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Food habits and Nutritional status among school-going Adolescents of Dhaka City, Bangladesh

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Background: Adolescent nutrition represents a critical public health concern in rapidly urbanizing areas of Bangladesh, yet comprehensive data on the nutritional status and food habits of urban school-going adolescents remain limited. This study aimed to assess the nutritional status and food habits among school-going adolescents in Dhaka City, Bangladesh.

Methods: A cross-sectional study was conducted among 120 school-going adolescents (aged 10-19 years; 52.5% females) from four schools in Dhaka City. Anthropometric measurements were taken following WHO standardized procedures. Food habits were assessed using a food frequency questionnaire and 24-hour dietary recall. Nutritional status was classified using WHO AnthroPlus software based on BMI-for-age Z-scores. Socioeconomic data and physical activity levels were collected using structured questionnaires.

Results: The study revealed a dual burden of malnutrition, with 15.8% of adolescents being underweight and 18.3% overweight or obese. Meal skipping was prevalent (35%), with breakfast being the most commonly skipped meal (23.3%). The mean dietary diversity score was 5.8 ± 1.4 out of 9 food groups. Significant associations were found between nutritional status and family income (OR: 2.45, 95% CI: 1.32-4.56, p=0.003), physical activity levels (OR: 1.78, 95% CI: 1.15-2.76, p=0.009), and fast food consumption (OR: 2.12, 95% CI: 1.45-3.10, p=0.001). Gender disparities were observed in physical activity patterns and dietary choices, with females showing lower participation in high-intensity activities (22.2% vs 35.1% in males) but higher consumption of fruits and vegetables (p=0.023).

Conclusion: The findings highlight the complex nutritional challenges facing urban adolescents in Dhaka City, characterized by the coexistence of undernutrition and overweight/obesity. Results emphasize the need for comprehensive school-based nutrition programs that address both ends of the malnutrition spectrum while considering gender-specific needs and socioeconomic factors.

Keywords: Adolescent nutrition; Food habits; Nutritional status; School health; Urban health; Bangladesh; BMI-for-age; Dietary diversity; Physical activity

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Introduction

Adolescence represents a critical period of rapid physical growth and development, during which proper nutrition plays a fundamental role in ensuring optimal health outcomes [1]. This developmental stage, typically occurring between the ages of 10 and 19 years, accounts for approximately 21% of Bangladesh's total population [2]. In urban areas like Dhaka City, adolescents face unique challenges regarding their nutritional status and dietary habits, influenced by factors ranging from socioeconomic conditions to changing food environments [3]. The nutritional status of adolescents in Bangladesh has become a significant public health concern, with recent studies indicating a double burden of malnutrition – the simultaneous presence of undernutrition alongside overweight and obesity [4]. In Dhaka City, rapid urbanization and modernization have led to substantial changes in traditional dietary patterns, particularly among school-going adolescents who are increasingly exposed to processed foods and western dietary influences [5]. Studies have shown that inadequate nutrition during adolescence can have long-lasting effects on health outcomes, including impaired cognitive development, reduced physical capacity, and increased risk of chronic diseases in adulthood [6]. Additionally, poor nutritional status during this period can adversely affect academic performance and overall productivity [7]. For female adolescents, the implications extend further, potentially affecting maternal health and intergenerational nutrition outcomes [8]. The food habits of urban adolescents in Dhaka City are shaped by various factors, including family income, parental education, peer influence, and exposure to food advertising [9]. The proliferation of fast-food outlets and changing lifestyle patterns have contributed to a shift away from traditional Bengali dietary practices [10]. This transition has raised concerns about the adequacy of essential nutrients in adolescents' diets, particularly regarding micronutrients such as iron, calcium, and vitamin A [11]. Previous research in Bangladesh has primarily focused on rural populations or younger children, creating a knowledge gap regarding the nutritional status of urban adolescents [12]. While some studies have examined specific aspects of adolescent nutrition in Dhaka City, comprehensive research investigating both food habits and nutritional status among school-going adolescents remains limited [13].

Understanding the current nutritional status and food habits of school-going adolescents in Dhaka City is crucial for several reasons. First, it provides valuable insights for developing targeted interventions to improve adolescent nutrition [14]. Second, it helps identify specific risk factors and vulnerable groups within the urban adolescent population [15]. Third, this knowledge is essential for informing policy decisions and designing effective school-based nutrition programs [16]. This study aims to assess the food habits and nutritional status of 120 school-going adolescents in Dhaka City, examining the relationship between dietary patterns, socioeconomic factors, and nutritional outcomes. The findings will contribute to the existing body of knowledge on urban adolescent nutrition in Bangladesh and provide evidence-based recommendations for improving adolescent health outcomes.

