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Dietary diversity of adolescent girls living in an urban resource-poor setting of Dhaka city: results from Nutri-CAP study

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ABSTRACT

Background Given the well-documented risks of undernutrition, micronutrient deficiencies and adverse health outcomes associated with poor dietary quality, we examined the effect of behaviour change communication (BCC) on dietary diversity (DD) among adolescent girls in a resource-poor urban setting.

Methods We conducted a quasi-experimental study with an embedded qualitative component to contextualise quantitative findings. We enrolled 700 adolescent girls aged 11–17 years (350 intervention and 350 comparison) in Bauniabadh, Mirpur, Dhaka, Bangladesh between April 2022 and November 2023. We also conducted focus group discussions (FGD) with 22 parents from intervention areas. The intervention group received two times-monthly BCC sessions for 6 consecutive months, along with zinc and iron-folic acid supplementation; the comparison group received no intervention. We assessed the primary outcome as change in DD using the Women's DD Score. Secondary outcomes included household DD, haemoglobin level and nutrition knowledge. We estimated intervention effects using difference-in-difference (DID) analysis implemented in R (V.4.4.2) and analysed qualitative data using thematic content analysis.

Results The mean (SD) age of participants was 13.5 (1.7) years, and approximately half were enrolled in secondary education. The median (IQR) family income was US$212.9 (158.4 to 280.6). Knowledge on health and nutrition improved significantly at endline in the intervention group. DID analysis showed a significant increase in the haemoglobin levels in the intervention group (adjusted coefficient (aCoeff.): 0.60, 95% CI 0.44 to 0.76, p value <0.001). We observed no significant change in DD (AOR: 0.09, 95% CI −0.06 to 0.23, p value=0.263). FGD indicated that rising food prices constrained parental purchasing power.

Conclusion Community-based BCC with supplementation improved knowledge and haemoglobin level but did not improve DD among adolescent girls. Achieving sustainable nutritional gains requires integrated strategies that combine nutrition education with improved household food security, affordability and active parental engagement in similar resource-poor settings.

Trial registration number NCT05311436.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Poor dietary quality during adolescence has been associated with undernutrition, micronutrient deficiencies and health risks during later life.

⇒ Limited knowledge of nutrition and dietary diversity further complicates the condition, especially in a resource-poor setting.

WHAT THIS STUDY ADDS

⇒ This manuscript focused on assessing the role of behaviour change communication (BCC) in improving dietary diversity among adolescent girls in an urban resource-poor setting of Dhaka, Bangladesh

⇒ Results indicated that community-based BCC with iron-folic acid supplements improved knowledge and haemoglobin status among adolescent girls, though it did not translate into significant changes in dietary diversity

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Addressing adolescent nutrition requires combining education with measures to strengthen household food security, affordability of diverse foods and parental engagement as key decision-makers.

INTRODUCTION

Adolescence, defined as the period from 10 to 19 years,[1] is the second most critical phase for growth after infancy. Almost 90% of the world's 1.2 billion teenagers reside in developing countries like Bangladesh.[2 3] During adolescence, rapid physical changes take place, there is a rapid gain in height, bone mass and overall body weight that places an increased nutritional demand.[4] Adequate dietary diversity, that is, consumption of a range of food groups including vegetables, fruits, grains and animal-source foods, is essential for health and overall development during this significant phase of life.[4 5]

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Nutrient adequacy is closely associated with dietary diversity. High nutritional intake is required during adolescence, yet it is marked by low dietary diversity, among females in particular. Adolescent girls have special dietary needs as future mothers, and the health of their offspring is often influenced by the mother's own nutritional status.[6] In Bangladesh, a study reported more than half of adolescent girls attain inadequate dietary diversity.[7] Poor diet quality during adolescence has been associated with undernutrition, micronutrient deficiencies and health risks during later life.[8] Bangladeshi adolescents also face a triple burden of undernutrition, overnutrition and micronutrient deficiency, and all these are found to be associated with poor dietary diversity.[9] Limited knowledge on nutritional aspects and dietary diversity further complicates the condition, especially among individuals living in a resource-poor setting.

