03

Table 14 presents the distribution of respondents by average Body Mass Index (BMI) across five follow-up visits according to age group (N = 226), expressed as mean $\pm$ standard deviation. Among respondents aged **10–14 years**, the mean BMI shows a consistent decreasing trend over time, declining from 25.22 $\pm$ 2.64 at the 1st visit to 23.54 $\pm$ 2.65 at the 5th visit. A similar pattern is observed among those aged **15–17 years**, where the mean BMI decreased from 27.21 $\pm$ 3.00 at baseline to 25.51 $\pm$ 3.18 at the 5th visit.

For respondents aged **18-19 years**, the mean BMI also gradually declined from 27.20 $\pm$ 4.14 at the 1st visit to 25.74 $\pm$ 4.24 at the final follow-up. Overall, the total sample exhibited a steady reduction in mean BMI across successive visits, decreasing from 25.71 $\pm$ 2.97 at the 1st visit to 24.05 $\pm$ 3.03 at the 5th visit.

These findings indicate a consistent downward trend in BMI across all age groups over the follow-up period, suggesting a positive impact of the intervention in reducing body mass index among the respondents.

Table 15: Distribution of study subjects by age at the 1st visit according to BMI

Group Age 1st visit	Overweight	Obese
10-14 years (n=170)	124	46
15-17years (n=36)	12	24
18-19 Years (n=20)	9	11
Total (n=226)	145	81
Pearson Chi-Square test- Significance (2-sided) = 0.000 (N=226)		

Significance, $p = <0.05$

Table 15 shows that the number of overweight and obese subjects at the 1st visit varies by age group as follows: 10--14 years of age group-Overweight 124 and obese 46; 15-17 years of age group-Overweight 12 and obese 24; and 18 years of age group-Overweight 9 and obese 11.

Table 16: Distribution of study subjects by age at the 2nd visit according to BMI

Group Age 1st visit	Normal	Overweight	Obese
10-14 years (n=170)	50	74	46
15-17years (n=36)	0	16	20
18-19 Years (n=20)	4	5	11
Total (n=226)	54	95	77
Pearson Chi-Square test- Significance (2-sided) = 0.000 (N=226)			

Significance, $p = <0.05$

Table 16 shows that among study subjects at 2nd visit by the age group of 10-14 years old, normal 50, overweight 74, obese 46; 15-17years old, normal 0, overweight 16, obese 20; and ≥ 18 years old, normal 4, overweight 5 and obese 11.

Table 17: Distribution of study subjects by the age of respondent's 3rd visit to BMI

Group Age 3rd visit	Normal	Overweight	Obese
10-14 years (n=170)	90	38	42
15-17years (n=36)	6	12	18
18-19 Years (n=20)	9	0	11
Total (n=226)	105	50	71
Pearson Chi-Square test- Significance (2-sided) = .000 (N=226)			

Significance, $p = <0.05$

From the table 17, it can be seen that, among study subjects at 3rd visit by the age group of 10-14 years old, normal 90, overweight 38, obese 42; 15-17years old, normal 6, overweight 12, obese 18; and ≥ 18 years old, normal 9, overweight 0 and obese 11.

Table 18: Distribution of respondents by the age of respondent's 4th visit to BMI

Group Age 3rd visit	Normal	Overweight	Obese
10-14 years (n=170)	106	26	38
15-17years (n=36)	6	12	18
18-19 Years (n=20)	9	1	10
Total (n=226)	121	39	66
Pearson Chi-Square test- Significance (2-sided) = 0.000 (N=226)			

Significance, $p = <0.05$

Table 18 presents the distribution of study subjects by age group according to BMI categories at the 4th visit (N = 226). Among respondents aged 10–14 years (n = 170), the majority were classified as normal weight (106), while 26 were overweight and 38 were obese. In the 15–17 years age group (n = 36), a smaller proportion fell within the normal category (6), whereas 12 were overweight and a notably higher number, 18 respondents, were classified as obese. For respondents aged 18-19 years (n = 20), 9 individuals were in the normal weight category, 1 was overweight, and 10 were obese, indicating a relatively high prevalence of obesity in this group.

Overall, out of the total sample (N = 226), 121 respondents were classified as normal weight, 39 as overweight, and 66 as obese.

The Pearson Chi-square test revealed a statistically significant association between age group and BMI category at the 4th visit ($p = 0.000$; $p < 0.001$). This suggests that BMI status is significantly related to age group, with higher proportions of overweight and obesity observed among older adolescents and adults compared to younger participants.

Table 19: Distribution of study subjects by age from the 5th visit to BMI

Group Age 5th visit	Normal	Overweight	Obese
10-14 years (n=170)	132	18	20
15-17years (n=36)	18	2	16
18-19 Years (n=20)	10	2	8
Total (n=226)	121	39	66
Pearson Chi-Square test- Significance (2-sided) = 0.000 (N=226)			

Significance, $p = <0.05$

From the table 19, it can be seen that, among study subjects at 5th visit by the age group of 10-14 years old, normal 132, overweight 18, obese 20; 15-17years old, normal 18, overweight 2, obese 16; and ≥ 18 years old, normal 10, overweight 2 and obese 8.

Table 20: BMI changes between the 1st and 5th visit in the paired samples t-test, in the paired group after the intervention of dietary counseling and physical activity

Paired Samples t Test					
Interventions	Paired group	Paired Differences		t	p- value
		Mean	Std. Deviation		
Dietary counseling	1 st Visit	25.71	2.97	22.577	.000
	2 nd Visit	25.20	3.05		
	2 nd Visit	25.20	3.05	27.422	.000
	3 rd Visit	24.77	3.05		
Physical activity	3 rd Visit	24.77	3.05	24.722	.000
	4 th Visit	24.38	3.05		
	4 th Visit	24.38	3.05	22.071	.000
	5 th Visit	24.06	3.03		

Table 20 presents the distribution of respondents by the differences in mean BMI across successive visits, analyzed using paired samples t-tests to assess the impact of dietary counseling and physical activity interventions (N = 226).

Under dietary counseling, a significant reduction in BMI is observed between the 1st visit (25.71 ± 2.97) and the 2nd visit (25.20 ± 3.05), with a t-value of 22.577 and a p-value of 0.000 ($p < 0.001$). Similarly, the comparison between the 2nd visit (25.20 ± 3.05) and the 3rd visit (24.77 ± 3.05) shows a further statistically significant decrease in BMI ($t = 27.422$, $p < 0.001$).

In terms of physical activity, the results also demonstrate a continuous and significant decline in BMI. The comparison between the 3rd visit (24.77 ± 3.05) and the 4th visit (24.38 ± 3.05) yields a t-value of 24.722 ($p < 0.001$). Likewise, a further significant reduction is observed between the 4th visit (24.38 ± 3.05) and the 5th visit (24.06 ± 3.03), with a t-value of 22.071 ($p < 0.001$).

Overall, all paired comparisons show statistically highly significant reductions in BMI ($p = 0.000$; $p < 0.001$), indicating that both dietary counseling and increased physical activity had a strong and cumulative effect in reducing BMI among the respondents over time.

Table 21: Distribution of the respondents by BMI at all visits

BMI	1st Visit	2nd Visit	3rd Visit	4th Visit	5th Visit
Normal (18.5-22.9)	0	54	105	121	160
Overweight (23.0-24.9)	145	95	50	39	22
Obese (≥ 25)	81	77	71	66	44
Total	226	226	226	226	226

Table 21 shows that, before the intervention at the 1st visit, 145 respondents were overweight, and 81 respondents were obese according to their BMI. Gradually, the respondents gradually returned to having a normal BMI and lost weight after the intervention. After intervention at the 5th follow-up visit, according to BMI, 160 patients became normal, 22 were overweight, and 44 remained obese. BMI was categorized into groups according to the Asian–Pacific cutoff points.

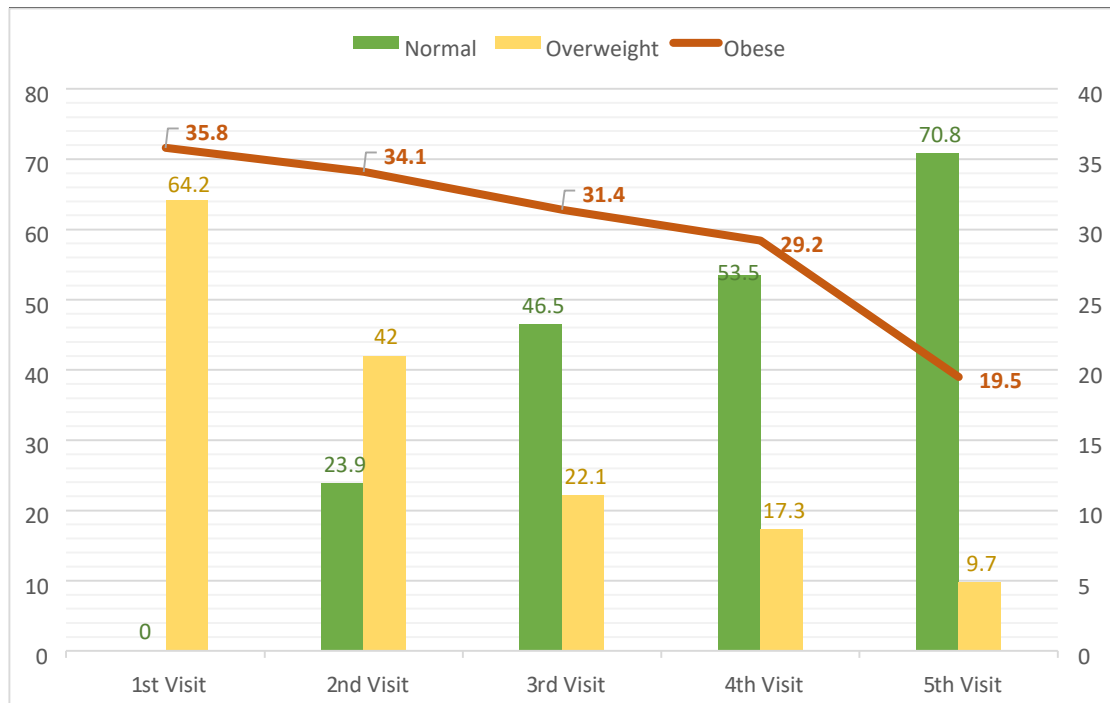


Figure 11: Distribution of the respondents by BMI at all visits

Figure 11 shows that, before the intervention at the 1st visit, 64.2% of the respondents were overweight, and 35.8% of the respondents were obese according to their BMI. Gradually, the respondents gradually returned to having a normal BMI and lost weight after the intervention. After intervention at the 5th follow-up visit, 70.8% of the participants were normal, 9.7% were overweight, and 19.5% remained obese. BMI was categorized into groups according to the Asian–Pacific cutoff points.

Part-2: Qualitative Findings based on Case Study and FGD

Case Study I: Shafin (Pseudonym)

Shafin, a 16-year-old boy, student of Class X from an urban, socioeconomically solvent family in Dhaka, attended the adolescent outpatient department of Bangladesh Shishu Hospital & Institute due to excessive weight. At baseline, his weight was 85 kg and height 165 cm, resulting in a BMI of 31 kg/m², indicating obesity. He had a family history of diabetes and reported unhealthy dietary habits, including frequent intake of rice-based meals, fried foods, snacks (chips, pizza, biscuits), and soft drinks. His lifestyle was predominantly sedentary, with excessive video gaming, minimal physical activity, and poor social interaction. He also experienced bullying at school, which negatively affected his psychological well-being and academic performance.

Following a comprehensive intervention of dietary counseling, a structured diet plan, psychological support, and recommendations for regular physical activity, he was monitored over five follow-up visits across 15 months. A steady reduction in BMI was observed (31.2 to 22.71 kg/m²), indicating a transition from obesity to normal nutritional status.