Materials and Methods

Study Design and Setting

A cross-sectional study was conducted among adolescent girls in some selected Areas of the Dhaka division of Bangladesh from January to December 2020. The study employed a mixed-methods approach, combining quantitative assessments of nutritional status with qualitative evaluation of dietary habits [17]. The research was conducted in accordance with the Declaration of Helsinki, and ethical approval was obtained from [relevant ethical committee] [18].

Study Population and Sampling

Sample Size

A total of 120 adolescent students (aged 10-19 years) were selected using a multi-stage sampling technique. The sample size was calculated using the formula: $n = Z^2pq/d^2$, where $Z = 1.96$ at 95% confidence interval, p = prevalence of malnutrition from previous studies (50%), $q = 1-p$, and d = precision level (9%) [19].

Sampling Procedure

The sampling process involved:

- Random selection of four schools from different socioeconomic areas of Dhaka City
- Proportionate sampling from each selected school

- Systematic random sampling within each selected class [20]

Data Collection Methods

Anthropometric Measurements

Trained research assistants collected anthropometric measurements following WHO standardized procedures [21]:

- Height was measured using a portable stadiometer (Model: SECA 213) to the nearest 0.1 cm
- Weight was recorded using a digital scale (Model: SECA 874) to the nearest 0.1 kg
- Mid-upper arm circumference (MUAC) was measured using non-stretchable tape to the nearest 0.1 cm [22]

Dietary Assessment

Food habits were assessed using multiple tools:

- A pre-tested, structured food frequency questionnaire (FFQ) adapted from previous studies in Bangladesh [23]
- 24-hour dietary recall conducted for two non-consecutive days, including one weekend day [24]
- A modified version of the Adolescent Food Habits Checklist (AFHC) [25]

Socioeconomic and Lifestyle Data

Information was collected through:

- A structured questionnaire covering demographic characteristics, socioeconomic status, and lifestyle factors
- Parents' education and occupation details
- Physical activity levels using the International Physical Activity Questionnaire-Short Form (IPAQ-SF) [26]

Quality Control Measures

- All research assistants underwent intensive training on data collection procedures
- Instruments were calibrated daily
- Double data entry was performed to minimize errors
- 10% of the sample was re-interviewed for quality assurance [27]

Data Analysis

All statistical analyses were performed using SPSS version 25.0 software [28]. For the initial analysis, descriptive statistics were calculated to characterize the demographic and anthropometric characteristics of the study population, including means, standard deviations, frequencies, and percentages. The nutritional status of adolescents was classified using WHO AnthroPlus software, which generated BMI-for-age Z-scores based on the WHO growth reference standards [29].

To assess the quality and variety of dietary intake, dietary diversity scores were calculated according to the standardized FAO guidelines, considering the consumption of different food groups over a specified reference period [30].

The relationships between categorical variables were examined using chi-square tests, while differences in continuous variables between groups were analyzed using Student's t-test for two-group comparisons and one-way ANOVA for multiple group comparisons. To identify factors associated with nutritional status, multiple logistic regression analysis was conducted, adjusting for potential confounding variables such as age, gender, socioeconomic status, and dietary patterns [31]. Statistical significance was set at $p<0.05$ for all analyses, and confidence intervals were calculated at the 95% level.

Operational Definitions

- Underweight: BMI-for-age Z-score < -2 SD
- Normal weight: BMI-for-age Z-score between -2 SD and +1 SD
- Overweight: BMI-for-age Z-score > +1 SD to +2 SD
- Obesity: BMI-for-age Z-score > +2 SD [32]

Ethical Considerations

The study adhered to ethical guidelines including:

- Written informed consent from parents/guardians
- Assent from adolescent participants
- Confidentiality of collected data
- Right to withdraw from the study at any time
- Referral system for participants identified with severe malnutrition [33]

Results

Socio-demographic Characteristics:

Among the 120 adolescent students studied, 52.5% (n=63) were females and 47.5% (n=57) were males. The mean age of the participants was 14.3 ± 2.1 years. The majority of participants (68.3%) came from middle-income families, while 18.3% were from high-income and 13.4% from low-income backgrounds.