The Bangladesh National Food Policy highlights urban dwellers in resource-poor settings as among the most vulnerable to food security.[10] The WHO recommends ensuring dietary diversity at the family level as a key strategy to improve nutrition.[6] Community-based public health interventions have shown to be effective in improving knowledge related to healthy eating habits and promoting the same.[11]

icddr,b, in association with Global Affairs Canada, has conducted a research project, at Mirpur, Dhaka to establish an evidence-based sustainable model for improving pregnancy weight gain, increasing dietary diversity among adolescent girls, safeguarding proper physical growth of under two children and improving water sanitation and hygiene (WASH) situation of the community. The current analysis focused on the adolescent component with an objective to assess the role of behaviour change communication (BCC) in improving dietary diversity and haemoglobin levels among adolescent girls in an urban resource-poor setting of Dhaka, Bangladesh.

METHODS

Study design and participants

This analysis employed a quasi-experimental design (ClinicalTrials.gov identifier NCT05311436) to assess whether BCC was associated with improvements in dietary diversity. Data were collected from 700 adolescent girls aged 11–17 years between April 2022 and November 2023, and participants were involved only at the time of data collection. A qualitative component was included in the study to explore parents' perceptions related to adolescent nutrition.

Study setting

This study was conducted in Baunibadh, a resource-poor slum settlement in Mirpur, Dhaka North City Corporation. This area is located in the greater Mirpur area, one of the 21 administrative units of the country's capital, Dhaka. This area is populated by poor and lower middle-class families, and their residential and sanitary conditions are similar to that of any resource-poor urban settlement.[12] The area includes five residential blocks, each comprising around 22 lines with an average of 2000 households, accommodating around 16 000 households, and more than 60 thousand people. Among the five blocks in this area, three blocks were intervention areas, and two blocks served as comparison.

Description of the intervention

Adolescent girls meeting the inclusion criteria (aged 11–17 years, willing to participate in the study, not involved in any nutrition project/programme, would stay in the study area for the next 2 years) were enrolled in the study in two groups. The intervention group received counselling sessions, zinc (20 mg/day for 1 month) and iron-folic acid (200 mg weekly for 3 months). The sessions were conducted in groups of 8–10 participants. Sessions were held once every 2 weeks for 6 months (total 12 sessions), each session lasted for around 1.5 to 2 hours. These sessions covered food and nutrition, balanced diet, malnutrition, nutrition for adolescents, vitamins, minerals, breast milk, child marriage, complementary feeding, safe water and food, importance of handwashing and menstrual hygiene. BCC materials were developed based on a formative study conducted at the beginning of the study. A group of counsellors, recruited from the local community, conducted the sessions. Follow-up data were collected monthly from both the intervention and comparison groups on the dietary diversity. On completion of the 12th session, the adolescent was approached to collect the endline data. Comparison group participants did not receive the BCC sessions or the iron-folic acid supplements.

Operational definition of the variables

Outcome variables

Primary outcome indicator (shift in dietary diversity)

The primary outcome indicator was shift in dietary diversity, which was measured using the Women's Dietary Diversity Score (WDDS). Apart from measuring the diversity of diet, WDDS also indicates changes in the micronutrient adequacy using nine food groups: cereal, meat-fish, egg, leafy vegetable, pulses-nut, dairy, other vegetables, other fruits and vegetables and fruits rich in vitamin A.[13]

Secondary outcomes

Knowledge of micronutrient intake: knowledge of micronutrient intake was assessed using a structured questionnaire covering five domains: vitamin A capsule intake by mothers after childbirth, vitamin A supplementation for children under 5 years, iron-folic acid consumption during pregnancy in-particular and during adolescence. Knowledge was considered present if the adolescent correctly reported awareness of each respective practice, and results were analysed separately for each domain.

Haemoglobin concentration: haemoglobin level (g/dL) was measured as an indicator of anaemia status using HemoCue.

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Household Dietary Diversity Score

The Household Dietary Diversity Score (HDDS) was used to evaluate household food access and overall food security. HDDS was calculated based on the consumption of 12 food groups in the previous 24 hours, following the Food and Nutrition Technical Assistance Project and United States Agency for International Development guidelines.[14] Scores were treated as continuous variables and ranged from 0 to 12, with higher values indicating greater household dietary diversity. Plant-based vitamin A included vitamin A-rich vegetables or tubers, dark green leafy vegetables and vitamin A-rich fruits. Animal-based vitamin A included organ meat, eggs and dairy products. Iron food groups included organ meat, flesh meat, fish and seafood.

Similarity of diet

A composite score namely similarity of diet was generated through keeping an alignment between food groups consumed by an adolescent girl and those reported to be consumed at the household level during the reference period. For generating a score, one point was assigned for each food group consumed by both the adolescent (individual) and at the household level, with a possible range of 0–9. Higher scores indicated greater overlap between individual and household dietary intake, reflecting the extent to which adolescents' diet mirrored the household food availability.

