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Impact Of Dietary Diversity And Its Associated Factors Among Adolescent Girls In Bangladesh

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Abstract: Background: Dietary diversity is crucial for the optimal growth and development of adolescent girls, as nutrition plays a pivotal role in their overall health. Some of the socio demographic factors significantly impact the adolescent dietary habits. Moreover, malnutrition leads to issues such as underweight, irregular menstruation, depression, and irritability, which can have long-term consequences. Implementing school-based education, mass media nutritional programs, and community-based public health interventions can raise awareness and encourage positive dietary changes. The government of Bangladesh should ensure uninterrupted electricity supply and accessible drinking water sources for all households. **Objective:** This study aimed to examine the Impact of dietary diversity and its associated factors among adolescent girls in Bangladesh. **Methodology:** This study utilized a descriptive cross-sectional analysis focused on adolescent girls in Bangladesh. Data collection was conducted through self-reported questionnaires administered online, and the subsequent analysis was performed using the SPSS software. **Findings:** The study highlights a significant relationship between the dietary habits of adolescents and their father's occupation. Findings indicate that near half of the adolescent girls with fathers in uncategorized occupations consume fewer food categories. Additionally, half the of girls without a TV at home consume less than five food categories. Furthermore, more than half of the adolescents living in houses with mud floors show a lower intake of diverse foods. Notably, irregular menstruation (17.3%) and symptoms of depression (11.8%) and irritability (23.7%) were reported among those due to malnutrition. **Conclusion:** The study findings reveal that various socio demographic factors, such as the father's occupation, access to electricity, financial status related to flooring, drinking water sources, and ownership of domestic animals, significantly affect the dietary habits of adolescent girls in Bangladesh. Furthermore, the study highlights the concerning impact of malnutrition on these girls, leading to underweight conditions, irregular menstruation, and feelings of depression and irritability. These findings emphasize the potential long-term consequences on their overall well-being.

Keywords: Adolescent, Dietary Diversity, Public Health, Bangladesh.

1. Introduction

There are 1.2 billion adolescents, worldwide and nearly 90% live in developing countries like Bangladesh [1]. Adolescence is a critical phase in the life cycle and during this phase that there occurs attainment of 40–60% of the peak bone mass and up to 50% of adult body weight along with a 15–20% increase in height [2]. The remarkable growth that occurs in adolescent time is second only to that in the first year of life and this physical growth occurs concomitantly with dramatic cognitive and psychosocial changes [1]. Nutrition is a main component of health and development at this stage of life. Healthy eating is related to the infant evolution, maternal and child health, healthier pregnancy and delivery, lower risk of chronic diseases and better academic achievement[3]. Besides, healthy growth and development essentially need a balanced diet of nutrients and vitamins which includes a variety of foods from different food groups (vegetables, fruits, grains, and animal source foods) [3]. Dietary Diversity is playing a vital role to ensure the proper growth and development of Adolescent girls. Dietary Diversity is defined as the number of different foods or food groups consumed over a given reference period [4]. It provides insights into household access to a variety of foods and can be used as a proxy for nutrient adequacy of the diet of individuals [5]. Furthermore, dietary diversity indicates a person's access to various food sources and thus reflects the adequacy of nutrients, household and individual food security, nutrient intake, and agricultural biodiversity of a particular region[6]. There is consistent evidence that dietary diversity is strongly associated with nutrition sufficiency and is therefore considered an essential element of diet quality [7]. The United Nations Children's Fund Conceptual Framework for Nutrition indicates that inadequate dietary intake results in growth failure, a condition referred to as chronic malnutrition [8]. Inadequate dietary diversity is one of the major public health problems and can result in physical, emotional, and psychological changes among adolescents [9].

This study is mainly focused on the analysis of dietary diversity of adolescent girls in Bangladesh. In Bangladesh, the leading causes for undernutrition, or low diet diversity, among the rural inhabitants include low family income, low education level, and periodic food shortage associated with inadequate dietary intake [7]. The main purpose of this study

is to identify the Impact of dietary diversity and its associated factors among adolescent girls in Bangladesh.