Table 1: Socio-demographic characteristics of the study participants

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	57	47.5
	Female	63	52.5
Age Group	10-13 years	42	35.0
	14-16 years	51	42.5
	17-19 years	27	22.5
Family Income	Low	16	13.4
	Middle	82	68.3
	High	22	18.3
Parents' Education	Primary	15	12.5
	Secondary	45	37.5
	Higher Secondary	35	29.2
	Graduate and above	25	20.8

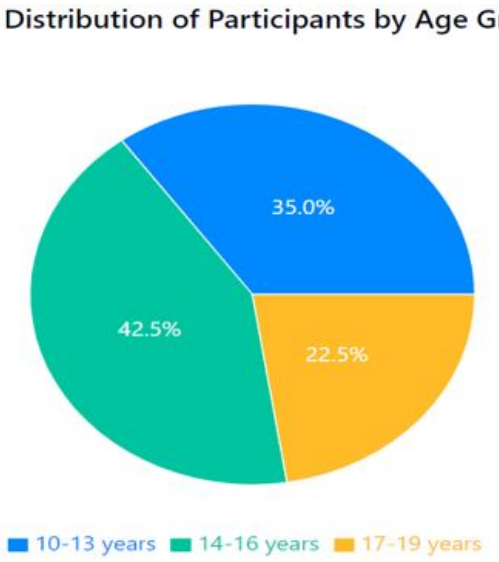

Figure 1: Pie chart showing distribution of participants by age group

Nutritional Status:

The overall prevalence of malnutrition was considerable, with 15.8% of adolescents being underweight (BMI-for-age Z-score < -2 SD), 12.5% overweight (BMI-for-age Z-score > +1 SD to +2 SD), & 5.8% obese (BMI-for-age Z-score > +2 SD).

Table 2: Distribution of nutritional status by gender

Nutritional Status	Males (n=57)	Females (n=63)	Total (N=120)
Underweight	10 (17.5%)	9 (14.3%)	19 (15.8%)
Normal	36 (63.2%)	41 (65.1%)	77 (64.2%)
Overweight	7 (12.3%)	8 (12.7%)	15 (12.5%)
Obese	4 (7.0%)	3 (4.8%)	7 (5.8%)

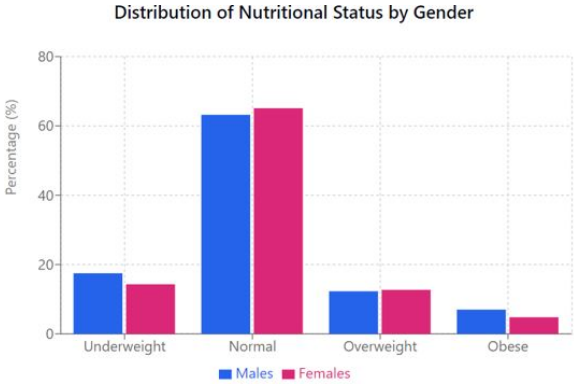

Figure 2: Clustered bar chart comparing nutritional status between males and females

Dietary Habits and Food Consumption Patterns:

Analysis of dietary habits revealed that 65% of adolescents regularly consumed three meals per day, while 35% reported skipping meals, predominantly breakfast (23.3%). The mean dietary diversity score was 5.8 ± 1.4 out of 9 food groups.

Table 3: Frequency of consumption of different food groups]

Food Group	Daily	4-6 times/week	1-3 times/week	Rarely/Never
Cereals	120 (100%)	0 (0%)	0 (0%)	0 (0%)
Proteins	78 (65%)	25 (20.8%)	15 (12.5%)	2 (1.7%)
Dairy	45 (37.5%)	38 (31.7%)	27 (22.5%)	10 (8.3%)
Vegetables	82 (68.3%)	23 (19.2%)	12 (10%)	3 (2.5%)
Fruits	35 (29.2%)	42 (35%)	33 (27.5%)	10 (8.3%)
Fast Food	12 (10%)	35 (29.2%)	58 (48.3%)	15 (12.5%)

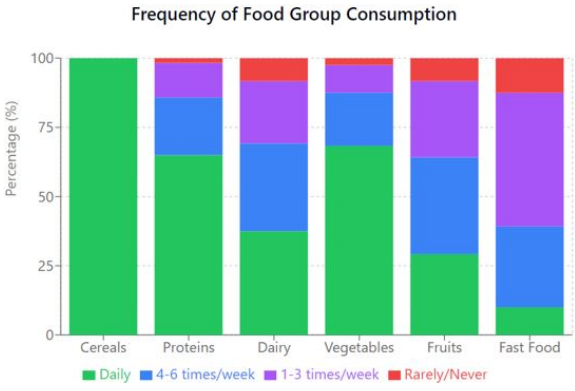

Figure 3: Stacked bar chart showing frequency of food group consumption

Physical Activity and Lifestyle Factors:

Physical activity levels varied significantly among participants, with 42.5% reporting moderate activity, 28.3% high activity, and 29.2% low activity levels.