Covariates

The covariates considered in this analysis included age (in years), educational status, still studying (no/yes), adolescent girl age under 18 years got married, height-for-age Z score, BMI-for-age z-score, BMI category (severe thinness/thinness/healthy/overweight/obesity), age of the mother (in years), mothers completed years of education (in years), sex of the household head (HH) (male/female), age of the HH (in complete years), HH's completed years of education (in years), occupation of the HH (not currently working/day labourer/businessman/professional or wage earner), toilet facility (unimproved/improved), shared toilet facility (no/yes), freedom in clothing-related choices (no/yes), average monthly family income (in US$).

Educational status of adolescent girls was recorded as a binary variable: up to primary (≤5 years of schooling) and postprimary (>5 years). BMI-for-age and height-for-age z-scores were calculated using WHO growth reference data for 5–19 years.[15] BMI-for-age was categorised as severe thinness (<−3 SD), thinness (<−2 SD), healthy (−2 SD to < +1 SD), overweight (> +1 SD) and obese (> +2 SD).

A household was classified as having an *improved toilet facility* if it had access to a flush system, septic tank or pit latrine that was not shared with other families.[16] Household wealth was assessed using principal component analysis of asset ownership. Assets included iron, mattresses, chairs or benches, tables, sofas, electric fans, computers, televisions, smart mobile phones, refrigerators, motorcycles, bank accounts, chicken or duck as well as agricultural lands. Then an asset index was constructed, which was divided into quintiles, ranging from the poorest (first quintile) to the richest (fifth quintile).

A binary variable was created to measure autonomy in clothing choices. Girls who reported independence in washing, changing and selecting clothes were considered to have freedom in clothing decisions.

Average monthly family income was calculated by dividing the recorded BDT by US$ purchase exchange rate of that particular day obtained from Bangladesh bank.

Statistical analysis

Quantitative data were reported using means and SD for normally distributed variables, or medians with IQRs for asymmetrically distributed variables. The normality of the data was evaluated using visual inspection of Q–Q plots and histograms, and further assessed through the Shapiro-Wilk test. Categorical variables were reported as frequencies and percentages. Continuous data that were normally distributed were analysed using t-tests, whereas the Wilcoxon rank sum test was used to compare asymmetrical continuous variables between independent groups. χ^2 tests were employed for analysing relationships between categorical variables across different groups. Within-group changes in knowledge over time were assessed using McNemar's test. The effect of the intervention on outcomes was evaluated using a difference-in-difference (DID) approach, applying linear regression with an interaction term between group (intervention vs comparison) and timepoint (baseline vs endline). Adjusted coefficient (aCoeff.) with the respective 95% CI was presented.

A post hoc power analysis was conducted based on the Wald z statistic derived from the regression models. The test statistic was calculated as the ratio of the regression coefficient to its SE, and this value was used to estimate the achieved statistical power for each outcome at a two-sided significance level of α=0.05.[17] For haemoglobin (g/dL), the unadjusted model yielded an estimated statistical power exceeding 99%, indicating a very high probability of detecting the observed association and a minimal risk of type II error. For HDDS, the estimated statistical power in the unadjusted model was 75.6%. After adjustment for potential confounders, the achieved power decreased to 62.4%, reflecting reduced precision in the multivariable model.

A p value of 0.05 was considered as statistically significant. Data management was done using STATA V.15 (Stata Corp. Texas). Statistical software R V.4.4.2 was used to perform statistical analysis.

Collection, management and analysis of qualitative data

Guidelines for the FGD were developed, and group discussions were conducted in the group's native language (Bangla), by staff with experience in qualitative data

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Table 1 Descriptive statistics of the study participants