In addition to physical improvement, significant behavioral and psychosocial changes were noted. He adopted regular exercise such as swimming and football, reduced screen time, improved peer relationships, and gained confidence. This case highlights the effectiveness of a holistic, multidisciplinary approach in managing adolescent obesity. The details case study was attached in Appendix-3 section.

Case Study II: Ratul (Pseudonym)

Ratul, a 14-year-old student of Class VIII from an urban, high socioeconomic background, presented with obesity (weight: 89.5 kg; height: 170 cm; BMI: 30.5 kg/m²). Despite being previously active and academically competent, he developed unhealthy dietary habits from early childhood, including frequent consumption of fast foods (burgers, pizza, chips) and fatty items, encouraged by parental indulgence. Over time, excessive screen exposure (mobile games, television, social media) replaced physical activity, leading to progressive weight gain.

As obesity increased, Ratul experienced fatigue, declining academic performance, social withdrawal, and an emerging inferiority complex. Concerned about these changes, his parents sought professional support. Baseline assessment revealed poor dietary patterns and high sedentary behavior.

A structured intervention was implemented, including dietary counseling, a personalized diet chart, behavioral modification strategies, and encouragement of regular physical activities such as cycling, cricket, and walking. Follow-up visits were conducted regularly over 15 months.

Gradual improvement was observed, with BMI decreasing from 30.5 to 27.5 kg/m². Alongside physical changes, significant psychosocial improvements occurred. Ratul regained interest in sports, reduced screen dependency, improved peer interaction, and demonstrated better academic engagement.

Key findings indicate that obesity in adolescents can result from a combination of unhealthy diet, sedentary lifestyle, and parental influence. A multidisciplinary intervention approach led to sustained improvements in both physical and psychological health, emphasizing the importance of early lifestyle correction and family awareness. The details case study was attached in Appendix-3 section.

Case Study III: Raju (Pseudonym)

Raju, a 15-year-old Class IX student from an urban middle-income family, presented with obesity (weight: 85.6 kg; height: 160 cm; BMI: 30.2 kg/m²). He had a family history of diabetes, hypertension, and obesity. Since childhood, he developed unhealthy habits such as eating while watching television, high consumption of snacks, sweets, and fatty foods, along with low engagement in physical activity.

Raju also experienced significant psychosocial distress due to bullying by peers and lack of emotional support from family members. He was frequently mocked, leading to social isolation, reduced self-esteem, and symptoms of depression. His sedentary lifestyle, poor dietary habits, and psychological stress contributed to worsening obesity. Following enrollment in the study, Raju received integrated counseling involving a nutritionist and psychologist. A structured intervention including dietary modification and regular physical activities such as swimming, skating, and walking was implemented. Follow-up assessments were conducted over 15 months.

A gradual reduction in BMI was observed (30.2 to 26.8 kg/m²), along with marked improvements in mental health. Raju reported reduced depressive symptoms, increased confidence, improved peer relationships, and greater family support.

Key findings highlight that adolescent obesity is strongly influenced by behavioral, genetic, and psychosocial factors. Addressing psychological well-being alongside diet and physical activity is essential for successful intervention outcomes. The details case study was attached in Appendix-3 section.

Themes Emerging from Case Studies

A qualitative thematic analysis of the case studies revealed several recurring themes related to adolescent obesity and its management:

1. Unhealthy Dietary Practices and Parental Influence: All cases demonstrated a strong association between obesity and frequent consumption of fast food, high-fat diets, and energy-dense snacks. Parental attitudes particularly overfeeding and lack of awareness, played a critical role in shaping these behaviors.

2. Sedentary Lifestyle and Digital Addiction: Excessive screen time, including video games, television, and social media, was a consistent factor contributing to physical inactivity. This sedentary behavior significantly reduced opportunities for energy expenditure and worsened obesity.

3. Psychosocial Impact and Peer Influence: Participants commonly experienced bullying, social exclusion, and low self-esteem due to obesity. These factors led to psychological distress, including inferiority complex, withdrawal, and reduced academic performance.

4. Lack of Awareness and Delayed Intervention: Families often failed to recognize obesity as a health concern in its early stages. Cultural perceptions equating excess weight with good health contributed to delayed intervention.

5. Effectiveness of Multidisciplinary Intervention: Integrated interventions combining dietary counseling, physical activity, and psychological support resulted in significant improvements across all cases. Behavioral changes were sustained through regular follow-up and personalized guidance.

6. Positive Behavioral and Psychosocial Transformation: All adolescents demonstrated improved physical health, increased self-confidence, enhanced social interaction, and better quality of life following intervention.

The findings emphasize that adolescent obesity is a multifactorial condition, influenced by behavioral, environmental, familial, and psychological factors. Effective management requires a holistic, multidisciplinary approach, addressing both physical and mental health components.

Findings from the Focus Group Discussion (FGD)

1. FGD with Adolescents

The focus group discussion with adolescents (n=8; aged 12–18 years) revealed several critical insights into the behavioral, environmental, and psychosocial factors associated with overweight and obesity. Most participants belonged to urban, affluent, nuclear families and were studying in private schools. A predominant belief among participants was that obesity is largely hereditary and difficult to reverse, indicating a significant gap in awareness regarding lifestyle-based prevention and management.

Dietary patterns were characterized by frequent consumption of fast and ultra-processed foods, including pizza, burgers, and sugary snacks, with limited intake of home-cooked meals. Academic pressure and busy schedules contributed to irregular eating habits. In addition, sedentary behaviors were highly prevalent, with most adolescents spending leisure time on mobile phones, gaming, and social media, resulting in minimal physical activity.

Psychosocial challenges emerged as a major theme, as nearly all participants reported experiences of bullying by peers and, in some cases, family members. This contributed to social withdrawal, low self-esteem, and emotional distress. Consequently, many preferred isolations and developed introverted tendencies.

Following intervention including dietary counseling, promotion of regular physical activity, and psychological support—participants demonstrated significant improvements. After six months, reductions in BMI, increased engagement in outdoor activities, improved confidence, and better academic performance were observed. Overall, the findings highlight the importance of addressing both behavioral and psychosocial dimensions in adolescent obesity management. The details FGD with adolescents was attached in Appendix-4 section.

2. FGD with Parents

The focus group discussion with parents revealed that most participants belonged to urban, financially stable nuclear families, with children enrolled in private schools. Despite high socioeconomic status, there was a substantial lack of awareness regarding childhood obesity as a medical condition. Nearly all parents perceived excess weight as a sign of good health and were unaware that obesity could be prevented through balanced diet and regular physical activity.

Parental practices significantly contributed to unhealthy lifestyle patterns. The majority reported indulgent feeding behaviors, frequently providing fast foods, sugary snacks, and energy-dense meals based on children's preferences. Limited supervision of children's dietary intake and physical activity was evident, largely due to busy professional schedules. Additionally, high levels of screen exposure were common, with most children engaged in television, mobile gaming, and social media, leading to reduced physical activity.

Notably, many parents acknowledged a family history of obesity and believed it to be hereditary and unavoidable. Psychosocial aspects were also concerning, as some parents reported criticizing children's appearance, while others showed limited response to bullying experiences faced by their children.

Following counseling and intervention over several months, a majority of parents reported positive changes, including improved dietary habits, increased physical activity, and noticeable reductions in BMI. Children became more active, confident, and socially engaged. These findings emphasize the crucial role of parental awareness and involvement in effective obesity prevention and management among adolescents. The details FGD with parents was attached in Appendix-4 section.

CHAPTER -5

DISCUSSION

5 Discussion

Because of their link with a wide range of health complications, such as hypertension, insulin insensitivity, diabetes mellitus, cardiovascular disease, and different types of cancers in adulthood, overweight and obesity in children (0–12 years) and adolescents (13–19 years) are recognized as major public health issues worldwide (De Onis M, *et al.* 2012). Bangladesh is a highly populated developing country in South Asia that is undergoing rapid demographic changes and economic transitions (Ahsan Karar Z, *et al.* 2009 and Islam A, *et al.* 2014). From 165 million in 2009 to 218 million in 2050, the population is predicted to rise (Streatfield PK, *et al.* 2008). One-third (33%) of the children in Bangladesh were underweight according to a prevalence study data analysis of the Bangladesh Health and Demographic Survey in 2014 (Biswas T, *et al.* 2017). In young people (aged 6–15 years), a recent nationwide epidemiological survey revealed that 3.5% were obese, 9.5% were overweight, and 17.6% were underweight (Bulbul T, *et al.* 2014). These studies show that the background of obesity and overweight in Bangladesh could soon become a main public health concern (Chopra M, *et al.* 2002). According to this study, 42.5% were female, and 57.5% were male. A similar study reported rates of 37% for girls and 45% for boys with overweight or obesity in Greece (Health at a Glance. 2011: OECD). Among children and adolescents, 22.9% of boys and 21.4% of girls were overweight or obese; boys often show greater obesity or overweight than girls do. (Health at a Glance 2011: OECD). According to research among Dhaka schoolchildren between the ages of three and eighteen, A total of 17.9% are obese, and 23.6% are overweight (Mohsin F, *et al.* 2010). In 2016, approximately A total of 340 million children and adolescents aged between five and 19 years worldwide are diagnosed with overweight or obesity (WHO. Obesity and overweight). This study revealed the distribution of the respondents by their age; 170 (75.20%)

respondents were between the ages of 10 and 14 years, 36 (15.9%) respondents were between the ages of 15 and 17 years, and 8.8% respondents were between the ages of $\geq$ 18 years. With respect to subject education, 61.1% of the respondents were junior secondary, 24.8% were primary, 8.8% were higher secondary, and 5.3% had secondary education. This study revealed that 68.6%

A total of 25.7% of the guardians had secondary education, 25.7% had primary education, and 5.8% had tertiary education. This study revealed that 88.9% of the respondents lived in a nuclear family, whereas 11.1% lived in a joint family. According to this study, 92.9% of families reside in urban areas, and 7.1% reside in rural areas. One study suggested that mothers' higher education ($OR = 1.98$) was positively associated with healthy, nonobese children (Rahman M, *et al.* 2009). In terms of maternal education, the findings are contradictory; one study reported a positive association between child obesity and higher maternal education (Das SK, *et al.* 2013), whereas another study reported no association (Bhuiyan MU, *et al.* 2013). According to this study, 81.0% of parents earn more than forty thousand taka per month, 10.2% earn between fifteen and twenty thousand taka per month, and 8.8% earn less than forty thousand taka per month. Similarly, studies have shown that obesity is significantly more common in the highest income group ($OR = 2.06$).