2. MATERIALS AND METHODS

Place of the study:
The research was carried out in both rural and urban areas of four specific districts in Bangladesh. The rural locations included Badargonj upazila (sub-district) in Rangpur district and Mohadevpur upazila in Nowgoan district. The urban settings consisted of Konabari in Gazipur metropolitan city, which is part of Gazipur district, and Bouniabadh in Dhaka metropolitan city, located in Dhaka district.

Study duration:
The study was conducted from July 2017 to December 2017.

Study design:
This stud utilized a cross-sectional design.

Study population:
The study focused on adolescent girls as the target population.

Sampling:
To select the adolescent girls in both settings, a multistage simple random sampling approach was employed. Initially, four upazilas (sub-districts) or metropolitan cities were purposively chosen from four districts. In the next step, 18 villages or mohallas were randomly selected from each upazila or metropolitan city. From each village, six adolescent girls were randomly selected as samples, with an additional two samples collected and interviewed.

Sample size:
A total of 434 participants were included in the study, with 217 selected from rural areas and 217 from urban areas.

Data collection procedure:
After obtaining written informed consent from the respondents and their guardians, interviews were conducted using a pretested structured questionnaire. Additionally, the selected adolescent girls underwent clinical examinations to measure their anthropometric data, including height, weight, and body mass index.

Study Instrument:
To gather pertinent information on socio-economic conditions and anthropometric data, a structured questionnaire was utilized after thorough pretesting.

Measurements of outcomes:

(i) Measurement of Body Characteristics:
Standard techniques were employed to measure the anthropometric characteristics, such as height and weight, of each individual. Trained field research assistants were responsible for conducting these measurements. Local wooden stadio-metres with a sliding headpiece were used for height measurement, while digital weighing scales (TANITA) were utilized for weight measurement. Height was recorded to the nearest 0.1 cm, and weight was recorded to the nearest 0.5 kg. Participants were weighed with minimal clothing and without footwear. To ensure accuracy, the scales were carefully handled and regularly calibrated using 5 kg iron bars as standard calibration weights. If the scale weight did not align with the weight of the 5 kg iron bar, the calibration screw of the scale was adjusted accordingly. The Body Mass Index (BMI) of each participant was calculated using the formula weight (kg)/ height (m2). Nutritional status was determined by classifying the participants into different categories based on the CDC guideline [10]. Anthropometric measurements were also utilized in the standard methods of BMI classification, Gomez Classification, and Water Low Classification to assess nutritional status [11], [12].

(ii) Indicators of Malnutrition in Adolescents:
One of the primary symptoms of malnutrition is noticeable weight loss, specifically a loss of more than 10% of body weight in the past three months, excluding intentional dieting. This is typically assessed using the Body Mass Index (BMI), which is calculated by dividing the weight in kilograms by the square of the height in meters. In healthy adults, a BMI within the range of 18.5 to 24.9 is considered normal. During observations and interviews, interviewers were provided with color photographs displaying signs of malnutrition.

(iii) Other symptoms include:
Additional symptoms encompass muscle weakness and fatigue, persistent tiredness and lack of energy throughout the day, heightened susceptibility to infections, delayed and prolonged healing of even minor wounds and cuts, irritability and dizziness, as well as dryness of the skin and hair. The skin may appear dry and flaky, while the hair may become dry and nails may become brittle and prone to breakage. Malnourished women may experience persistent diarrhea or long-term constipation, irregular menstruation, or amenorrhea. Depression is also commonly associated with malnutrition and can be both a cause and an effect of it [10].

Sample Size:
(iv) Collection of socio-demographic information was done using a household questionnaire.

(v) Age estimation involved asking for the date of birth, age of first admission in school, current grade, year of first menstruation, etc. Field Research Assistants (FRAs) were trained to accurately calculate the actual age.

Data Analysis:
The malnutrition status of the adolescent girls was analyzed using standard descriptive statistics. Mean, standard deviation (SD), and proportions were used as appropriate. The malnutrition statuses were examined by age, literacy level, and place of residence. Statistical significance was determined using the Chi Square test at a 95% confidence interval.