Characteristic	N	Overall N=700*	Comparison N=350*	Intervention N=350*	P-value
Age (in years)	700	13.5 (1.7)	13.5 (1.7)	13.5 (1.6)	0.820†
Educational status	700				0.447‡
Up to primary		314 (44.9%)	162 (46.3%)	152 (43.4%)	
Above primary		386 (55.1%)	188 (53.7%)	198 (56.6%)	
Still studying	700				0.089‡
Yes		611 (87.3%)	298 (85.1%)	313 (89.4%)	
No		672 (96.0%)	340 (97.1%)	332 (94.9%)	
Adolescent girl aged under 18 years got married	700	28 (4.0%)	10 (2.9%)	18 (5.1%)	0.123‡
BMI-for-age z-score	700	−0.5 (1.3)	−0.6 (1.2)	−0.5 (1.4)	0.151†
BMI category	700				0.034‡
Severe thinness (<−3 SDs)		21 (3.0%)	9 (2.6%)	12 (3.4%)	
Thinness (≥−3 and <−2 SDs)		68 (9.7%)	30 (8.6%)	38 (10.9%)	
Healthy		524 (74.9%)	276 (78.9%)	248 (70.9%)	
Overweight (>1 and ≤2 SDs)		67 (9.6%)	31 (8.9%)	36 (10.3%)	
Obesity (>2 SDs)		20 (2.9%)	4 (1.1%)	16 (4.6%)	
Age of the mother (in years)	658	37.8 (5.8)	37.7 (6.2)	37.9 (5.5)	0.672†
Mothers complete year of education	658	5.0 (2.0, 6.0)	5.0 (2.0, 5.0)	4.0 (1.0, 6.0)	0.244§
Characteristic	**N**	**Overall N = 700***	**Comparison N = 350***	**Intervention N = 350***	**p-value**
Sex of household head	700				0.395
Male		510 (72.9%)	250 (71.4%)	260 (74.3%)	
Female		190 (27.1%)	100 (28.6%)	90 (25.7%)	
Age of household head (in years)	700	44.0 (9.3)	43.5 (7.9)	44.4 (10.5)	0.230†
Household heads complete year of education	700	5.0 (0.0, 7.0)	5.0 (0.0, 7.0)	5.0 (1.0, 6.0)	0.908§
Occupation of household head	700				0.317‡
Not currently working		122 (17.4%)	55 (15.7%)	67 (19.1%)	
Day labourer		75 (10.7%)	43 (12.3%)	32 (9.1%)	
Businessman		228 (32.6%)	119 (34.0%)	109 (31.1%)	
Professional/wage earner		275 (39.3%)	133 (38.0%)	142 (40.6%)	
Toilet facility	700				0.099‡
Unimproved		490 (70.0%)	255 (72.9%)	235 (67.1%)	
Improved		210 (30.0%)	95 (27.1%)	115 (32.9%)	
Shared toilet facility	700				0.099‡
Yes		490 (70.0%)	255 (72.9%)	235 (67.1%)	
No		210 (30.0%)	115 (32.9%)	95 (27.1%)	
Freedom in clothing-related choices	700				0.638
Yes		442 (63.1%)	224 (64.0%)	218 (62.3%)	
No		258 (36.9%)	126 (36.0%)	132 (37.7%)	
Characteristic	**N**	**Overall N = 700***	**Comparison N = 350***	**Intervention N = 350***	**p-value**
Average monthly family income (US$)	700	212.9 (158.4, 280.6)	209.7 (140.0, 269.7)	213.3 (159.7, 284.4)	0.028§

*All are n (%) except age (year), height-for-age z-score, BMI-for-age z-score, age of the mother (year) and age of household head (year) were mean (SD) and mothers complete year of education, mothers complete year of education and average monthly family income (US$) were median (IQR).
†Welch two sample t-test.
‡Pearson's χ^2 test.
§Wilcoxon rank sum test.
BMI, body mass index.

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Table 2 Knowledge of the adolescents regarding micronutrient intake

Characteristic	Baseline N	Baseline Comparison N=350	Baseline Intervention N=350	Baseline P-value	Endline N	Endline Comparison N=350	Endline Intervention N=350	Endline P-value
Vitamin A capsule intake of mother after child delivery	700	48 (13.7%)	43 (12.3%)	0.574	700	100 (28.6%)	243 (69.4%)	<0.001
Vitamin A capsule intake of under 5 years children	700	343 (98.0%)	279 (79.7%)	<0.001	700	345 (98.6%)	333 (95.1%)	0.009
Iron-folic acid consumption	700	263 (75.1%)	218 (62.3%)	<0.001	700	313 (89.4%)	348 (99.4%)	<0.001
Iron-folic acid intake during pregnancy	700	210 (60.0%)	139 (39.7%)	<0.001	700	273 (78.0%)	331 (94.6%)	<0.001
Iron-folic acid intake of adolescents	700	136 (38.9%)	115 (32.9%)	0.098	700	233 (66.6%)	345 (98.6%)	<0.001

All are n (%).

collection. Discussions were recorded using an audiotape, and field notes were taken simultaneously. To analyse the qualitative data, all responses from the audio tapes were transcribed verbatim into a Microsoft Word document and then compiled, with each respondent's contribution tagged using a unique ID number. The responses were assembled under several themes or codes generated from the data. The responses under particular codes were translated into English, without changing their meaning. Thematic content analysis was carried out to provide a descriptive narrative of the results. This method of analysis is also known as a framework approach and consisted of deductive and inductive data analysis strategies.