(Sultana S, *et al.* 2010). In this study, 77 (74.8%) respondents were of good socioeconomic status, and 22 (21.4%) respondents were of medium socioeconomic status. In total, 4 (3.9%) respondents had low socioeconomic status. Similarly, studies in India, Pakistan, Nepal, and Sri Lanka demonstrated that children from higher socioeconomic statuses were more prone to obesity than those from low-income families were (Mahajan BP, *et al.* 2011; Warraich JH, *et al.* 2009; Piryani S, *et al.* 2016 and Rathnayake KM, *et al.* 2014). Similar to the findings of previous studies in

developing countries, a higher socioeconomic status was associated with overweight/obesity (Popkin BM, *et al.* 2012). This study revealed that 46.9% of the respondents consumed beef once or twice per week, whereas 16.8% and 14.6% consumed beef once per month or less and 3--6 times per week, respectively. The other 19.5% of the respondents do not take beef at all. This study shows that 64.1% of the respondents do not take mutton at all, and 20.4% of them take mutton once per month or less. A total of 13.6% of the respondents consumed mutton once or twice per week, and only 1.9% of them consumed mutton 3--6 times per week. In this study, 56.6% of the respondents consumed chickens 3--6 times per week. A total of 24.3% and 8% of them consumed chickens once or twice per week and once per day, respectively. The other 8% of the respondents consumed chickens more than once per day. This study revealed that approximately 36.7% of the respondents consumed fish 3--6 times per week. Approximately 34.1% of the respondents consumed fish once per day. A total of 16.4% and 7.5% of them consumed fish more than once per day or once or twice per week, respectively. In this study, most of the respondents (approximately 58.8%) ate eggs once per day. A total of 14.6% and 13.7% of them consumed eggs 3--6 times per week and once or twice per week, respectively. This study revealed that for most of the respondents, approximately 81% consumed rice more than once per day. Only 17.3% of the participants consumed rice once per day. Amazingly, 1.8% of the respondents consumed rice 3--6 times per week. This study revealed that 11.5% of the respondents did not consume bread at all. A total of 57.5% of the respondents consumed bread once per day. The other 11.9% and 8.4% of the respondents consumed bread more than once per day and once per month or less, respectively. This study shows that about

A total of 27.9% of the respondents consumed pulse and legumes 3--6 times per week. Approximately 27.4% and 19.5% of the respondents took pulses and legumes once per

day and once or twice per week, respectively. In this study, 31.9% of the respondents never consumed nuts. A total of 21.7% and 18.1% of the respondents consumed nuts once per month or less and once per day, respectively. This study revealed that approximately 54.9% of the respondents consumed vegetables 3--6 times per week, whereas 16.8% and 15.9% of the respondents consumed vegetables once per day and once or twice per week, respectively. This study revealed that approximately 58.3% of the respondents consumed fruits once or twice per week. A total of 25.2% and 9.7% of the respondents consumed fruits 3--6 times per week and once per month or less, respectively. The volume in all dietary categories increases as the child or adolescent grows and develops between the ages of five and eighteen. Still suggested are vegetables, especially no starchy ones such as broccoli, spinach, green beans, and tomatoes. It is not advisable to consume sweets or added carbohydrates, including those found in all fluids (M.M. Davis, *et al.* 2007 and N.F. Krebs, *et al.* 2007). This study revealed that 50% of the respondents consumed milk and milk products once or twice per week. A total of 26.5% and 14.2% of the respondents consumed milk and milk products once per month or less and 3-6 times per week, respectively. Only 4% of the respondents consumed milk and milk products daily. This study revealed that 26.1% of the respondents ate fast food once per day. A total of 23.9% and 19.9% of the respondents ate fast food once or twice per week or more than once per day, respectively. The other 14.2% and 11.9% of them ate fast food 3--6 times per week and once per month or less, respectively. Amazingly, only 4% of the respondents did not consume fast food at all.

“Studies in India and Pakistan indicated regular consumption of fast food” (42.9% and 80.0%, respectively) “among this group of children” (Mahajan BP, *et al.* 2011; Warraich JH, *et al.* 2009). Multidisciplinary interventions include nutritional strategies,

activity modifications, behavioral strategies, and improved sleep hygiene. Tailoring the macronutrient content to target specific cardiometabolic risk factors, such as a low-carbohydrate diet to treat insulin resistance, may be possible (M.L. Gow, *et al.* 2014). In this study, most of the respondents consumed food as they recalled by servings on average. The number of carbohydrate servings was 18.72, which is high, with up to 11 servings; the number of protein servings was 6.61, which is high, with up to 3 servings being normal; the number of milk and milk product servings was 0.32, which is low, with up to 3 servings being normal; the number of fat servings was 11.68, which is high, with up to 3 being normal; the number of vegetable servings was 1.43, which is low, with up to 3 servings being normal; and the number of fruit servings was 0.51, which is low, with up to 3 servings being normal. A study conducted in Sri Lanka reported high energy intake and low fruit and vegetable consumption as contributing factors for obesity among adolescent girls (Rathnayake KM, *et al.* 2014). In this study, before the intervention, the average calorie consumption was 2461.57g, carbohydrate consumption was 227.85 g, protein consumption was 102.41 g, and fat consumption was 154.54 g. High energy intake and food preference are major contributors to the development of overweight/obesity in children (Sahoo K, *et al.* 2015 and Osei-Assibey G, *et al.* 2012). Over the past few decades, the food consumption patterns and eating habits of school-going youngsters have drastically altered across the nation (Das KS, *et al.* 2013). We discovered that normal-weight teenagers participated in sports activities far more often than overweight or obese teenagers did. This is expected and has also been shown in earlier research, as a lack of physical exercise in adolescents has been known to cause obesity (Tremblay, M.S., *et al.* 2003). A lack of physical activity has a bidirectional influence on BMI, as although it may increase BMI, inversely, an increased BMI may cause lower engagement in sport activities (Pietilainen, K.H, *et al.*

2008). Moreover, teenagers might be more self-conscious about their appearance and thus avoid working out in front of others (Stankov, E, *et al.* 2012). In this study, 71% of the respondents had low physical activity levels, and 28.3% had moderate physical activity levels. After the intervention, 46.5% of the respondents had high physical activity levels, 31.4% had low physical activity levels, and 22.1% had moderate physical activity levels. Hossain MT *et al.* reported that the majority (>80.0%) of overweight/obese children do not participate in sports at school or after school (Hossain MT, *et al.* 2020). The table shows that 112 respondents had emotional symptoms at the 1st visit, whereas only 32 had emotional symptoms at the last visit according to the total SDQ score. Eighty respondents had conducted problems at the 1st visit but only 15 had conducted problems at the last visit according to the statistics of the SDQ total score. Two respondents reported hyperactivity/inattention at the 1st visit, whereas only one respondent reported hyperactivity/inattention at the last visit according to the total SDQ score. Three respondents had peer relationship problems at the 1st visit, while only one had peer relationship problems at the last visit according to the total SDQ score. The finding that physical well-being was lower in adolescents with higher BMI-SDQ scores is in line with previous findings (Williams J, *et al.* 2005 and Ottova V, *et al.* 2012). An explanation might be reduced physical activity and fitness in adolescents with higher BMIs (Raistenskis J, *et al.* 2016). With respect to psychological well-being, previous studies have shown lower levels in obese children and adolescents than in normal-weight children and adolescents (Schwimmer JB, *et al.* 2003 and Meixner L, *et al.* 2020). Separation anxiety was associated with increased waist circumference and BMI in boys, whereas in girls, somatic symptoms of anxiety were associated with waist circumference and increased body fat (Anderson, S.E, *et al.* 2006). Previous research has demonstrated associations between obesity and depression in children and

adolescents (Mühlig, Y., *et al.* 2015). Nevertheless, the mental well-being and psychiatric health of children and adolescents suffering from obesity are the subject of considerable debate (Aparicio, E, *et al.* 2013; Duarte, C.S, *et al.* 2010; Goodman, E, *et al.* 2002; Hillman, J.B, *et al.* 2010; Midei, A.J, *et al.* 2010; Rhew, I.C, *et al.* 2008; Rofey, D.L, *et al.* 2009 and Tanofsky-Kraff, *et al.* 2006). The results of this study revealed that, among the 10–14 years age group, the mean BMI decreased to 23.54 from 25.22, the 15–17 years age group’s mean BMI decreased to 25.51 from 27.21, and the 18-19 years age group’s mean BMI decreased to 25.74 from 27.20 gradually from the 1st to the 5th visit, which was a significant change ($p \leq 0.05$) in BMI. There was a significant (.000) change in the respondents’ BMI at every visit after the intervention. Similarly, in the clinical setting, multicomponent pediatric weight management interventions were modestly effective in reducing BMI z scores in 6- to 17-year-old participants. Clinical decision support tools and the inclusion of nutrition professionals have been identified as effective intervention methods to reduce BMI z scores (Thompson K.L., *et al.* 2019 and Flodgren G, *et al.* 2017). The figure shows that, before the intervention at the 1st visit, 64.2% of the respondents were overweight, and 35.8% of the respondents were obese according to their BMI. Gradually, the respondents gradually returned to having a normal BMI and lost weight after the intervention. After intervention at the 5th follow-up visit, 70.8% of the participants were normal, 9.7% were overweight, and 17 (16.5%) were obese. BMI is categorized into groups according to the Asian–Pacific cutoff points (Pan WH, *et al.* 2008). In pediatric individuals 2 to 17 years of age with overweight or obesity, three systematic reviews reported that, compared with controls, multicomponent weight management interventions, including nutrition, reduced BMI z scores (Mead E., *et al.* 2017; Al-Khudairy L., *et al.* 2017 and Salam R.A., *et al.* 2020). Recommendations for pubertal

children with obesity (10–14 years) address optimal behavior and sleep patterns, pharmacology, food intake, and activity levels (Expert Committee recommendations: summary report -Pediatrics, 120:4:2007 and B.A. Spear, *et al.* 2007). Most likely, high consumption of food rich in fat and calories, less involvement in sports/activities, and a sedentary lifestyle play important roles in increasing overweight/obesity among this age group of children. Similar findings were reported in studies conducted in different parts of India, Pakistan, Nepal, and Sri Lanka, which established the relationships among dietary patterns, sedentary behaviors, and obesity (Mahajan BP, *et al.* 2011; Warraich JH, *et al.* 2009; Piryani S, *et al.* 2016; Rathnayake KM, *et al.* 2014 and Jacob KS, *et al.* 2014).

The present study demonstrated that combined dietary counseling and physical activity interventions significantly improved both physical and psychological outcomes among adolescents with overweight and obesity. Quantitative findings revealed a progressive reduction in BMI, improvement in physical activity levels, and better dietary practices following intervention. These results are consistent with previous studies indicating that multi-component interventions are more effective than single approaches in reducing adolescent obesity (Bleich et al., 2018; Friedrich et al., 2012).

The qualitative case studies (Case I–III) further supported these findings by providing in-depth insights into behavioral and psychosocial changes. All three cases initially exhibited unhealthy dietary habits, characterized by high intake of fast foods, sugary beverages, and fatty diets, which aligns with the global nutrition transition described by Popkin (2001) and recent updates (Popkin et al., 2020). Similar to findings by Misra et al. (2007), these adolescents showed early signs of obesity-related risks influenced by both lifestyle and environmental factors.

A key observation across cases was the strong influence of parental behavior and lack of awareness, particularly overfeeding and normalization of unhealthy weight gain. This is supported by recent literature emphasizing family environment as a critical determinant of adolescent obesity (WHO, 2021). Additionally, sedentary behavior and digital addiction were consistently identified as major contributors, corroborating global evidence that excessive screen time is associated with increased adiposity and poor health outcomes (WHO, 2020).

Psychosocial impacts were prominent, with participants experiencing bullying, social isolation, and low self-esteem, consistent with studies highlighting the bidirectional relationship between obesity and mental health (Simmonds et al., 2016). Importantly, the intervention led to significant improvements in psychological well-being, as reflected in reduced SDQ scores and improved social interactions.

The case studies demonstrated that multidisciplinary interventions—including dietary modification, physical activity, and psychological counseling—resulted in sustainable lifestyle changes. Similar improvements in BMI and behavioral outcomes have been reported in school- and clinic-based interventions globally (Anderson et al., 2005; Sahota et al., 2001).

The present study also provides a comprehensive understanding of adolescent obesity by integrating quantitative outcomes with qualitative insights from case studies and focus group discussions (FGDs). The findings confirm that obesity among adolescents is a multifactorial condition, influenced by dietary behaviors, physical inactivity, parental practices, and psychosocial factors.

Unhealthy Dietary Practices and Nutrition Transition: Both quantitative findings and FGDs with adolescents revealed a high consumption of fast foods, sugary beverages, and energy-dense diets, with limited intake of fruits, vegetables, and home-

prepared meals. Adolescents reported a strong preference for junk food due to convenience, taste, and peer influence, while parents acknowledged frequent provision of such foods. These findings are consistent with the global “nutrition transition” described by Popkin (2001) and recent updates (Popkin et al., 2020), which highlight increased reliance on ultra-processed foods in urban settings.

Parental indulgence and lack of dietary regulation emerged as key contributors, as many parents equated higher food intake with better health. This aligns with existing literature emphasizing the role of family environment and parental feeding practices in shaping children’s dietary behaviors (WHO, 2021).