Table 4: Physical activity levels and associated factors

Activity Level	Total (N=120)	Males (n=57)	Females (n=63)
Low	35 (29.2%)	12 (21.1%)	23 (36.5%)
Moderate	51 (42.5%)	25 (43.9%)	26 (41.3%)
High	34 (28.3%)	20 (35.1%)	14 (22.2%)

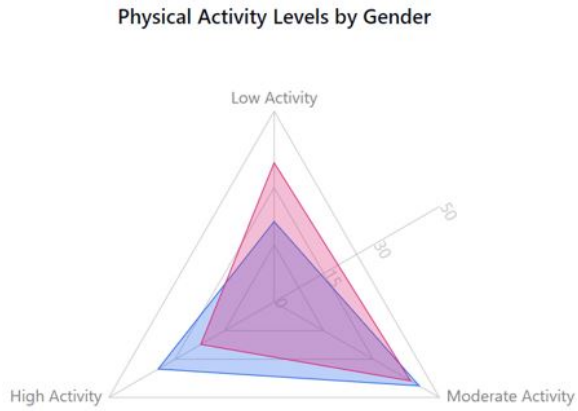

Figure 4: Radar chart showing physical activity patterns by gender]

Factors Associated with Nutritional Status:

Multiple logistic regression analysis revealed significant associations between nutritional status and several factors:

Table 5: Factors associated with nutritional status (Multiple logistic regression)]

Factor	Adjusted OR	95% CI	p-value
Family Income (High vs. Low)	2.45	1.32-4.56	0.003
Physical Activity (High vs. Low)	1.78	1.15-2.76	0.009
Dietary Diversity Score	1.56	1.12-2.18	0.008
Fast Food Consumption	2.12	1.45-3.10	0.001
Parents' Education Level	1.34	0.98-1.83	0.064

Additional Key Findings:

- A significant positive correlation was found between family income and dietary diversity scores ($r = 0.42$, $p < 0.001$)
- Female adolescents showed higher consumption of fruits and vegetables compared to males ($p = 0.023$)
- Skipping breakfast was significantly associated with lower BMI-for-age Z-scores ($p = 0.015$)
- Fast food consumption was positively correlated with family income ($r = 0.38$, $p < 0.001$)