RESULTS

At baseline, the mean (SD) age of adolescent girls was 13.5 (1.7) years, and 55.1% had education beyond primary school. Most (74.9%) were classified as healthy by BMI-for-age . Median monthly family income was US$212.9 (IQR: 158.4–280.6) and was significantly higher in the comparison group compared with the intervention group (p=0.028). Other baseline characteristics were comparable across groups (table 1).

Knowledge of micronutrient intake improved significantly in the intervention group compared with the comparison group. At endline, awareness of vitamin A capsule intake after childbirth (69.4% vs 28.6%; p<0.001), iron-folic acid consumption (99.4% vs 89.4%; p<0.001), iron-folic acid intake during pregnancy (94.6% vs 78.0%; p<0.001) and iron-folic acid intake for adolescents (98.6% vs 66.6%; p<0.001) were all significantly higher among intervention participants (table 2).

Table 3 describes the DID analysis of different indicators. WDDS was found comparable between intervention

Table 3 Difference in difference analysis of the outcome indicators

Characteristic	Baseline Comparison N=350	Baseline Intervention N=350	Baseline Difference	Endline Comparison N=350	Endline Intervention N=350	Endline Difference	DID crude Coefficient (95% CI)	DID crude P-value	DID adjusted Adjusted coefficient (95% CI)	DID adjusted P-value
Haemoglobin (g/dL)	12.2 (1.3)	12.0 (1.3)	0.20	12.5 (1.3)	12.8 (1.3)	−0.33	0.60 (0.44 to 0.76)	<0.001	0.60 (0.44 to 0.76)	<0.001
WDDS	5.0 (1.1)	5.2 (1.2)	−0.23	5.1 (1.2)	5.2 (1.4)	−0.11	0.11 (−0.04 to 0.26)	0.157	0.09 (−0.06 to 0.23)	0.263
HDDS	8.3 (1.4)	8.3 (1.5)	−0.01	8.7 (1.4)	8.7 (1.4)	0.04	0.24 (0.06 to 0.41)	0.008	0.20 (0.03 to 0.38)	0.023
Adolescent girl consumes similar food group as household	8.3 (1.4)	8.3 (1.5)	0.01	8.8 (1.4)	8.6 (1.4)	0.15	0.16 (−0.01 to 0.34)	0.063	0.13 (−0.04 to 0.30)	0.143

Adjusted for adolescent girl's age, complete years of education, sex of household head, freedom in clothing-related choices and average monthly family income (US$).
DID, difference-in-difference; HDDS, Household Dietary Diversity Score; WDDS, Women's Dietary Diversity Score.

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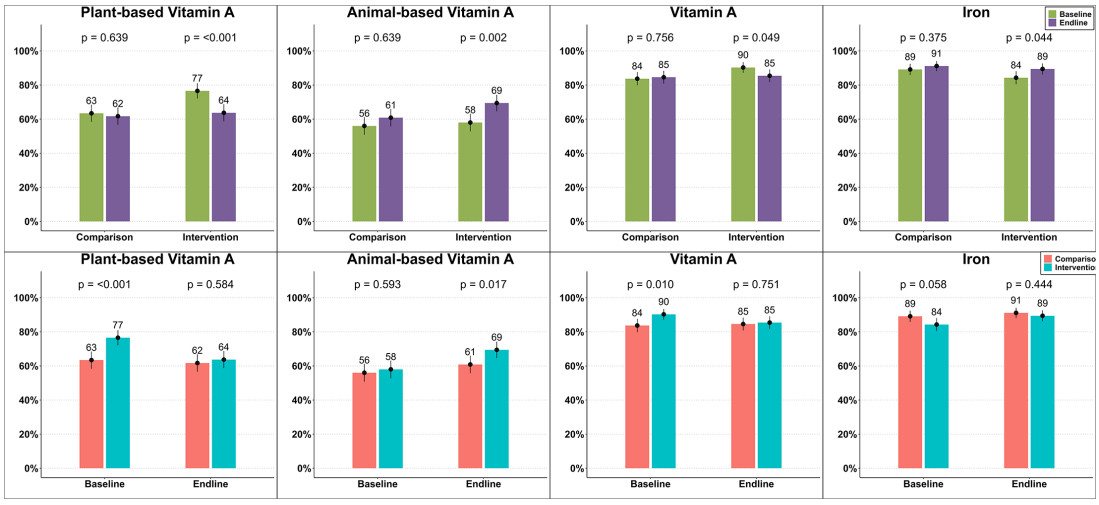