Sedentary Lifestyle and Digital Addiction: A dominant theme across adolescents and parents was the prevalence of sedentary behavior, particularly excessive screen time involving mobile phones, video games, and social media. Both FGDs and case studies consistently showed that adolescents spent most of their leisure time in digital activities, resulting in minimal physical activity.

These findings support global evidence that physical inactivity is a major risk factor for obesity and related metabolic disorders (WHO, 2020). The decline in outdoor play and sports participation, combined with academic pressure and urban lifestyle constraints, further exacerbates the problem. The study reinforces the need for structured and enjoyable physical activity interventions tailored to adolescents.

Psychosocial Impact and Behavioral Consequences: Psychosocial challenges emerged as a critical theme. Adolescents reported frequent bullying, social exclusion, and negative labeling, which significantly affected their self-esteem and mental health. Some parents also acknowledged criticizing their children’s appearance, which may further contribute to emotional distress.

These findings are consistent with previous studies demonstrating a strong association between obesity and psychological problems, including depression, anxiety, and social withdrawal (Simmonds et al., 2016). The case studies further illustrated how obesity-related stigma can lead to isolation and reduced academic performance.

Misconceptions and Lack of Awareness: Both adolescents and parents demonstrated misconceptions regarding obesity, particularly the belief that it is primarily hereditary and difficult to reverse. Despite some awareness of balanced diets, there was limited understanding of practical implementation and lifestyle modification.

This gap in knowledge has been widely reported in LMICs, where obesity is often underestimated as a health risk (WHO, 2021). The findings highlight the need for targeted health education programs addressing both adolescents and parents.

Role of Family Environment and Parental Influence: The FGDs strongly emphasized the influence of parental behavior, including overfeeding, lack of supervision, and limited engagement in children's physical activities. Busy work schedules and urban lifestyles contributed to reduced parental involvement.

Consistent with existing literature, family dynamics play a central role in shaping adolescent health behaviors. Interventions that actively involve parents are more likely to achieve sustainable outcomes.

Effectiveness of Multidisciplinary Intervention: The integration of dietary counseling, physical activity promotion, and psychological support resulted in significant improvements across all domains. Quantitative results showed reductions in BMI and improved physical activity levels, while qualitative findings highlighted enhanced confidence, better social interaction, and improved mental well-being.

FGDs confirmed that adolescents became more motivated and confident after counseling, and parents reported positive behavioral changes in their children. These

findings are in line with previous intervention studies demonstrating the effectiveness of combined lifestyle approaches (Bleich et al., 2018; Friedrich et al., 2012).

Behavioral Transformation and Long-Term Implications: A notable outcome of the study was the transformation in lifestyle behaviors. Adolescents adopted healthier eating habits, engaged in regular physical activity, reduced screen time, and demonstrated improved academic performance and social interaction. Parents also became more aware and supportive over time. This behavioral shift underscores the importance of early intervention during adolescence, a critical period for establishing lifelong habits. The findings support the life-course approach to obesity prevention and align with global public health priorities.

The thematic integration of quantitative and qualitative findings demonstrates that adolescent obesity is not merely a biological issue but a complex interplay of behavioral, environmental, familial, and psychological factors. Addressing this challenge requires a holistic, context-specific, and family-centered approach.

CHAPTER -6

CONCLUSIONS

LIMITATIONS AND

RECOMMENDATIONS

CONCLUSIONS

Adolescent obesity is an escalating public health concern affecting both developed and developing countries, with serious physical and psychological consequences. This study confirms that obesity among adolescents is driven by multiple interrelated factors, including unhealthy dietary habits, physical inactivity, excessive screen time, parental influence, and psychosocial challenges.

The findings demonstrate that a comprehensive intervention combining dietary counseling, structured nutrition plans, physical activity promotion, and psychological support is effective in addressing this issue. Participants showed significant improvements in physical activity levels, healthier dietary behaviors, enhanced psychological well-being, and a notable reduction in BMI and overall obesity prevalence.

Importantly, parental awareness and involvement emerged as critical determinants of adolescent health behaviors, highlighting the need for family-centered strategies.

In conclusion, a holistic and multidisciplinary approach integrating nutrition, physical activity, behavioral support, and family engagement is essential for the effective prevention and management of adolescent obesity. Such strategies can contribute to sustained lifestyle changes, reduced risk of noncommunicable diseases, and improved long-term health outcomes.

LIMITATIONS

- This study has several limitations. This was a single-center study. Our ability to identify a causal relationship between predictors and factors of overweight and obesity is limited.
- Unhealthy choices concerning everyday meals seem to have prevailed as the pandemic continued into the COVID-19 era.
- The dataset lacks several key variables, including eating habits and smoking habits before and after COVID-19.
- However, the study does not include a representative sample across Bangladesh, including both urban and rural areas. We used the Asian BMI category for the analysis, strengthening our evidence base.
- The prognosis of the study participants could not be evaluated because of time limitations.

RECOMMENDATIONS

- Prevention is the key strategy for controlling adolescent overweight and obesity.
- The combination of diet, physical activity and psychological factors is an important factor in controlling adolescent overweight and obesity.
- Primary prevention methods should be aimed at educating adolescents and families and encouraging appropriate diet and physical activity from a young age.
- Secondary prevention should be targeted at lessening the effects of adolescent obesity through a combination of diet, physical activity and psychological factors.
- A combination of primary and secondary prevention is necessary to achieve the best results.
- At the same time, introduce structured nutrition education and physical activity programs in schools to promote healthy habits from an early age.
- Encourage adolescents to engage in at least 30–60 minutes of daily physical activity, including sports and outdoor games, while limiting screen time.
 - Formulate policies to reduce availability of unhealthy foods, promote healthy food environments, and create community-based programs supporting active lifestyles.

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APPENDICES

Appendix-1: Questionnaire

Appendix-2: Case Study

Appendix-3: FGD

Appendix-4: Dietary Guidelines

Appendix-5: Physical Activity Guidelines

Appendix-6: Photo Gallery of Activities

Appendix-1: Questionnaire

Questionnaire on

“Effects of Dietary Counseling and Physical Activities on Overweight and Obesity among Adolescents Visiting a Tertiary Care Hospital, Dhaka”

Part-A: Informed Consent Form

I am Mohammed Rizwanul Ahsan and want to obtain your consent regarding your diet and physical activity for academic purposes.

Aim: Effects of Dietary Counseling and Physical Activities on Overweight and Obese among Adolescents Visiting a Tertiary Care Hospital, Dhaka.

Risk of the participants in this research: If you participate in this research work, you may not have any physical risk.

Alternate: If you want, then you may not have any physical risk.

Expenditure: For this research purpose, you do not need to pay, or you will not obtain any financial expenditures.

Privacy: Your personal information, which will be concealed, will be used for research purposes.

Self-participation: It is your own choice. You may or may not have participated in this research work or any time Quit from this research.

Questions: If you have any questions about research work, you can ask the researcher any time.

Consent of the participants: The aim, purpose, advantage, and risk of this research work were fully explained by the researcher, and I am satisfied with it and give my consent and some personal information with my own interest.

Participant's Signature: Date:	Research's Signature: Date:
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Part-B: Background and Socio-economic Information

Name :

Father's name:

Mother's name:

Age in (years):

Sex : ☐ Male ☐ Female

Address :

Marital Status : Married/unmarried//Widow

Number of children:

Date of birth:

Socioeconomic Status: ☐ Low ☐ Medium ☐ Good

Occupation:

Monthly income:

Level of education:

Family Type:

Living Area :

Part-C: Anthropometric Information

Height in cm :

Weight in kg :

BMI :

Nutritional Status: ☐ Underweight ☐ Normal ☐ Overweight ☐ Obese

Part-D: Clinical History

Any Clinical problem:

Family history (DM/HTN/OBESITY) -

Part-E: Information regarding Physical Activity and Life Style

Physical activities:

Sedentary/no work

Light/1-3 days/wk

Moderate/3-5 days/wk

Very/6-7 days/wk

Extreme/twice days/wk/Heavy work

Life Style:

Watch TV

Videogame

Reading

Use of mobile

Playing

Others

Smoking

Alcoholic

Sleeping pill

Others

Secondary Habit:

School Performance:

Poor

Moderate

Good

Part-F: Dietary Information

1. 24-hour Recall Methods

Breakfast:

Snacks:

Lunch:

Snacks:

Dinner:

Others:

2. Food Frequency Questionnaire

Appendix-2: Case Study

CASE STUDY - I

Shafin (pseudonym). A 16-year-old boy of Class X visited the adolescent OPD of Bangladesh Shishu Hospital & Institute for excessive weight. After an interview, he reported that his school performance was moderate. He is the second child of a solvent family and lives in Dhaka city. There was a history of hereditary diabetes in the patient's family. Shafin reported that 15 months prior, his weight was 85 kg, and his height was 165 cm; thus, his BMI was 31 kg/m². His daily diet consisted of two meals of meat, pulses, and three meals of rice, fish and fries. He used to eat chips, pizza biscuits and soft drinks as snacks. He did not work physically during the whole day. He spent most of his time playing video games. He did not like to go to school, and he did not have friends. He was quite inattentive in studies. Friends at school used to call him 'Motu'. At home, his mother used to feed him frequently, even if he told her that he was getting fat. His mother would say that, he would be healthy when he grew up', but he did not want to understand that he was bullied by the students at school. Under these conditions, Shafin visited Bangladesh Shishu Hospital & Institute, an adolescent OPD department, for 15 months. After the interviews, he informed us of everything friendly to us.

Researcher gives him necessary counseling along with diet chart and suggested physical activities like sports, cycling, swimming, etc., and recommended follow up visits in sequence. In subsequent five visits, the BMI gradually reduced from 31.2 to 29.1, 27.5, 26.1, 24.4, and to 22.71. He is now quite happy with his reduced weight, by following advice of researcher, nutritionist and psychologist. Now he swims for an hour every day and plays football for an

hour on the field, so he has almost no addiction to video games. In Shafin's words, 'Now a days no one makes fun of me as 'Motu'. Those who used to laugh at me, have become my best friends now. Now I do not eat without diet chart even if mom insists. Before I used to have many contractions due to excess weight and obesity, now it's all absent. My family is also very happy. Currently, I like to go to the field and play football the most. I want to be a good football player in the future.

CASE STUDY -II

Ratul is studying class VIII. His roll is 90 out of 100 students. He is 14 years old and weighs 89.5 kg with a height of 170 cm. He was obese, and his BMI was 30.5 kg/m^2 .

His father is a businessman, and his mother is a homemaker. Their socioeconomic status is very good. The ratul is growing in a city environment with no family history of diabetes, hypertension or obesity.

He has been accustomed to eating fast food since his growing age. Among them, burgers, chips, pizza, etc., are the favorite foods. The ratul is also fond of butter and fatty foods, so the mother used to feed him lovingly. In this way, day by day, Ratul was becoming fatty, which made Ratul's mother happy.

According to Ratul and his “mother”, Ratul has been a good student since childhood, smart and playful. Ratul excelled in class activities as well as in studies. He was a free-spirited and independent child who interacted well with everyone, sharing everything with his mother. Owing to Ratul's food habits and excessive device addiction, Ratul was turning away from sports as he became obese daily, and watching TV, playing mobile games and watching tiktok were becoming addictions. Spending too much time on these activities made him obese, so he experienced extreme fatigue, less interest in his surroundings, poor school performance, staying away from classmates and suffering from an inferiority complex. These factors create concern in the minds of Ratul's parents. In this situation, Ratul's parents resorted to the researcher.

What happened in Ratul's life, why he is disappearing like this, and how to find solutions to various questions and try to restore the normal pace of Ratul's life.

Eighth-class student Ratul, roll 90, from the age of 10, Ratul's health started to change. At the same time, his class performance also started to deteriorate. No one in the family understood that Ratul's physical change was responsible for this. Mothers' indulgent feeding of greasy food and excessive fast food pushes the Ratul to dire situations mentally and physically.