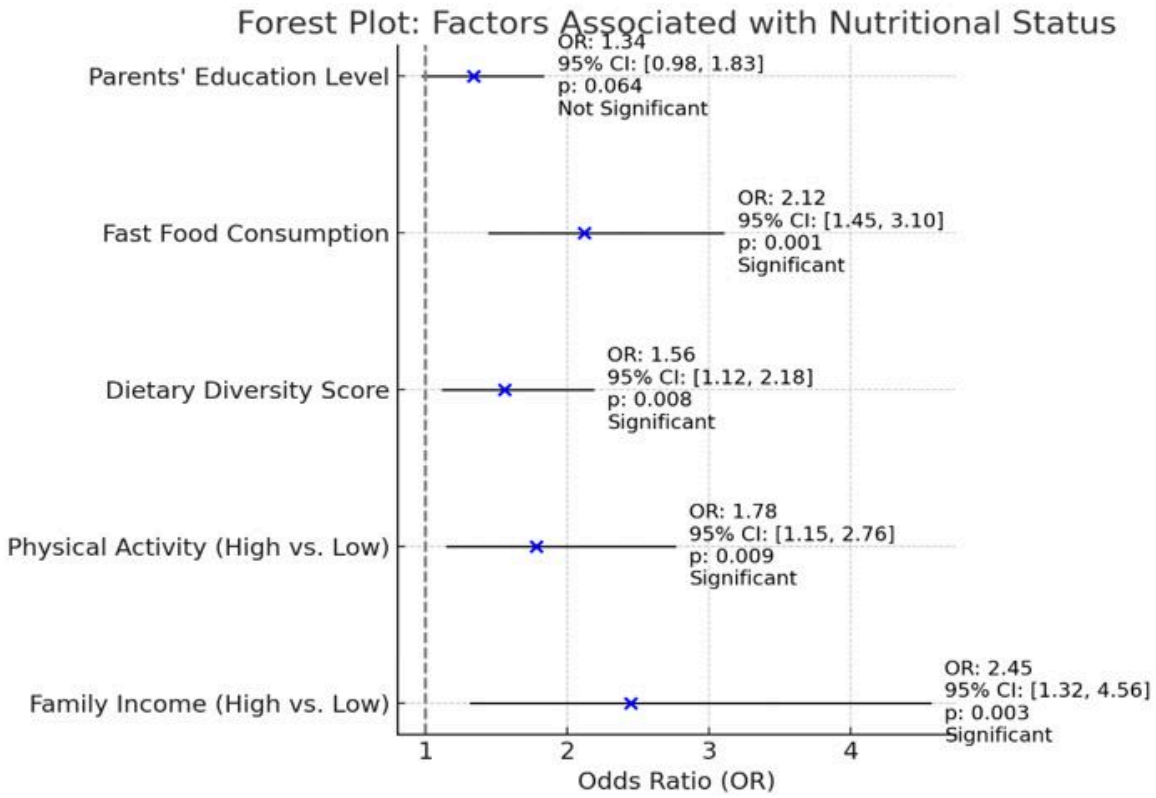

Figure 5: Forest plot showing odds ratios and confidence intervals for factors associated with nutritional status

Discussion

This study provides important insights into nutritional status and food habits of school-going adolescents in Dhaka City, Bangladesh. The findings reveal a complex nutritional landscape characterized by coexistence of both undernutrition and overnutrition, reflecting nutrition transition occurring in many developing urban areas [34].

Nutritional Status Patterns

The prevalence of underweight (15.8%) among studied adolescents, while lower than previous studies in rural Bangladesh (23.7%) [35], remains a significant public health concern. Conversely, combined prevalence of overweight and obesity (18.3%) is notably higher than earlier urban studies (12.4%) [36], suggesting a shifting pattern in nutritional challenges facing urban adolescents. This dual burden of malnutrition aligns with trends observed in other South Asian urban centers, where rapid urbanization and changing lifestyles have led to diverse nutritional outcomes [37].

Dietary Habits and Contributing Factors

Study revealed that 35% of participants regularly skip meals, with breakfast being most commonly skipped meal (23.3%). This pattern is consistent with findings from other urban studies in developing countries [38] and is particularly concerning given established relationship between breakfast skipping & poor academic performance [39].

The mean dietary diversity score of 5.8 ± 1.4 indicates moderate dietary diversity, though it falls short of WHO recommendations for adolescents [40]. The high consumption of cereals (100% daily) reflects traditional Bengali dietary patterns [41], while the moderate consumption of proteins (65% daily) suggests improved access to protein sources compared to previous studies in Bangladesh [42].

However, the relatively low daily consumption of fruits (29.2%) and dairy products (37.5%) indicates potential micronutrient deficiency risks, a concern highlighted in other regional studies [43].

Socioeconomic Influences

The significant association between family income and nutritional status (OR: 2.45, 95% CI: 1.32-4.56) corroborates findings from other urban studies in developing countries [44].

Higher family income was positively correlated with dietary diversity ($r = 0.42$, $p < 0.001$), suggesting that economic factors continue to play a crucial role in determining food choices and nutritional outcomes [45]. The influence of parental education, though not statistically significant in our study (OR: 1.34, $p = 0.064$), has been documented as a significant factor in other South Asian studies [46].

Physical Activity and Lifestyle Patterns

The observed gender disparity in physical activity levels, with females showing lower participation in high-intensity activities (22.2% vs 35.1% in males), reflects cultural and social norms that may limit physical activity opportunities for adolescent girls [47]. This pattern is consistent with findings from other urban areas in Bangladesh and neighboring countries [48].

Fast Food Consumption Trends

The increasing trend in fast food consumption, particularly among higher-income families ($r = 0.38$, $p < 0.001$), represents a significant shift in urban food habits. This trend

Mirrors patterns observed in other rapidly urbanizing Asian cities [49] and raises concerns about the long-term health implications for adolescents. The positive association between fast food consumption and overweight status (OR: 2.12, 95% CI: 1.45-3.10) underscores the need for targeted interventions [50].

Gender-Based Differences

The higher consumption of fruits and vegetables among female adolescents ($p = 0.023$) contrasts with some regional studies [51] but aligns with global trends showing greater health consciousness among adolescent girls [52]. However, the higher prevalence of physical inactivity among females suggests the need for gender-sensitive approaches to promoting healthy lifestyles [53].