Ethical Issues and Considerations:
The study obtained ethical clearance from the Centre for Injury Prevention and Research, Bangladesh (CIPRB) Ethical Review Committee. Verbal consent was obtained from all respondents, and the approved verbal consent form was provided by the Ethical Review Committee. Strict anonymity was maintained for all interviewees, and

participants were informed that the collected data would be used solely for research purposes.

3. Result

Table1.shows the socio-demographic statistics of 434 respondents of Bangladesh. The result shows 77.4% respondents are having foods with less than 5 categories and alternatively, 22.6% are consuming more than 5 categories of foods. Table1 shows, young girls have high tendency of consuming less categories (<5) of foods who are in the range of 11 to 13 years old. This group holds 64% of overall respondents followed by 34.5% girls under the age group of 14-16 years old. The study shows lack of education plays a vital role behind the scene in terms of dietary diversity. Most of the adolescence girls are functionally illiterate and having less than 5 categories of foods which is more than half (56%) of all respondents. Almost another half of them is yet to complete the secondary education that shows 42.9% girls having less assortment of dietary foods. The current study shows, practice of adequate dietary intake significantly depends on father's occupation of adolescent girls. Table1. Shows respondents whose fathers' occupation are from variety of sources or not acknowledged properly take less diversity of foods which is 40.5%. According to floor types and drinking water source of adolescent girls, the present study reveals that 56.5% from mud floor type and 43.5 % from Dalai floor type are intaking less variety of foods. Besides, girls who have tube well and supply water intaking 58.0% and 42.0% of less diversity of food. Adolescent girls who have sanitary latrine, pit, no latrines and others consume 34.2%, 47.3%, 17.0% and 1.5% of less variety foods. In addition, family of respondents who have domestic animals are intaking 57.1% and 42.9% of less categorized foods whose have no domestic animals. According to availability of electricity, the table1 revealed that girls who have electricity in their house consumes 58.6% of less variety of foods. On the other hand, girls having no electricity in their house intakes 41.4% of less variation of foods. Besides, respondents having Tv in their house intakes 42.9% of less diversified food and 57.1% of respondents' intake less variety of foods who don't have TV in their houses. It also shows, 53.9% and 46.1% girls intaking less diversified foods who have Fan in their house and who have not.

Table 1: Socio-demographic statistics of adolescence girls in Bangladesh.

	n (%)	*=<5 categories*	*>5 categories*
Overall	434	336(77.4)	98(22.6)
	=<5 categories	>5 categories	P value
Age of adolescent girls			
11-13 years	215 (64.0)	55(56.1)	0.364
14-16 years	116(34.5)	41(41.8)	
17 years	5(1.5)	2(2.0)	
Adolescent girls' education			
Functionally illiterate	188(56.0)	55(56.1)	0.941
Secondary Incomplete	143(42.6)	42(42.9)	
Secondary Complete	5(1.5)	1(1.0)	
Father occupation of adolescent girls			
Daily wage earner	90(26.8)	26(26.5)	0.000
Agriculture	110(32.7)	12(12.2)	
Others	136(40.5)	60(61.2)	
Floor types of adolescent girls			
Dalai	146(43.5)	69(70.4)	0.000
Mud	190(56.5)	29(29.6)	
Drinking water source of adolescent girls			
Tube well	195(58.0)	34(34.7)	0.000
Supply water	141(42.0)	64(65.3)	
Latrine types of adolescent girls			
Sanitary	115(34.2)	30(30.6)	0.077
Pit	159(47.3)	59(60.2)	
No latrine	57(17.0)	8(8.2)	
Others	5(1.5)	1(1.0)	
Domestic animal at home of adolescent girls			
Yes	192(57.1)	37(37.8)	0.001
No	144(42.9)	61(62.2)	
Electricity at home of adolescent girls			
Yes	197(58.6)	78(79.6)	0.000
No	139(41.4)	20(20.4)	
Fan at home of adolescent girls			
Yes	181(53.9)	76(77.6)	0.000
No	155(46.1)	22(22.4)	
TV at home of adolescent girls			
Yes	144(42.9)	64(65.3)	0.000
No	192(57.1)	34(34.7)	