My intention in taking the matter as a case study was to determine the cause of the problem created for Ratul and try to escape this situation. The lively Ratul stays quiet all day, plays video games, watches the computer and tiktok and studies the rest of the time. After falling sick frequently for several months. He does not play sports at home either.

The day Ratul first comes to me, I knew about his food list for the last 24 hours and the excess of fast food and fatty foods with his device addiction.

Then, I counseled him and told him about some regular exercise, such as swimming, playing crickets, playing football, walking, cycling, etc., along with diet charts. The participants were asked to visit three times per month.

Since he had been exercising, cycling and playing crickets regularly for the past 15 months, his BMI gradually decreased from 30.5 to 28.70, 28.50, 28.10, 27.90 and 27.50, respectively. At this time, quite a change was noticed in Ratul's life. Currently, Ratul is able to mix with his classmates as before. Interest in sports has developed, and mental exhaustion and fatigue have decreased. At present, Ratul is not addicted to devices. Ratul and his family are very happy to

overcome this curse, which is called obesity. Currently, he and his mother are very conscious of their diet.

My own opinion on Ratul's overall change: –

Ratul health is constantly increasing due to weight variation with height and age and excessive addiction to devices. From a lively and cheerful child to a lifeless child.

His performance in class deteriorated daily, and he lost interest in studies.

The ratul is a very lively and normal child, which is a very normal phenomenon. However, owing to Ratul's mother's ignorance and excessive affection, a normal life takes an unusual turn, which subsequently causes damage to Ratul's health, studies, body and mind. The subject of my case study, as a researcher, was an attempt to solve his problem. Owing to excess weight and device addiction, he loses his normality, becomes quiet and suffers from an inferiority complex. As a result, he feels more comfortable being alone.

Finally, Ratul overcome the problem of obesity Successfully manage and present the complete case through a series of stages such as: introduction, characteristics, purpose, duration, identity of the student, rationale for taking the case, cause of the problem, steps taken to solve the problem, analysis of test results, description and cause of the problem, own opinion on the case and follow-up. Feeling relieved from a place of responsibility.

CASE STUDY -III

Raju, a student in class IX, aged 15 years, was a good student with Roll-8. His weight was 85.6 kg, height was 160 cm, and BMI was 30.2 kg/m^2 , indicating that he was obese. The father is an employee, and the mother is a homemaker. Their socioeconomic status is fairly good. Raju lives in a city environment. There was a family history of diabetes, hypertension and obesity. Raju has had a habit of eating while watching TV since childhood. To date, there has been no change in his habit. Rather, it increased with age. His interest in outdoor sports has been low since childhood. Currently, his food list shows that snacks are his favorite foods. In addition, he likes to eat beef. He also has an effect on sweet foods and chocolate ice cream soft drinks. Late sleeping, TV addiction, reluctance to play, an inactive lifestyle and poor digestion may be the main reasons for obesity in Raju. Raju is a fairly good student in class. However, becoming obese daily, Raju is often bullied in class by teachers, classmates and playmates. Talking to Raju, it is known that his classmates call him 'alien', 'fat ghost'. Some escaped with occasional bodily harm. Owing to obesity, classmates or friends are not interested in playing with them in sports. It hurts him a lot. As a result, he suffers from an inferiority complex and tries to stay away from his classmates. He tried to talk to his parents about it, but they did not care much about it. In this situation, Raju becomes depressed. At this point, he turned to the researcher.

What happened in Raju's life, why is he disappearing like this, and how to find solutions to various questions and try to restore the normal pace of Raju's life, I am taking the problem as a case study. The Class IX student Raju has been healthy since childhood. Additionally, his

addiction to fatty foods worsened his addiction. In addition, Raju is traumatized because of the bullying of classmates and a lack of family support. In this situation, I take the matter as a case study to bring Raju out of mental trauma and try to give him a safe health system and a happy life. My intention was to know the cause of the problem created for Raju and try to get him out of this situation.

I and the psychologist counseled Raju and advised him on some regular exercises, such as swimming, playing crickets, walking, working out, skating, etc., along with healthy diet charts and asked them to visit every three months apart. Since then, he has been exercising, skating and swimming regularly for the past 15 months with a healthy diet. As a result, his BMI gradually decreased from 30.2 to 29.60, 28.40, 28.00, 27.70 and 26.80.

Currently, Raju has started to overcome mental depression. Interest in skating and swimming has developed. He is very happy to come out of this hostile environment. Raju's family realizes the mistake and gives him time to evaluate every word. This helped Raju avoid psychological trauma. In the future, Raju wanted to become a doctor so that obese adolescents like him would not be bullied.

My own opinion on Raju's overall change:

Raju's constant deterioration of health due to junk food and genetics, being neglected by friends and bullying at school eventually leads to the trauma of a child not being supported by family. In this case, Raju's lack of support from his school, classmates and, finally, his family left him mentally disturbed. Here, the unawareness of family and society is noticeable. As a

result, a normal life was turning into uncertainty and darkness. The subject of my case study, as a doctor, was an attempt to solve this problem.

Finally, this case study was conducted on a ninth-grade student who suffered from trauma due to bullying and a lack of support from his family due to obesity. Successfully manage and present the complete case through a series of stages, such as introduction, characteristics, purpose, duration, identity of the student, rationale for taking the case, cause of the problem, steps taken to solve the problem, analysis of test results, description and cause of the problem, own opinion on the case and follow-up. Feeling relieved from a place of responsibility.

CASE STUDY SERIES OPINION

- Obesity is curable. This can be eliminated by changing healthy lifestyles and good dietary habits.
- Children from wealthy families are usually more affected by this problem. Obesity and overweight are closely related to each other.
- Excess body weight increases the likelihood of various diseases, especially cardiovascular diseases, type 2 diabetes mellitus, insomnia, hypertension, stroke, etc.
- Exercise regularly every day.
- Eating the right food in the right amount and right time.
- Adequate amount of sleep (at least 6–8 hours).
- Foods high in sugar (bakery products, chocolate, and sweets) should be avoided.
- Avoiding processed food and junk food.
- Adolescence is an important period in human life; during this time, a human child takes everything anew, and the child's next steps depend on this stage and society, family and surroundings are responsible for helping the child reach this stage. What we get from today's child in the future depends entirely on the diet and environment we are giving him.

Appendix-3: FGD

1. FOCUS GROUP DISCUSSION (FGD) WITH ADOLESCENTS

FGD – A qualitative research method and data collection technique in which a selected group of people discusses a given topic and issue in depth, facilitated by a professional, external moderator. Its importance is to gain insight into the experiences of various stakeholders.

According to the WHO, the adolescents are as follows:

Early: 10--14 years.

Mid: 15 to 18 years.

Late: 18-19 years.

In this study, the FGD included a total of 6 participants aged between 12 and 18 years living in urban areas, and all of them were overweight or obese ($\text{BMI} \geq 25 \text{ kg/m}^2$ ref. BMI Asian scale). Most of them have a nuclear family, are affluent and study in private schools in urban areas. With respect to family history, most parents have DM/HTN/OBESITY. Their active participation in discussing everything was so nice. Most of the participants thought that overweight and obesity are hereditary and that it was not possible to achieve normal body weight by following a healthy diet, engaging in physical exercise and providing psychological support.

The participants reported that their parents are very reluctant about their food habits and that most parents are busy with their services. Most of the time, participants are busy in school and coaching classes. They are accustomed to consuming snacks and even lunch with fast, junky foods such as pizza, burger, and pasta, the ingredients of which are highly salted with

carbohydrates and cholesterol. Only a few of them are habituated to family food. While they get some leisure time, most of them are becoming busy with laptop and mobile games. Their school performances are also gradually deteriorated. An important issue that has been raised is that almost all of them are bullied by their friends, school and sometimes by family members. This is why they like to spend their leisure time alone, which sometimes makes them emotionally depressed and introverted.

The “Healthy diet, lifestyle and confidence” rules counseled the adolescents. A diet chart and physical activities (ref-Asian-Pacific scale) provide advice to them that is more focused on outdoor games, such as football, swimming, and walking, at least 20--30 minutes/day, and ensure that if they maintain this routine, they will receive a dramatic response within a few months to year. If any psychological support is needed, a counselor is also with them. They looked very confident and accepted it as a challenge.

After 6 months, their BMI significantly decreased. Currently, they are habituated to a healthy diet, exercise regularly and look very smart and confident. School performances are becoming good, and they are quite happy now.

At present, they are very much optimistic about their future life.

2. FOCAL GROUP DISCUSSION (FGD) WITH PARENTS

- Ninety-five percent of parents live in single households. Only 5% live with joint families. Children receive less attention and care from parents because of their business.
- Almost all parents are financially solvent. The social status of these children is good, and 98% of them study in private schools in English.
- Parents are acknowledged for their children's daily lifestyle and food habits. Ninety-nine percent of them lived a luxurious life. Children like junk food, chips, soft drinks, fish, meat, eggs, etc.
- Ninety-five percent of children are overweight or obese. The remaining 5% of children are close to having obesity.
- Almost 100% of parents do not know that obesity is a disease, and it can be solved through a regular daily lifestyle, physical exercise and healthy dietary habits.
- Sixty percent of parents have hereditary obesity and overweight problems. These individuals believe that obesity and overweight are hereditary problems.
- Approximately 99% of parents reported indifference regarding children's food intake and physical labor with increasing age.
- The emotions of all parents are that their child does not eat adequately. Eating more will make the child look healthy. It is one kind of mental peace for them.
- 40% of parents criticize the behavior or appearance of their obese child in front of their other children and make fun of their appearance.

- Sixty percent of parents are less inclined to protest when children are bullied by family, school, relatives, or friends. Twenty percent of parents protest, but it is not so strong. The remaining twenty percent of parents protest strongly on behalf of their children.
- Sixty-five percent of parents could not tell if their children were following them when they roamed with the virtual world. Thirty-five percent of parents noted that their children followed along as they roam the virtual world.
- Ninety-nine percent of parents said that their children preferred to play games on television, video games, computers, mobiles, etc.; surf on Facebook, twitter, etc.; and tik tok. For these reasons, the physical labor of children is reduced.
- Eighty percent of parents expressed their negative attitudes in front of their children. Twenty percent of parents never revealed it.
- Almost all parents love to pamper their babies. Ninety-five percent of parents always put the child's needs first in regard to food and prepare the preferred food even if it is unhealthy. Children obtain fast food, chocolate, ice cream and fatty food, junk food, drinks and tasty food only when they demand it. Children do not want to eat fibrous foods, such as vegetables and fruits.
- Eighty percent of children are averse to family-prepared food. Twenty percent of the children ate homecooked meals and ate junk food.
- While 70% of parents are aware of a balanced diet, there is less awareness about whether children are taking a balanced diet properly. The remaining 30% of parents

were conscious of both the caloric content and the balanced diet, but they provided rich food per the requirements of their children.

- Ninety percent of parents desired good results in their studies from their children. That is why they provide home tutoring and coaching for them. Ten percent of parents felt that they did not think about the child's merits and results.
- 98% of parents allow their kids to bed late and wake up late in the morning.
- Almost all parents said that their children were obese, which may be due to a lack of interest in play dust.
- Sixty percent of parents said that they take their kids out on weekends. However, there is no interest in outdoor gaming.
- Ninety percent of the children had a BMI above 25 kg/m² before being brought to the researcher, and parents were not aware of the children's diet at that time.
- Seventy percent of parents were taking advice from the research team for approximately 15 months and followed a diet chart and exercise as per counseling and advice.
- Twenty percent of parents agreed with the advice and followed the instructions for the previous six months.
- Ten percent of parents agreed but did not completely follow the instructions.
- The children's BMI decreased significantly during this time. Children seem to them to be more cheerful and lively than before.