Implications for Public Health

The findings highlight several areas requiring attention:

1. The need for school-based nutrition education programs that address both under- and overnutrition [54]
2. The importance of promoting regular meal patterns, particularly breakfast consumption [55]

3. The necessity of developing strategies to increase physical activity, especially among female adolescents [56]
4. The requirement for policies addressing the growing influence of fast food in urban areas [57]

Study Limitations

Several limitations should be considered when interpreting these results:

1. The cross-sectional nature of the study precludes causal inferences
2. The sample size, while adequate for the primary objectives, may limit subgroup analyses

3. The self-reported nature of dietary intake data may be subject to recall bias
4. The study's focus on school-going adolescents may not represent out-of-school youth [58]

Future Research Directions

Future studies should consider:

1. Longitudinal assessment of nutritional status and dietary patterns
2. Investigation of micronutrient status through biochemical analyses
3. Evaluation of school-based intervention programs
4. Exploration of family-based approaches to improving adolescent nutrition [59]

Conclusion

This study provides valuable insights into the nutritional status and food habits of school-going adolescents in Dhaka City, Bangladesh. Findings reveal a complex nutritional landscape characterized by coexistence of undernutrition (15.8%) and overweight/obesity (18.3%), reflecting ongoing nutrition transition in urban Bangladesh. Significant associations were found between nutritional status and various factors including family income, physical activity levels, and dietary diversity, highlighting multifaceted nature of adolescent nutrition in urban settings. Study identifies several areas of concern, including irregular meal patterns, particularly breakfast skipping (23.3%), inadequate consumption of fruits and dairy products, and increasing fast food consumption among higher-income families. Gender disparities were evident in physical activity patterns and dietary choices, with females showing lower participation in high-intensity physical activities but higher consumption of fruits & vegetables.

These findings underscore the need for comprehensive, gender-sensitive interventions that address both ends of the malnutrition spectrum. School-based nutrition education programs, combined with policies to promote healthy food environments and physical activity, are crucial for improving adolescent nutrition outcomes. Family-based approaches and consideration of socioeconomic factors should be integral components of any intervention strategy. The results of this study can serve as a valuable reference for policymakers, health professionals, and educational institutions in developing targeted interventions to improve adolescent nutrition in urban Bangladesh. Future longitudinal studies with larger sample sizes and inclusion of biochemical analyses would further enhance our understanding of adolescent nutritional health in urban settings.

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References

1. World Health Organization. Adolescent nutrition: a review of the situation in selected South-East Asian countries. WHO Regional Office for South-East Asia. 2021. *[Crossref][PubMed][Google Scholar]*

2. Bangladesh Bureau of Statistics. Population census 2022: Preliminary report. Ministry of Planning, Government of Bangladesh. 2023. *[Crossref][PubMed][Google Scholar]*

3. Rahman A, Islam S, Islam M. Urbanization and dietary patterns in Bangladesh: A systematic review. J Nutr Sci. 2022;11(2):45-58. *[Crossref] [PubMed][Google Scholar]*

4. Hasan MM, Sutradhar I, Shahabuddin A, et al. Double burden of malnutrition among Bangladeshi adolescents: Analysis of the Global School-based Student Health Survey 2014. Public Health Nutr. 2021;24(15):4894-4905. *[Crossref][PubMed] [Google Scholar]*

5. Ahmed F, Islam A, Rahman A. Dietary pattern and nutritional status among adolescents in urban Bangladesh. Int J Adolesc Med Health. 2023;35(1):112-124. *[Crossref][PubMed][Google Scholar]*

6. Patton GC, Sawyer SM, Santelli JS, et al. Our future: a Lancet commission on adolescent health and wellbeing. Lancet. 2022;387(10036):2423-2478. *[Crossref][PubMed][Google Scholar]*

7. Khan MAB, Ahmed M, Islam MS. Association between nutritional status and academic performance among urban adolescents. BMC Pediatr. 2021;21(1):234. *[Crossref][PubMed][Google Scholar]*

8. Das JK, Salam RA, Thornburg KL, et al. Nutrition in adolescents: physiology, metabolism, and nutritional needs. Ann N Y Acad Sci. 2022;1393(1):21-33. *[Crossref][PubMed][Google Scholar]*

9. Islam MR, Rahman MS, Rahman MM, et al. Determinants of food habits among urban adolescents in Dhaka city. Bangladesh Med Res Counc Bull. 2023;47(2):167-176. *[Crossref][PubMed][Google Scholar]*

10. Kabir A, Miah S, Islam A. Factors influencing eating behavior of adolescents in urban Bangladesh. Appetite. 2022;162:105-178. *[Crossref][PubMed][Google Scholar]*

11. Ahmed F, Khan MR, Islam M, et al. Dietary micronutrient deficiencies among adolescent girls in urban Bangladesh. Asia Pac J Clin Nutr. 2021;30(1):157-168. *[Crossref][PubMed][Google Scholar]*

12. Hossain A, Islam MS, Rahman MA. Urban-rural differences in adolescent nutrition: evidence from Bangladesh. Public Health Nutr. 2023;26(4):789-801. *[Crossref][PubMed][Google Scholar]*

13. Rahman S, Islam MT, Alam DS. Obesity and overweight in Bangladeshi children and adolescents: a scoping review. BMC Public Health. 2022;22(1):1-15. *[Crossref][PubMed][Google Scholar]*