Table 2 shows the distribution of weekly food intake by adolescent girls according to food group. The result shows only 3.7% of adolescent girls consume egg almost every day in a week. Nevertheless, 34.6% respondents don't intake egg at all in a week. Inversely, 54.3% of respondents' intake egg 1 to 3 times in week. According to food group of meats, results revealed that 18% of girls don't eat meat in a weak and more than one -fourth person which is 28.6% are consuming any kind of meat in a week. Considering fish group, the current study revealed that 47% respondents are intaking any kind of fish 1-3 times in a week whereas 9.9% don't intake any fish at all. However, 29% respondents are consuming fish almost every day in a week. In case of Milk group, the table2 shows us, 44% girl do not drink milk in a week however only 18.7% girls drink milk almost every day in a week. It only shows 33.8% respondents drink milk 1-3 times in a week. And last but not the least, for Dal/nuts related food, the result reveled this food group is economical for them to intake 1-3 times per week which depicts almost 60% of respondents. Besides, 12.4% of girls consuming this food group in 6-7 days in a week. However, 22.4% adolescent girls do not intake dal/nuts at all in a week.

Table 2: Distribution of weekly food intake by adolescent girls according to food group

Food group	Don't intake n (%)	1-3 times n (%)	4-5 times n (%)	6-7 times n (%)
Egg	150 (34.6)	236 (54.3)	32 (7.4)	16 (3.7)
Beef/Mutton/chicken/ Duck and another meat	78 (18.0)	80 (18.4)	152 (35.0)	124 (28.6)
Big/small fish	43 (9.9)	204 (47.0)	61 (14.1)	126 (29.0)
Milk	191 (44.0)	147 (33.8)	15 (3.5)	81 (18.7)
Dal/nut or nuts related food	97 (22.4)	260 (59.9)	23 (3.5)	54 (12.4)

Table3 revealed the daily food consumption of adolescent girls. From this table we can say that adolescent girls have high tendency to intake different kinds of foods rather nutrient foods in 24 hours. Table3 shows respondents are intaking 79.3% other foods in every single day. On the other hand, they don't consume any starchy food category within 24 hours. Besides, both DGLV and Vita rich foods holds 61.8% followed by meat and Fish which is 62.7% per day. Organ, Egg and milk show very low intakes which are 24.9%, 20.5% and 17.5% in 24 hours.

Table 3: 24-hours recall for food consumption by adolescent girls

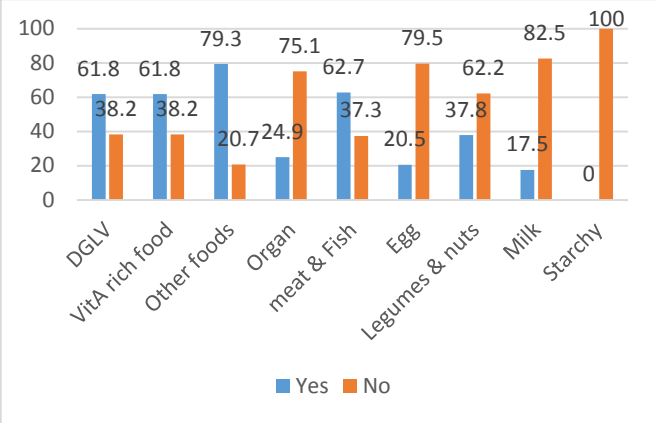

Table 4 shows the result of BMI, wight and height of adolescent girls in Bangladesh. It shows the BMI is 17.8 which is less than 18.5 and the standard deviation is ±2.6. If the BMI is less than 18.5, it falls within the underweight range[13]. The overall weight is 38.3 and height is 73.7 as well.

Table 4: Distribution of mean & SD of adolescent's weight, height and BMI

Measurement Unit	*Mean (SD)*
BMI	17.8 (±2.6)
Weight (kg)	38.3 (±7.2)
Height (cm)	73.7 (±3.2)

Table 5 shows the symptom of malnutrition presence among adolescent girls according to the study area. The distribution shows the highest rate of ill-tempered girls which is 254 respondents (23.7%). Secondly, 18.6% adolescents have been suffering from hair-fall problem followed by 17.3% of Irregular menstruation. Moreover, they are suffering from weight loss, diarrhea, depression and skin diseases which is 14.4%, 2.4%, 11.8% and 7.1%.