3. Guidelines for FGDs for adolescents aged 10--19 years (Questionnaire)

1. Family type. Social status refers to the type of school, whether public or private.
2. What illnesses do teenagers have? What is their BMI?
3. Whether there is HTM DM or AVCT in family history is unknown. Concepts about obesity and overweight.
4. Do parents love to feed?
5. Whether their favorite food is prepared at home.
6. How interested are they in the food that is prepared for the whole family? If he is not interested in food, parents try to feed him.
7. How do obese and overweight children change their daily life, food, behavior and behavior?
8. What kind of food do obese and overweight children want to eat more? What are their likes and dislikes, studies, sports, sleep and physical activity?
9. How was there interest in physical activity and sports before seeing the doctor? How has it changed after seeing the doctor?
10. How was the children's school performance in the beginning? Their opinion is about whether the family is bullied by friends, school and relatives.
11. This affects their school performance and their thinking, ability to protest, ability to complain and how they feel about themselves.
12. How was their support at school and family after being bullied?
- 13 When children see Doctors with Obesity and Overweight Problems and how the children perform in school after taking the doctor's advice.
14. As a result, the children's thinking and their attitude toward sports changes. Whether children's BMI has changed.

FGD case study guidelines

1. Questions - Discussion about family status, social status, school performance, and economic status.
2. Question - Are there any hereditary diseases related to obesity?
3. Question - What were her weight, height and BMI before seeing the doctor?
4. Question - Discuss the daily food list before seeing the doctor.
5. Question- Discussion about physical labor of the day before seeing the doctor. How did he spend his time?
6. Question -What kind of comments did school, family, classmates or others give him about obesity?
7. Question - Does the school authority or family have a chance to complain about the comment? Did they take any action if given the opportunity?
8. Question -When did you come to the doctor with obesity and overweight problems, for how long and what kind of treatment did you take? What kind of changes did he have after exercising following the researcher's counseling and advice?
9. Question -Currently discuss daily living for him? How do family and friends accept him now?
10. Question - Do you follow the diet chart and exercise given by the doctor? Talk about his feelings and thoughts at present.

Appendix-4: Dietary Guidelines

কি কি খাবেন -----

খাদ্য শস্য ও তা দি য়ে তৈরী খাবার :

- আটা (লাল), পাউরুটি (ব্রাউন), ওটস খাবেন।

মাছ ও মাংস জাতীয় খাবার :

- মুরগীর মাংস, ছোট মাছ (মলা, ঢেলা, কাঁচকী ইত্যাদি)।
- সামুদ্রিক মাছ (রূপচাঁদা, কোরাল, ভেটকি, লাক্ষা, পোয়া ইত্যাদি) সপ্তাহে ৩/৪ দিন খাবেন।
- নদী ও মিঠা পানির মাছ।

ডিম :

- ডিমের সাদা অংশ (কুসুম ছাড়া) প্রতিদিন খাওয়া যাবে।
কুসুমসহ ডিম সপ্তাহে ৩/৪ দিন খাবেন।

দুধ ও দুধ দি য়ে তৈরী খাবার :

- ননীবিহীন দুধ প্রতিদিন খাওয়া যাবে।
- দই এর ঘোল (পাতলা করে)।

ডাল :

- ছোলার ডাল, অরহর ডাল, মাস কলাইয়ের ডাল ইত্যাদি সীমিত পরিমাণে খাওয়া যাবে।

ফল :

- আপেল, নাসপাতি, পেয়ারা, পাকা পেঁপে, আনারস, জাম, বাঙ্গী ইত্যাদি খাওয়া যাবে।
- টক ফল যেমন- আমলকী, লেবু, মাল্টা, মোসাম্বী, জাম্বুরা, আমড়া, কামরান্দা ইত্যাদি বেশি পরিমাণে খাওয়া যাবে।

শাক-সবজি :

- অধিক আঁশযুক্ত সবুজ শাক-সবজি এবং কাঁচা সালাদ বেশি করে খাবেন।

তেল :

- উদ্ভিজ্জ তেল যেমন- সানফ্লাওয়ার, কর্ণ অয়েল, অলিভ অয়েল রান্নায় ব্যবহার করবেন।

কি কি খাবেন না -----

খাদ্য শস্য ও তা দিয়ে তৈরী খাবার :

- ময়দার রুটি, কর্ণফ্লাওয়ার, এরারুট, কাস্টার্ড পাউডার।
- চিড়া, মুড়ি, খৈ ইত্যাদি কম পরিমাণে খাবেন।

মাছ ও মাংস জাতীয় খাবার :

- চর্বি যুক্ত গরু, খাসী, হাঁস ও কবুতরের মাংস খাবেন না।
- মুরগীর চামড়া, মাথা, গিলা, কলিজা, গুরদা ইত্যাদি খাবেন না।
- মাছের মাথা, মাছের ডিম, খাবেন না।
- চিংড়ি, কাঁকড়া ইত্যাদি খাবেন না।

দুধ ও দুধ দিয়ে তৈরী খাবার :

- ঘন দুধের তৈরী সেমাই, পায়োস, ক্ষীর, পুডিং, কেক ইত্যাদি খাবেন না।
- ঘি, মাখন খাবেন না।

ফল :

- আম, কাঁঠাল, লিচু, কলা, সফেদা, আঙ্গুর, আতা, শরীফা, আনার, বেল ইত্যাদি খুব সীমিত পরিমাণে খাওয়া যাবে।

শাক-সবজি :

- আলু, মিষ্টি আলু, মুলা, শালগম, কঁচু, কঁচুরমুখী, কাঁচকলা,

মিষ্টি কুমড়া ইত্যাদি সীমিত পরিমাণে খাওয়া যাবে। তেল :

- ডালডা, বাটার অয়েল ইত্যাদি।

বেভারেজ :

পেপসি, কোকাকোলা, ফান্টা, হরলিক্স, মাল্টোভা, ওভালটিন

ইত্যাদি খাবেন না।

বিবিধ :

- নারকেল ও নারকেলের দুধ দিয়ে তৈরী খাবার খাবেন না।
- শুকনা খাবার যেমন- খেজুর, কিসমিস, মোরব্বা ইত্যাদি খাবেন না।
- তেলে ভাজা খাবার যেমন- সিঙ্গারা, সমুসা, পুরি, পাপড়, চিপস, চানাচুর ইত্যাদি খাবেন না।
- মিষ্টি ও মিষ্টি জাতীয় খাবার খাবেন না।
- চিনি, গুড় ও তা দিয়ে তৈরী খাবার খাবেন না।

সঠিক খাদ্যাভ্যাস এর সাধারণ কিছু নিয়ম

- ❖ প্রতিদিন সকালে ঘুম থেকে উঠার পরে খালি পেটে কুসুম গরম পানিতে একটি লেবু চিপে পান করলে তা শরীরের চর্বি কমাতে সাহায্য করে।
এতে এক চা চামচ মধুও যোগ করা যেতে পারে।
- ❖ সকালে হালকা ব্যায়াম করা শরীরের জন্য উপকারী।
- ❖ সকালের খাবার কখনোই বাদ দেয়া উচিত না। এতে সারাদিনের শক্তি ও পুষ্টি ব্যাহত হবে।
- ❖ প্রতিদিন কমপক্ষে ৮-১০ গ্লাস পানি পান করা উচিত।
- ❖ খাবার গুরু করার আগে পানি ও সালাদ খেয়ে নিয়ে বেশি খাওয়ার প্রবণতা কমে যাবে।
- ❖ সারাদিনের খাবারে ৩-৫ চা চামচ রান্নার তেল ব্যবহার করা যেতে পারে।
- ❖ খুব বেশি মশলাযুক্ত ও ভাজা খাবার খাওয়া উচিত না।
- ❖ বেশি রান্না, বার বার তাপ দেয়া খাবার এবং বেশিদিন ফ্রিজ এ রাখা খাবার না খাওয়াই ভাল।
- ❖ যে কোন খাবার রান্নার ক্ষেত্রে প্রিজারভেটিভ, রং, সোডা বাই কার্বোনেট ইত্যাদির ব্যবহার পরিহার করা উচিত।
- ❖ ফলের জুসের পরিবর্তে কেটে চিবিয়ে খাওয়া ভাল।
- ❖ চা/কফি/দুধ খাবার খাওয়ার পরপরই পান করা উচিত নয়। এতে দেহে আয়রনের শোষণ বাঁধাপ্রাপ্ত হয়।
- ❖ ❖ যদি কোন বেলা খাবার শম বা বেশি খাওয়া হয় তাহলে তা পরবর্তী খাবারের সাথে ভারসাম্য বজায় রাখতে হবে।
এটি করা যায় সে বেলায় কেবল সালাদ, সবজি বা টক জাতীয় ফল খেয়ে।
- ❖ আয়োডিনযুক্ত খাওয়ার লবণ ব্যবহার করা উচিত।
- ❖ সালাদ খাওয়া যাবে যত খুশি ততো।
- ❖ প্রতিদিন অন্তত এক পরিবেশন শাক খাওয়া উচিত।
- ❖ ফলের ক্ষেত্রে প্রতিদিন অন্তত এক পরিবেশন টক ফল খাওয়া ভাল। এছাড়া সহজপ্রাপ্য ও মৌসুমি ফল খাওয়া যেতে পারে।
- ❖ প্রচুর আঁশ আছে এমন খাবার খাদ্য তালিকায় রাখা উচিত।
- ❖ চর্বিযুক্ত খাবার বর্জন করা উচিত।

- ❖ রাতে ঘুমানোর অন্তত ২ ঘন্টা আগে রাতের খাবার গ্রহণ করা উচিত। এতে হজম ভাল হয়।
- ❖ একটু জোরে হাঁটার চেষ্টা করুন।
- ❖ বাদামী ভাত বা রুটি স্বাস্থ্যের জন্য উপকারী।
- ❖ খাবার কেনার সময় প্যাকেটের গায়ে উৎপাদন ও ব্যবহারের সময়সীমা দেখে নেয়া উচিত।
- ❖ রান্নার জন্য সানফ্লাওয়ার অয়েল, অলিভ অয়েল, কর্ণ অয়েল অথবা রাইস ব্রান অয়েল ব্যবহার করুন।
- ❖ প্রতিদিন ৭ থেকে ৮ ঘন্টা ঘুমাবেন।