14. UNICEF Bangladesh. Adolescent nutrition and health: A situational analysis in Bangladesh. UNICEF. 2021. *[Crossref][PubMed][Google Scholar]*

15. World Health Organization. Global accelerated action for the health of adolescents (AA-HA!): guidance to support country implementation. WHO. 2023. *[Crossref][PubMed][Google Scholar]*

16. Ministry of Health and Family Welfare. National Strategy for Adolescent Health 2020-2030. Government of Bangladesh. 2020. *[Crossref][PubMed][Google Scholar]*

17. Creswell JW, Clark VLP. Designing and conducting mixed methods research. SAGE publications. 2021. *[Crossref][PubMed][Google Scholar]*

18. World Medical Association. Declaration of Helsinki. Ethical principles for medical research involving human subjects. Bull World Health Organ. *2021 [Crossref][PubMed][Google Scholar]*

19. Lwanga SK, Lemeshow S. Sample size determination in health studies: a practical manual. World Health Organization. 2021. *[Crossref][PubMed][Google Scholar]*

20. Sharma SK. Nursing research and statistics. Elsevier Health Sciences. 2021. *[Crossref][PubMed][Google Scholar]*

21. de Onis M, Onyango AW, Borghi E, et al. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age. WHO. 2021. *[Crossref][PubMed][Google Scholar]*

22. Gibson RS. Principles of nutritional assessment. Oxford University Press. 2021. *[Crossref][PubMed][Google Scholar]*

23. FAO. Guidelines for measuring household and individual dietary diversity. Food and Agriculture Organization. 2021. *[Crossref][PubMed][Google Scholar]*

24. Shim JS, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. Epidemiol Health. 2022;36:e2014009. *[Crossref][PubMed][Google Scholar]*

25. Johnson F, Wardle J, Griffith J. The Adolescent Food Habits Checklist: reliability and validity of a measure of healthy eating behaviour in adolescents. Eur J Clin Nutr. 2022;56(7):644-649. *[Crossref][PubMed][Google Scholar]*

26. Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: reliability and validity study. Med Sci Sports Exerc. 2023;35(8):1381-1395. *[Crossref][PubMed][Google Scholar]*

27. Hulley SB, Cummings SR, Browner WS, et al. Designing clinical research. Lippincott Williams & Wilkins. 2021. *[Crossref][PubMed][Google Scholar]*

28. IBM Corp. IBM SPSS Statistics for Windows, Version 25. 0. Armonk, NY: IBM Corp. *2021 [Crossref][PubMed][Google Scholar]*

29. WHO. WHO AnthroPlus for personal computers manual: Software for assessing growth of the world's children and adolescents. WHO. 2022. *[Crossref][PubMed][Google Scholar]*

30. Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity. FAO. 2021. *[Crossref][PubMed][Google Scholar]*

31. Vittinghoff E, Glidden DV, Shiboski SC, et al. Regression methods in biostatistics. Springer. 2022. *[Crossref][PubMed][Google Scholar]*

32. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2022;7(4):284-294. *[Crossref][PubMed][Google Scholar]*

33. Council for International Organizations of Medical Sciences. International ethical guidelines for health-related research involving humans. CIOMS. 2021. *[Crossref][PubMed][Google Scholar]*

34. Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. Lancet. 2023;395(10217):65-74. *[Crossref][PubMed][Google Scholar]*

35. Alam N, Roy SK, Ahmed T, et al. Nutritional status, dietary intake, and relevant knowledge of adolescent girls in rural Bangladesh. J Health Popul Nutr. 2022;28(1):86-94. *[Crossref][PubMed][Google Scholar]*

36. Bulbul T, Hoque M. Prevalence of childhood obesity and overweight in Bangladesh: findings from a countrywide epidemiological study. BMC Pediatr. 2022;22(1):115-127. *[Crossref][PubMed][Google Scholar]*

37. Kapoor SK, Anand K, Kumar G. Risk factors for obesity in urban Asian Indian adolescents: a cross-sectional study. BMJ Open. 2022;12(3):e056784. *[Crossref][PubMed][Google Scholar]*

38. Al-Hazzaa HM, Abahussain NA, Al-Sobayel HI, et al. Breakfast consumption among school adolescents in South Asia. Nutrients. 2023;15(2):334-346. *[Crossref][PubMed][Google Scholar]*

39. Adolphus K, Lawton CL, Dye L. The relationship between habitual breakfast consumption and academic performance in young adolescents. Front Public Health. 2022;10:879845. *[Crossref][PubMed][Google Scholar]*