Table 5: Distribution of under-nutritional syndrome to the adolescent girls according to the study areas.

Syndrome of Malnutrition	***n (%)***
weight loss and feel weak	154 (14.4)
Hair falls in large amount	199 (18.6)
Skin & hair appear dry	60 (5.6)
Nails appear brittle and break easily	16 (1.5)
Ulcer in the tongue & corner of the mouth	51 (4.8)
Irregular menstruation	185 (17.3)
Frequent diarrhea	26 (2.4)
Depression	127 (11.8)
Irritable	254 (23.7)

4. Discussion

The purpose of this study is to identify the impact of dietary diversity of adolescent girls and its associate factors in Bangladesh. To achieve this objective, the present study used cross-sectional analysis of adolescent girls in the selected districts of Bangladesh. For analyzing, the present study focuses on socio-demographic statistics, distribution of weekly food intake by adolescent girls, 24-hours recall for food consumption, distribution of mean & SD of adolescent's weight, height and BMI and last but not the least distribution of under-nutritional syndrome to the adolescent girls. According to socio-demographic statistics, the result shows, 77.4% respondents are consuming <5 categories of food and majority of them 64% are very young age of 11 to 13 years old. Therefore, they suffer in malnutrition at the early stage of childhood which drive them to grow into Undernourished women. Undernourished female preschoolers are likely to grow into undernourished young women who are more likely to give birth babies who are undernourished [14]. The study shows that adolescent dietary significantly depends on their father's occupation. The result shows 40.5% girls are having less category of foods whose fathers' occupation is not properly categorized. After that, 37% of respondents consume less dietary of foods whose fathers' occupation is agriculture. The father's occupation is considered to be an important contributing factor, where studies have shown a negative association between nature of parental occupation and child survival in the developing countries [15]. Electricity and Mass media plays a vital role to make the family aware of providing proper foods to their children. The present study shows that 46.1% adolescent girls are taking fewer dietary foods who don't have any electric fan in their house. Besides, adolescent girls who have no TV in their house are taking <5 categories of food which is 57.1% and its P value is 0.000. A previous study suggests that exposure to specific types of mass media as sources of nutrition information may influence food consumption among adolescents to a different degree and direction [16]. Eggs, milk, meat and fish were the major sources of protein, calcium and preformed vitamin A [17]. According to Table2, the result shows adolescent girls are not taking necessary proteins per week. The lack of protein intaking will lead them to fetch protein deficiency at later stage of their life. Because Protein deficiency has been shown to reduce growth during adolescence [18]. Protein needs during adolescence are dictated not only by the maintenance processes but also by the growth of new tissues, considering the individual variations [19]. Nutritional status is the condition of health of the individual as influenced by the utilization of the nutrients[20]. Only, 3.7% of adolescent girls consume egg almost every day in a week However, 34.6% and 18% of respondents don't intake egg and meat at all in a week. Fish and Dal are more convenient to most of