Figure 1 Micronutrient containing food intake among the adolescent girls.

and comparison groups at endline. HDDS was found significantly higher in intervention group (aCoef.: 0.20, 95% CI 0.03 to 0.38, p=0.023). However, no significant difference was observed in dietary similarity between adolescent girls and their households (aCoeff.: 0.13; 95% CI −0.04 to 0.30; p=0.143). Haemoglobin level has increased significantly in the intervention group (aCoef.: 0.6, 95% CI 0.44 to 0.76, p<0.001) compared with the comparison group.

Figure 1 describes the micronutrient intake of adolescent girls. Overall, vitamin A containing food intake in the intervention group has reduced significantly, but the intake of iron-rich food has significantly increased during the endline.

Figure 2 describes the intake of a particular food group. Intake of dark green leafy vegetables, eggs and milk and milk products has been increased significantly among the intervention group participants from baseline to endline.

Qualitative component findings

FGD sessions were conducted with the parents after the completion of the intervention. The discussion focused on the overall changes of the adolescent girls with respect to the study objectives. Parents consistently reported that rising food prices limited their ability to purchase diverse foods for their daughters. Fathers noted that higher prices of commodities restricted their ability to buy preferred items such as chicken or liver. Several also mentioned reducing the quantity of vegetables purchased, leading to smaller portions of curry compared with previous times. One father mentioned, 'Prices of all the vegetables has increased… I used to purchase one kg before, now I purchase half a kg… we used to consume in an ample amount, now a bit less, previously we used to buy a lot, now a bit less…'

Mothers reported that their daughters had started consuming foods such as small fish and leafy vegetables, which were not part of their usual diet before the intervention. They also noted that daughters shared information learnt from the BCC sessions, particularly regarding the proper preservation of iodised salt. One mother explained: '…(she) mentioned about the salt… the salt is kept open, I am not going to take this, I will

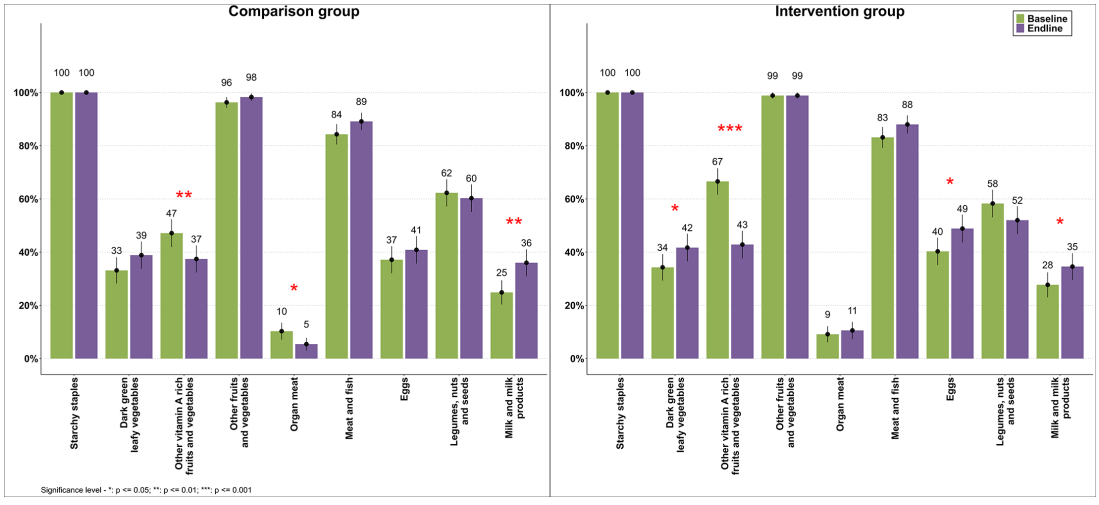

Figure 2 Consumption of different food groups by the adolescents.

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throw this away… and she threw it…as the iodine does not remain in it, she actually threw the salt… I did not say her anything, as she has learnt this from this session'.

DISCUSSION

This study assessed the association of a community-based BCC intervention with dietary diversity, knowledge and haemoglobin concentration among adolescent girls living in an urban resource-poor setting in Bangladesh. The intervention was associated with significant improvements in knowledge of micronutrient intake and haemoglobin concentration. However, no significant differences were observed in dietary diversity between intervention and comparison groups. Qualitative findings further indicated that rising food prices were a major barrier to food purchasing, limiting the ability of families to act on nutrition knowledge.