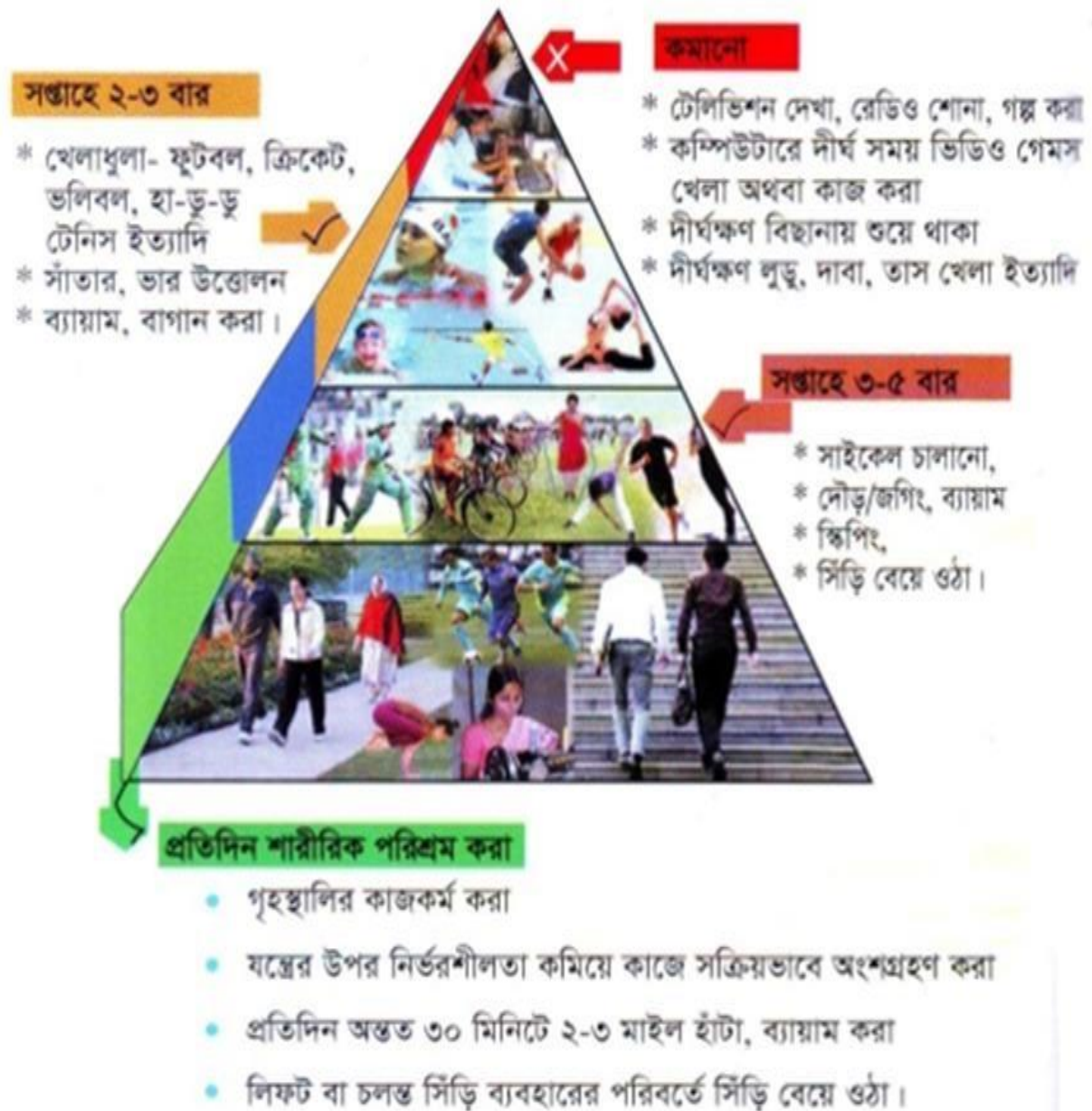
প্রতিদিনের খাবার তালিকা*

সময়	খাবার	পরিমাণ
সকালের খাবার ৭.৩০-৮.০০	ভাত/রুটি/ওটস	.....
	সবজির নিরামিষ/ভাজি/সেদ্ধ	.....
	পাউরুটি (স্বাভাবিক/টোস্ট)	.....
	মাখন/জেলি/মারজারিন/পনির	.....
	চিড়া/মুড়ি	.....
	ডিম (কুসুম সহ/ছাড়া)	.....
	সালাদ	
	চা/কপি/দুধ.....	
	চিনি	
	অন্যান্য	
মধ্য সকালের নাস্তা ১০.৩০-১১.০০	বাদাম	.....
	টক দই	.....

	ফল (মিষ্টি/টক জাতীয় ফল) সুপ (মুরগী/সবজি/টমেটো) চিড়া/মুড়ি/নুডুলস/সেমাই/কেক/ছোলা সিদ্ধ বিষ্কুট (নোনতা/মিষ্টি) সালাদ অন্যান্য	..... ..... ..... ..... ..... .....
দুপুরের খাবার ১.০০-১.৩০	ভাত/রুটি মাছ/মাংস ডাল (পাতলা/মধ্যম/ঘন) সবজি (ভাজি/সিদ্ধ) শাক সালাদ অন্যান্য	..... ..... ..... ..... ..... ..... .....
বিকালের নাস্তা ৪.৩০-৫.০০	বাদাম টক দই ফল (মিষ্টি/টক জাতীয় ফল) সুপ (মুরগী/সবজি/টমেটো) চিড়া/মুড়ি/নুডুলস/সেমাই/কেক/ছোলা সিদ্ধ বিষ্কুট (নোনতা/মিষ্টি) সালাদ অন্যান্য	..... ..... ..... ..... ..... ..... .....

রাতের খাবার ৮.০০-৮.৩০	ভাত/রুটি/ওটস মাছ/মাংস ডাল সবজি (ভাজি/সিদ্ধ) শাক সালাদ অন্যান্য	..... ..... ..... ..... ..... .....
ঘুমোনের আগে ১০.০০-১০.৩০	দুধ (ফ্যাট/ফ্যাট ফ্রি/সয়া)	.....

Appendix-5: Physical Activities Guidelines



Activities

Physical activity	MET ^[a]
Light-intensity activities	< 3
writing, desk work, using computer	1.5 ^[10]
walking slowly	2.0 ^[10]
Moderate-intensity activities	3 to 6
walking, 3.0 mph (4.8 km/h)	3.0 ^[10]
sweeping or mopping floors, vacuuming carpets	3 to 3.5 ^[10]
yoga session with asanas and pranayama	3.3 ^[11]
Tennis doubles	5.0 ^[10]
Weight lifting (moderate intensity)	5.0 ^[12]
sexual activity, aged 22	5.8 ^[13]
Vigorous intensity activities	≥6
aerobic dancing, medium effort	6.0 ^[12]
bicycling, on flat, 10–12 mph (16–19 km/h), light effort	6.0 ^[10]
jumping jacks	>6.0 ^[14]
sun salutation (Surya Namaskar, vigorous with transition jumps)	7.4 ^[11]
basketball game	8.0 ^[10]
swimming moderately to hard	8 to 11 ^[10]
jogging, 5.6 mph (9.0 km/h)	8.8 ^[12]
rope jumping (66/min)	9.8 ^[12]
football	10.3 ^[15]
rope jumping (84/min)	10.5 ^[12]
rope jumping (100/min)	11.0 ^[12]
jogging, 6.8 mph (10.9 km/h)	11.2 ^[12]

Strengths and difficulties questionnaire (SDQ)

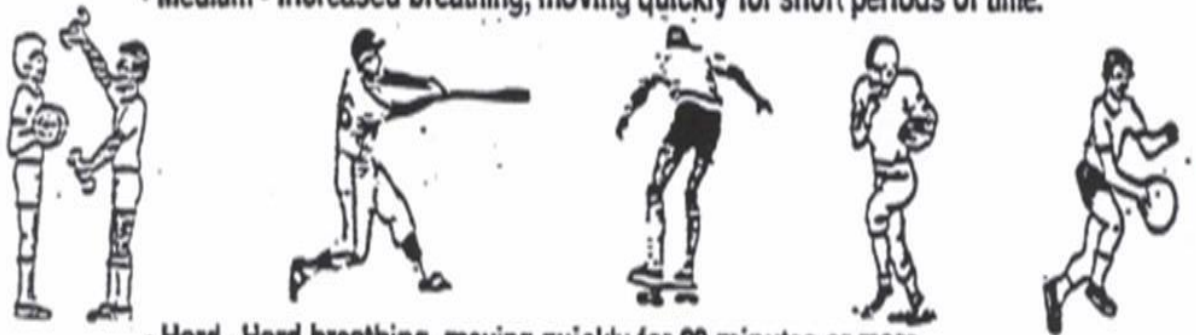
• Very Light - Slow breathing, little or no movement.



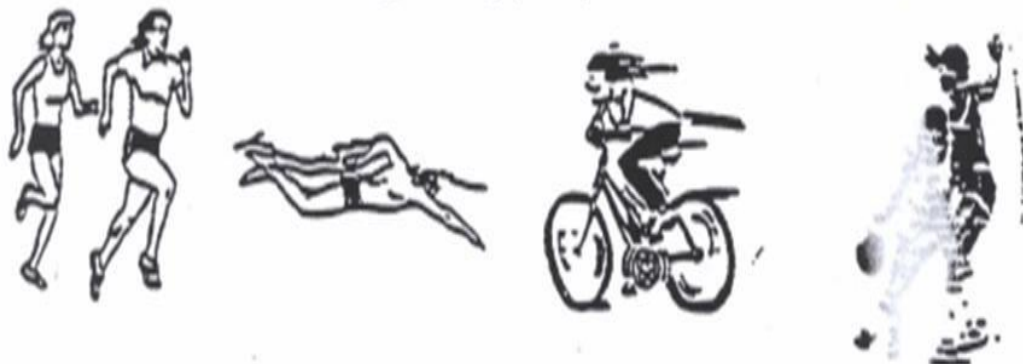
• Light - Normal breathing, regular movement.



• Medium - Increased breathing, moving quickly for short periods of time.



• Hard - Hard breathing, moving quickly for 20 minutes or more.



সবকতা বা অসুবিধা নির্ণয়ক প্রশ্নমালা
(১১-১৭ বছরের ছেলেমেয়েদের জন্য)

প্রত্যেকটি প্রশ্নের জন্য সত্য নয়, কিছুটা সত্য বা নিশ্চিতভাবে সত্য ঘরে টিক চিহ্ন দাও। সবকটি প্রশ্নের উত্তর দিলে আমাদের যাচাই করতে সুবিধে হবে। গত ছয় মাসে অথবা স্কুলের এই বছরে প্রশ্নগুলো তোমার ওপর যেভাবে খাটে সেই ভিত্তিতে উত্তর দাও।

তোমার নাম.....

ছেলে/মেয়ে

জন্ম তারিখ.....

	সত্য নয়	কিছুটা সত্য	নিশ্চিতভাবে সত্য
আমি অন্যদের অনুভূতিকে মূল্য দিই	☐	☐	☐
আমি অস্থির বোধ করি, বেশি ফল চূপ করে থাকতে পারি না	☐	☐	☐
আমার প্রায়ই মাথাধরা, পেটবাথা বা বমি বমি ভাব হয়	☐	☐	☐
সাধারণতঃ অন্য ছেলেমেয়েদের সাথে খাবার, খেলনা, পেন্সিল ইত্যাদি সহজেই ভাগাভাগি করে নিই	☐	☐	☐
আমি খুব রাগ হয়ে যাই, প্রায়ই মেজাজ খারাপ করি	☐	☐	☐
আমি বেশ একা, সাধারণতঃ একা একা খেলি বা নিজের মধ্যে থাকি	☐	☐	☐
বড়রা আমাকে যা করতে বলে, সাধারণতঃ তা করি	☐	☐	☐
আমি অনেক দুশ্চিন্তা করি	☐	☐	☐
কেউ বাথা পেলে, মন খারাপ করলে বা অসুস্থ বোধ করলে সাহায্য করি	☐	☐	☐
আমি সারাক্ষণ উসখুস করি বা গা-হাত মোড়ামুড়ি করি	☐	☐	☐
আমার অন্ততঃ একজন ভালো বন্ধু আছে	☐	☐	☐
আমি খুব মারামারি করি। আমি যা চাই অন্যদেরকে দিয়ে তা করিয়ে নিতে পারি	☐	☐	☐
আমি প্রায়ই বিষয়, মনসরা ও কীদো কীদো থাকি	☐	☐	☐
আমার বয়সী ছেলেমেয়েরা সাধারণতঃ আমাকে পছন্দ করে	☐	☐	☐
আমি সহজেই অন্যমনস্ক হয়ে পড়ি, মনোযোগ ধরে রাখতে আমার কষ্ট হয়	☐	☐	☐
অচেনা পরিবেশে আমি ঘাবড়ে যাই, সহজেই সাহস হারাই	☐	☐	☐
ছোটদের প্রতি আমার মায়া মমতা আছে	☐	☐	☐
আমি প্রায়ই মিথ্যা কথা বা খাওয়া দেবার দায়ে অভিযুক্ত হই	☐	☐	☐
অন্য ছেলেমেয়েরা আমার পেছনে লাগে ও আমার ওপর গায়ের জোর দেখায়	☐	☐	☐
আমি অপরকে সাহায্য করতে প্রায়ই এগিয়ে যাই (বাবা-মা, শিক্ষক, অন্য ছেলেমেয়েদের)	☐	☐	☐
আমি ভেবে চিন্তে কাজ করি	☐	☐	☐
বাড়ি, স্কুল বা অন্য জায়গা থেকে আমি না বলে অন্যের জিনিস নিয়ে থাকি	☐	☐	☐
আমার বয়সী ছেলেমেয়েদের চাইতে বড়দের সাথে ভালো মিশতে পারি	☐	☐	☐
আমি অনেক ভয় পাই, একটুতেই চমকে যাই	☐	☐	☐
আমি কোন কাজ ধরলে শেষ করি, আমার মনোযোগ ভালো	☐	☐	☐