the adolescent's family. In Bangladesh, fish is consumed frequently, often daily or several times per week in peak seasons of high availability, although the portions consumed can be too small to provide a sufficient amount of key micronutrients [21]. The result shows us 60% of adolescent girls are having fish 3 to 4 times in weak. However, 44.0% of adolescent are not drinking milk in a week at all. A previous study shown that the consumption of milk and milk products during adolescence improves bone mineral density without the increase of body weight or accumulation of body fat [22]. Essential micronutrients are also important for disease prevention during adulthood. Other examples of micronutrient deficiencies linked to disease and impairment are anemia (Fe, folic acid, Cu, Co, Mg, Zn, and vitamins B-12, B-6, and A,), birth defects (vitamin A and folate), cancer (vitamins E and C, folate, and Fe), central nervous system function (Fe, I, Se, and Zn), cognitive function (Fe, Zn, and vitamins B-1 and B-12), gene interactions (Fe, Zn, and vitamins B-6, C, and K), heart disease (vitamins E, C, B-6, and B-12, carotenoids, folic acid, and Fe), immune system development and host defense (Zn and vitamin E), and osteoporosis (Ca and vitamins D and K)[23]. One of the previous studies reveals about adolescent nutritional status in developing countries that stunting in adolescence is 32% in India, 36% in Bangladesh and 47% in Nepal, and their body mass index (BMI) is lower than other, such as in India 53%, in Bangladesh 50%, and in Nepal 36% respectively [18]. According to our findings of the present study we see the BMI is 17.8% which indicates underweight. According to the World Health Organization (WHO) classification, underweight can be defined as a body mass index (BMI) of $<18.5\ kg/m^2$ for adults and for children and adolescents, the corresponding BMI for age of more than 1 standard deviation below the median of the WHO growth reference for school-aged children and adolescents [24] . If underweight was primarily caused by undernutrition, it is reasonable to believe that the relatively higher prevalence of underweight among children from less-developed Asian countries was a result of food insecurity [25]. Other studies have also consistently demonstrated a low meal frequency (fewer than two meals/day) and irregular meal times are risk factors of being underweight among adolescent girls [26]. Because of underweight, adolescent may fetch lower height and weight issue. Underweight is also associated with problems in activities and withdrawal/depression [27]. Besides, there are many symptoms arise due to undernutrition or malnutrition of adolescent girls as Hair falls in large amount, Skin & hair appear dry, Nails appear brittle and break easily, Ulcer in the tongue & corner of the mouth, Irregular menstruation, Frequent diarrhea, Depressio and Irritability. According to present study, the result shows us 17.3% of adolescent girls are fetching trouble in irregular menstruation which may reflect in their re-productive health in future. The present study also identifies 11.8% and 23.7% of adolescent girls are in depression and irritable due to malnutrition which will be affecting in their personal health as well as professional life in the long run. One study revealed that depression during adolescence is a serious problem because of its high prevalence, considerable burden of disease, suicide risk, other comorbid psychiatric disorders and the high risk of recurrence [28]. On the other hand, Irritability can interfere with core aspects of adaptive functioning during the developmental period, including social affiliation and situationally functional goal-directed behavior, which can have cascading consequences and become more severe in adulthood [29].

5. Conclusion

Adolescence is a critical period of life and nutrition is one of the main key components of this time period for ensuring healthy and successful life style in future. The present study analyzed many issues to identify the cause and effects. However, socio-economic status significantly affects the dietary food habits of adolescent girls. Besides, due to malnutrition most of the adolescent girls are being underweight, fetching irregular menstruation, feeling of depression and irritable which could potentially have long-term implications on their well-being.

6. Recommendations

According to this present study researchers suggest that more attention should be given to ensure proper dietary habits of adolescent girls in all over the Bangladesh. To mitigate the malnutrition an intervention should be taken for providing knowledge about nutrition to the adolescent girls through school-based education. Along with this, Mass media might play a vital role for spreading correct message regarding adolescent nutrition and its effectiveness to the general people. Bangladesh Govt. should ensure the availability of uninterrupted electricity supply and the source of drinking water to all households. In addition, community-based public health intervention regarding awareness building and follow-up about dietary diversity among adolescent girls can be provided to ensure proper dietary intake.

7. Contributors

Evana Yasmin played a role in literature review, database search, interpretation of data, and writing of the original paper and revising it critically for important intellectual content and final approval of the version to be published. Mohammad Salim and Naima Siddika Rn contributed his intellectual skill in the revision of the manuscript. Kabir Hossen contributed conceptualization and design of the study, supervise data collection and analysis, and reviewed the original paper. All of the above authors read and approved the final manuscript.

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9. Ethics

The authors listed in the manuscript have collectively acknowledged their agreement to be included as authors. They have thoroughly reviewed and endorsed the manuscript, providing their consent for its submission and subsequent publication. The order of authorship was mutually decided by all authors prior to submission.

10. Provenance and peer review

The content of this article has been subjected to evaluation through a rigorous process of peer review.

11. Conflicts of Interest

The authors affirm that there are no conflicts of interest to disclose.

12. Availability of data and materials

For access to the data sets that underpin the findings of this study, interested parties may request them from the corresponding author. The data, unfortunately, cannot be made publicly available due to privacy concerns.

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