The improvement in knowledge among adolescents following community-based BCC sessions is consistent with findings from another study in South Asia.[18] These sessions can help in reaching the students and their families.[18] Furthermore, it has been shown that discussion groups and peer support can engage adolescents in meaningful ways for lifestyle modifications.[19] These strategies were used in our current study to regularly provide group counselling to adolescent girls living in a resource-poor situation with information about diet, health and hygiene.

Previous research has reported that adolescents often demonstrate good awareness of micronutrient deficiencies such as iron, iodine and vitamin A after targeted interventions.[18] In our study, this was reflected in significantly higher knowledge of vitamin A capsule intake and iron-folic acid supplementation at endline. However, similar to reports from several other studies, knowledge gains did not translate into measurable improvements in dietary diversity.[19–21] This may result in adolescents consuming an imbalanced diet despite an acceptable level of knowledge on nutrition. Connecting knowledge and practice in nutrition education is challenging, particularly among this age group, and hence requires alteration of behaviour and attitude.[19 20]

While nutrition knowledge can positively influence food choices, dietary behaviour is shaped by multiple psychological and environmental factors.[19] However, this study did not explore these pathways, but they represent important areas for future research.

Our study found that the haemoglobin level of adolescent girls, as well as intake of iron-rich foods, have increased in the intervention group. These findings are consistent with studies showing that increased dietary diversity, particularly with animal-source foods, is associated with reduced prevalence of anaemia among women of reproductive age.[22 23] Our results suggest that even in the absence of broad improvements in overall dietary diversity targeted improvements in the consumption of iron-rich foods along with iron-folic acid supplements may contribute to better haemoglobin status. This aligns with evidence that specific nutrient-focused counselling, coupled with access to supplementation, can yield measurable benefits in adolescent health.

The qualitative findings highlighted persistent economic barriers to achieving dietary diversity. Parents frequently reported being unable to afford preferred foods such as chicken, liver and vegetables and described reducing portion sizes due to rising prices. These insights support previous studies in Bangladesh and elsewhere linking low dietary diversity among adolescents with poor socioeconomic conditions.[7 18] Moreover, adolescents are not independent decision-makers within households. Food purchasing decisions are largely made by parents, particularly fathers and mothers, which underscores the importance of including parents in adolescent nutrition interventions. BCC strategies that involve parents may ensure that nutritional messages reach the household level and foster an enabling environment for adolescent girls.[24]

This study has several strengths. It used a mixed-methods design, providing both quantitative and qualitative evidence. The intervention covered a wide range of topics on nutrition, health and WASH, delivered through locally recruited counsellors, which enhanced trust and acceptability. By combining adolescent-focused group counselling with parental perspectives, the study provides insights into both knowledge acquisition and the structural barriers that prevent translation into practice.

Several limitations must also be considered. The quasi-experimental design without randomisation may introduce selection bias and limit generalisability of findings. The study did not capture psychological or environmental determinants of dietary behaviour, such as food preferences, social norms or media influences, which could have explained why knowledge did not translate into improved dietary diversity. As BCC and iron supplementation were delivered concurrently, their independent effects cannot be distinguished. Additionally, dietary intake was assessed using recall-based measures, which may be subjected to reporting bias.

CONCLUSIONS

Our study indicated that community-based BCC with supplementation improved knowledge and haemoglobin status among adolescent girls. However, it did not translate into significant changes in dietary diversity. The gap between knowledge and practice highlights the influence of structural barriers, particularly limited household purchasing power. Addressing adolescent nutrition therefore requires combining education with measures to ensure affordability of diverse foods and parental engagement, as parents are key decision-makers. Operational research is needed to develop tailored communication materials and guide policymakers and service providers to work in a coordinated manner. Adolescent girls' involvement in community-based forums should

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also be strengthened. Improving household economic conditions is essential to support dietary diversity, including promotion of income-generating activities alongside routine household responsibilities. Standardised and validated indicators for adolescent nutrition are required, with consistent methods for measuring growth and dietary diversity among younger adolescents. Further qualitative research should explore social and contextual factors, including the roles of parents, grandparents and peers in shaping food access and choices.