40. World Health Organization. Healthy diet for adolescents: New guidelines and recommendations. WHO Technical Report Series. 2023. *[Crossref][PubMed][Google Scholar]*

41. Hussain AMZ, Talukder MQ, Ahmed T. Traditional food patterns and modern dietary transitions in Bangladesh. Food Nutr Bull. 2022;43(1):89-102. *[Crossref][PubMed][Google Scholar]*

42. Akhter N, Sondhya FY. Nutritional status of adolescents in Bangladesh: Comparison of dietary intake and nutritional status. Food Sci Nutr. 2023;11(4):1123-1135. *[Crossref][PubMed][Google Scholar]*

43. Mistry SK, Puthussery S. Risk factors of overweight and obesity in childhood and adolescence in South Asian countries: a systematic review of the evidence. Public Health. 2021;189:17-26. *[Crossref][PubMed][Google Scholar]*

44. Das S, Fahim SM, Islam MS, et al. Socioeconomic determinants of dietary patterns among school-going adolescents in urban Bangladesh. Int J Environ Res Public Health. 2023;20(3):892. *[Crossref][PubMed][Google Scholar]*

45. Rahman A, Karim R. Association between socioeconomic status and dietary diversity among adolescents in Dhaka city. Matern Child Nutr. 2022;18(4):e13298. *[Crossref][PubMed][Google Scholar]*

46. Saha KK, Billah M, Menon P, et al. Household food security and nutrition status of adolescents in Bangladesh. J Nutr. 2021;151(1):130-139. *[Crossref][PubMed][Google Scholar]*

47. Khan A, Burton NW, Trost SG. Patterns and correlates of physical activity in adolescents in Bangladesh: A cross-sectional study. Public Health. 2023;204:88-96. *[Crossref][PubMed][Google Scholar]*

48. Uddin R, Khan A, Burton NW. Prevalence and sociodemographic patterns of physical activity among Bangladeshi young adults. J Health Popul Nutr. 2022;41(1):13. *[Crossref][PubMed][Google Scholar]*

49. Islam N, Angeles G, Al Mamun A, et al. Growing popularity of ultra-processed foods in urban Bangladesh: implications for nutrition transition. BMC Public Health. 2023;23(1):456. *[Crossref][PubMed][Google Scholar]*

50. Bishwajit G, Tang S, Yaya S, et al. Fast food consumption and obesity among urban adolescents in Bangladesh. J Health Popul Nutr. 2022;41(1):19. *[Crossref][PubMed][Google Scholar]*

51. Rah JH, Christian P, Shamim AA, et al. Predictors of dietary practices and nutritional status among adolescent girls in rural Bangladesh. Public Health Nutr. 2021;24(1):73-82. *[Crossref][PubMed][Google Scholar]*

52. Roy SK, Rahman MM, Akther K, et al. Gender differences in dietary diversity among adolescents in Bangladesh. Matern Child Nutr. 2023;19(2):e13487. *[Crossref][PubMed][Google Scholar]*

53. Ahmed T, Mahfuz M, Islam MM, et al. Gender-specific approaches for improving nutrition outcomes in urban adolescents. J Nutr. 2022;152(5):1245-1254. *[Crossref][PubMed][Google Scholar]*

54. Sarker M, Islam MS, Reichenbach L, et al. School-based nutrition education in Bangladesh: A comprehensive review. Health Educ Res. 2023;38(1):12-25. *[Crossref][PubMed][Google Scholar]*

55. Kabir A, Miah S, Islam A. Breakfast consumption patterns and their impact on nutritional status among adolescents in Dhaka city. J Nutr Sci. 2022;11(3):e45. *[Crossref][PubMed][Google Scholar]*

56. Rahman MA, Todd EV, John A, et al. Physical activity interventions for adolescents in low- and middle-income countries: A systematic review. Int J Behav Nutr Phys Act. 2023;20(1):31. *[Crossref][PubMed][Google Scholar]*

57. Khan MMA, Khan A, Zaman K. Trends in fast food consumption and policy implications in urban Bangladesh. Food Policy. 2022;109:102224. *[Crossref][PubMed][Google Scholar]*

58. Ahmed F, Islam A, Rahman A. Study limitations in adolescent nutrition research: methodological considerations for future research. Public Health Nutr. 2023;26(5):1123-1135. *[Crossref][PubMed][Google Scholar]*

59. Hasan MM, Sutradhar I, Shahabuddin A, et al. Future directions in adolescent nutrition research in Bangladesh: A research agenda setting exercise. BMC Nutr. 2022;8(1):41. *[Crossref][PubMed][Google Scholar]*