তোমার স্বাক্ষর

আজকের তারিখ

তোমার সাহায্যের জন্য অনেক ধন্যবাদ

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Respondent Sample Reports:

Sample Report:

BIOCHEMISTRY REPORT			
Invoice No : BA2112077498	Invoice Date : 19/12/21	Delivery Date : 19/12/21	Report No : 202112141586
Patient Name : SHAHRIAR HASAN NIPUN	Age : 11 Y	Gender : Male	
Referred By : DR. RIZWANUL AHSAN (BIPUL) MBBS,PFT(CHILD) DCH(C)			
Sample : BLOOD		LAB. No : 202112171296	
Tests : Lipid Profile Serum (F)			
Test is carried out by automated analyzer: Dimension RxL Max			
Test	Result	Ref. Range	Classification
Lipid Profile Serum			
Total Cholesterol	148 mg/dL	< 200 200-239 ≥ 240	Desirable Borderline High
HDL Cholesterol	47 mg/dL	<40 ≥60	Low High
LDL Cholesterol	65 mg/dL	< 100 100 - 129 130 - 159 160 - 189 ≥ 190	Optimal Near or above Optimal Borderline High High Very High
Triglycerides	89 mg/dL	<150 150-199 200-499 ≥500	Normal Borderline High Very High
Non-HDL Cholesterol	101 mg/dl	30 mg/dl higher than LDL goal	
The Ref Range are according to the recommendations of Adult Treatment Panel III (ATP III) of National Cholesterol Education Program.			
 Dr. Zafar Mollah Clinical Technologist(Lab)		 DR. LOKESH CHAKRABORTY MBBS(DU), M. Phil Clinical Pathology(BSMM) Asst. Professor & Head of the Department of Pathology National Institute of ENT, Dhaka	
by & Date :: ZAFAR on 19/12/2021 01:30:11 PM			
4, Road 10, Merul Badda, Dhaka 1212, Bangladesh, Tel : 02 55053711-2, E-mail : info@labaidgroup.com, Web : www.labaidgroup.com			

BANGLADESH SHISHU HOSPITAL & INSTITUTE
DEPARTMENT OF BIOCHEMISTRY & MOLECULAR BIOLOGY
 Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh.
 Tel: 9104211-9104220, Ext. No: 255

Bill No : 323118174
 Patient Name : SUNAN AHMED
 Specimen : BLOOD
 IP NO :

Inv. Date : 17-JUL-23
 Sex : Male
 Bed No :

Print Date : 17-JUL-23 04:34 PM
 Age : 12 Y 0 M 0 D

OUTDOOR

Biochemistry

Test	Result	Unit	Reference Value
Random Blood Sugar (RBS)	5.5	m mol/L	3.3 - 8.1 m mol/L
S. Creatinine	55	u mol/L	Child 40 - 110 u mol/L Adult 60 - 120 u mol/L
S. Cholesterol	5.7	m mol/L	Child: 2.8 - 4.8 m mol/L Adult: 3.2 - 6.7 m mol/L

DEPARTMENT OF BIOCHEMISTRY & MOLECULAR BIOLOGY
 Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh.
 Tel: 9104211-9104220, Ext. No: 255

Bill No : 323118174
 Patient Name : SUNAN AHMED
 Specimen : BLOOD
 IP NO :

Inv. Date : 17-JUL-23
 Sex : Male
 Bed No :

Print Date : 18-JUL-23 11:13 AM
 Age : 12 Y 0 M 0 D

OUTDOOR

Immunology

Test	Result	Unit	Reference Value
S.FT4	1.41	ng/dl	Adult: 0.89 - 1.76 Male: (1-07 Days.) 1.71 - 6.60 (8-15 Days.) 1.33 - 3.60 (1-3 YEARS) 0.98 - 2.00 (4-6 YEARS) 0.93 - 1.77 (7-8 YEARS) 1.00 - 1.78 (9-10 YEARS) 0.80 - 6.20 11 YEARS 0.97 - 7.10 Female: (01-07 Days) 2.30 - 6.90 (08-15 Days) 1.69 - 5.20 (1-3 YEAR) 0.86 - 1.90 (4-6 YEARS) 1.11 - 2.10 7-8 YEARS 1.10 - 1.98
S. Thyroid Stimulating Hormone (TSH)	3.01	μIU/ml	Adult: 0.40 - 4.0 1 Year 0.40 - 8.60 2 Year 0.36 - 7.60 3 Year 0.33 - 6.70 4 Year 0.33 - 6.30 5 Year 0.34 - 6.10 6 Year 0.35 - 5.60 M (01-07 Days.) 1.99 - 28.0 (08-15 Days.) 2.30 - 12.2 F (01-07 Days.) 1.81 - 12.0 (08-15 Days.) 1.78 - 12.6

Appendix-6: Photo Gallery of Activities



Photo-1: Nutrition Counselling Session



Photo-2: FGD with Parents

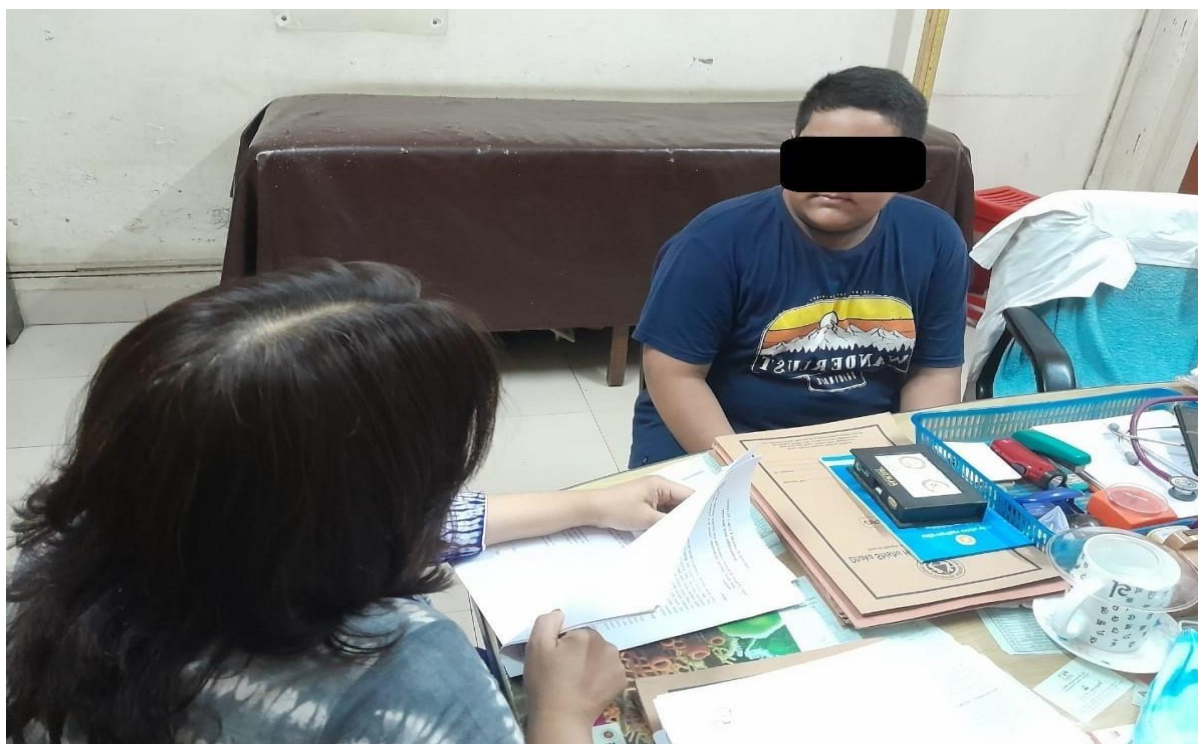


Photo-3: Collection of Data at OPD Center



Photo-4: Anthropometric Measurement (Height) at OPD Center

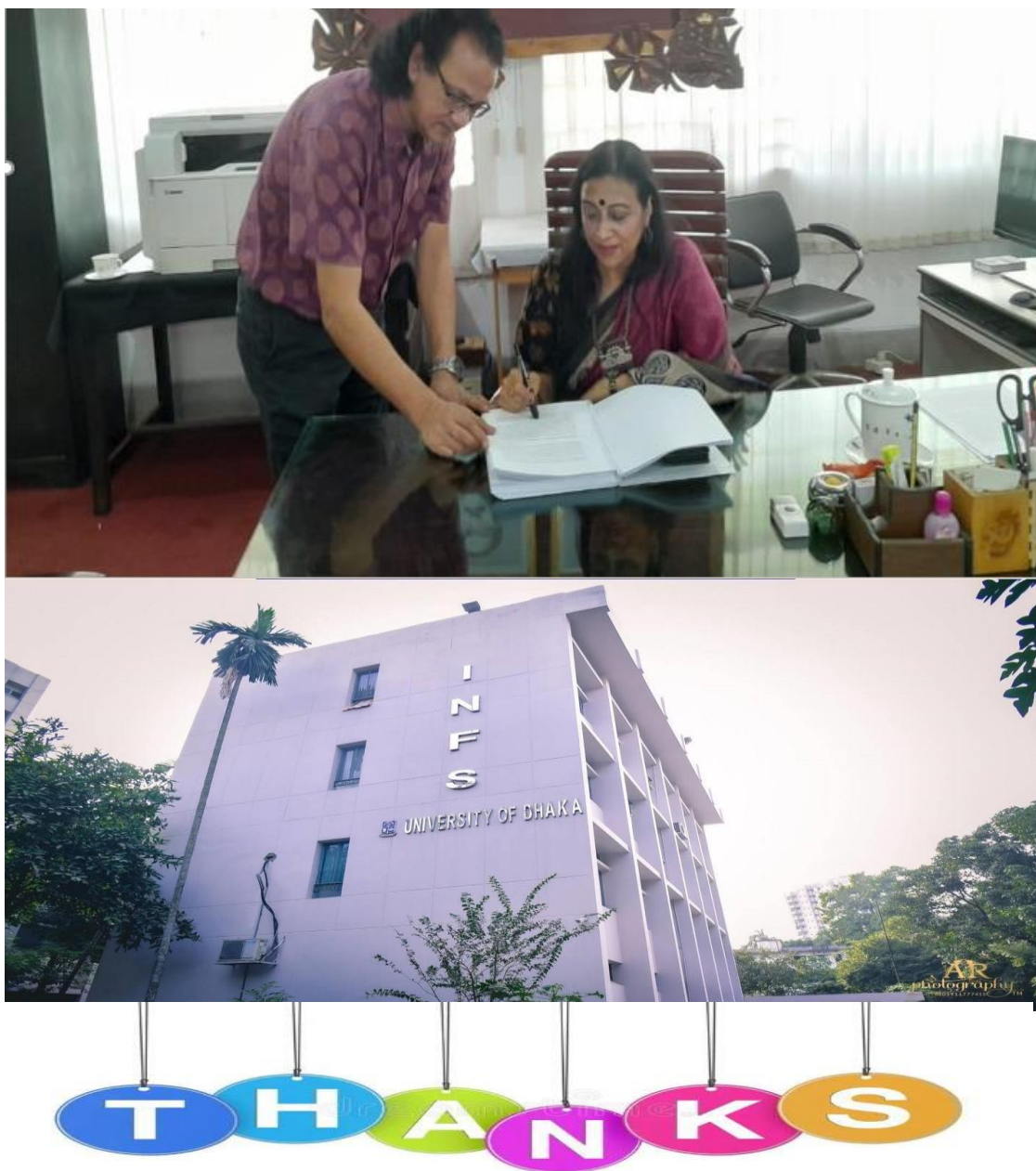


Photo-5: Working Discussion with Supervisor at INFS, Dhaka University