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REFERENCES

1 de Onis M, Onyango AW, Borghi E, *et al*. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ* 2007;85:660–7.
2 Alam SS, *et al*. Dietary diversity and nutritional status of adolescent girls in selected urban slum of Dhaka City in Bangladesh. *Nutri Food Sci Int J* 2018;7:1–5.
3 Cappa C, Wardlaw T, Langevin-Falcon C, *et al*. Progress for children: a report card on adolescents. *The Lancet* 2012;379:2323–5.
4 Islam MR, Rahman SM, Tarafder C, *et al*. Exploring Rural Adolescents' Dietary Diversity and Its Socioeconomic Correlates: A Cross-Sectional Study from Matlab, Bangladesh. *Nutrients* 2020;12:2230.
5 Vakili M, Abedi P, Sharifi M, *et al*. Dietary diversity and its related factors among adolescents: a survey in Ahvaz-Iran. *Glob J Health Sci* 2013;5:181:181–6:.
6 Organization, W.H. Adolescent nutrition: a review of the situation in selected south-east asian countries. 2006.
7 Akter F, Hossain MM, Shamim AA, *et al*. Prevalence and socio-economic determinants of inadequate dietary diversity among adolescent girls and boys in Bangladesh: findings from a nationwide cross-sectional survey. *J Nutr Sci* 2021;10:e103.
8 Kabir Y, Shahjalal HM, Saleh F, *et al*. Dietary pattern, nutritional status, anaemia and anaemia-related knowledge in urban adolescent college girls of Bangladesh. *J Pak Med Assoc* 2010;60:633:633–8:.
9 Akter F, Hossain MdM, Shamim AA, *et al*. Inadequate Dietary Diversity and Its Determinants Among Adolescent Girls and Boys: Evidence from the National Nutrition Surveillance Study in Bangladesh. *Current Developments in Nutrition* 2020;4:nzaa046.
10 Bhattacharjee P, Sassi M. Determinants of the severity of household food insecurity among the slums of Dhaka city, Bangladesh. *International Journal of Urban Sustainable Development* 2021;13:233–47.
11 Yasmin E, *et al*. Impact of dietary diversity and its associated factors among adolescent girls in bangladesh.
12 Mahfuz M, Alam MA, Fahim SM, *et al*. Aflatoxin exposure in children living in Mirpur, Dhaka: data from MAL-ED companion study. *J Expo Sci Environ Epidemiol* 2019;29:655–62.
13 Guidelines for measuring household and individual dietary diversity. In: *Food and Agriculture Organization of the United Nations (FAO) the Food and Nutrition Technical Assistance (FANTA) Project*. Rome, Italy, 2007.
14 Kennedy G, Ballard T, Dop M. *Guidelines for Measuring Household and Individual Dietary Diversity*. 2011: FAO,
15 WHO. Growth reference data for 5-19 years. 2007.
16 WHO. Improved sanitation facilities and drinking-water sources available from. n.d. Available: https://www.who.int/data/nutrition/nlis/info/improved-sanitation-facilities-and-drinking-water-sources#:~:text=Improved%20sanitation%20facilities%20are%20defined,with%20slab%20or%20composting%20toilets
17 Cohen J. *Statistical Power Analysis for the Behavioral Sciences*2nd ed. Hillsdale,NJ: Lawrence Erlbaum, 1988.
18 Melaku Y, Dirar A, Feyissa GT, *et al*. Optimal dietary practices and nutritional knowledge of school adolescent girls in Jimma Town, South West Ethiopia. *Int J Adolesc Youth* 2018;23:299–307.
19 Sireesha G, Rajani N, Bindu V. Teenage girls' knowledge attitude and practices on nutrition. *Int J Home Sci* 2017;3:491–4.
5 Kigaru DMD, Loechl C, Moleah T, *et al*. Nutrition knowledge, attitude and practices among urban primary school children in Nairobi City, Kenya: a KAP study. *BMC Nutr* 2015;1.
21 Naeeni MM, Jafari S, Fouladgar M, *et al*. Nutritional Knowledge, Practice, and Dietary Habits among school Children and Adolescents. *Int J Prev Med* 2014;5:S171:S171–8:.
22 Olumakaiye MF. *Adolescent Girls with Low Dietary Diversity Score Are Predisposed to Iron Deficiency in Southwestern Nigeria*. 5. . ICAN: Infant, Child, & Adolescent Nutrition, 2013:85–91.
23 Jin Y, Talegawkar SA, Sedlander E, *et al*. Dietary Diversity and Its Associations with Anemia among Women of Reproductive Age in Rural Odisha, India. *Ecol Food Nutr* 2022;61:304–18.
24 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* 2010;28:86:86–94:.

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