



# Peer Counseling Promotes Appropriate Infant Feeding Practices and Improves Infant Growth and Development in an Urban Slum in Bangladesh: A Community-Based Cluster Randomized Controlled Trial

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## ABSTRACT

**Background:** Undernutrition and poor cognitive development affect many children in developing countries. Good nutrition and health care are essential for optimal child development and growth.

**Objectives:** We assessed the impact of peer counseling combined with psychosocial stimulation on feeding practices and child growth and development in slums in Bangladesh.

**Methods:** We performed a community-based cluster randomized controlled trial in selected slums; 350 mother–infant pairs were allocated to receive peer counseling on feeding practices plus psychosocial stimulation (PC + PCS;  $n = 175$ ) or usual health messages (control;  $n = 175$ ) using restricted randomization. Data were collected at enrollment and 1, 3, 5, 7, 9, and 12 mo after delivery. We collected data on infant and young child feeding practices and anthropometric measurements from birth until 12 mo to assess the main outcomes, including feeding practices and growth. We used the Bayley Scale III at 12 mo to assess child development. The effects of the PC + PCS intervention were assessed by using regression models.

**Results:** More mothers in the PC + PCS group than in the control group reported early initiation of breastfeeding (in the first hour: 89% compared with 78%, respectively;  $P < 0.05$ ) and exclusive breastfeeding at 5 mo (73% compared with 27%, respectively;  $P < 0.001$ ). Peer counseling had positively impacted infant length gain at 12 mo ( $P < 0.005$ ). Children in the PC + PCS group were found to be more socially and emotionally active compared with controls at 12 mo (standardized score: 0.165 compared with  $-0.219$ , respectively;  $P < 0.05$ ).

**Conclusion:** Combining peer counseling with psychosocial stimulation had positive effects on infant feeding practices and growth at 12 mo and on the social–emotional development of young children. This trial was registered at [clinicaltrials.gov](http://clinicaltrials.gov) as NCT03040375. *Curr Dev Nutr* 2019;3:nzz072.

## Introduction

Adequate nutrition during infancy and early childhood is essential for growth, health, and development to allow children to reach their full potential. Globally, one-third of the 9.5 million deaths of children aged  $<5$  y are attributed to poor nutrition, either directly or indirectly. Poor nutrition increases the likelihood of illness, with long-standing growth impairment and poor health status (1, 2). Malnutrition is a pervasive but preventable barrier to childhood development (3). Children aged  $<2$  y who are affected by malnutrition can develop stunting, which can lead to



**Keywords:** peer counseling, psychosocial stimulation, infant feeding practices, growth, development

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Abbreviation used: aOR, adjusted OR; BSID-III, Bayley Scales of Infant and Toddler Development—Third Edition; CBC, city blocks cluster; EBF, exclusive breastfeeding; ECD, early child development; EIBF, early initiation of breastfeeding; FRA, field research assistant; IFP, infant feeding practice; IYCF, infant and young child feeding; MAD, minimum acceptable diet; MDD, minimum dietary diversity; MMF, minimum meal frequency; NGO, nongovernmental organization; PC, peer counseling; PCS, psychosocial stimulation.

a reduced height for age, inhibit the ability to reach potential adult height (4), impair intellectual and cognitive performances (5, 6), and reduce work capacity (7, 8).

The effects of malnutrition are intergenerational—that is, mothers of reproductive age are likely to deliver children with low birth weight and also suffer delivery-related complications (9), which in turn have implications on a country's development. These consequences highlight the importance of the first 2 y of life or 1000 d, referred to as the critical period for a child's growth and development (10, 11). Childhood undernutrition remains prevalent in low- and middle-income countries. A major proportion of the global burden of childhood malnutrition is in South Asia (6), where an estimated 96 million children have stunted growth due to chronic malnutrition. Childhood malnutrition is a pervasive problem in Bangladesh, with stunting rates as high as 36% in the general population aged <5 y (12) and 50% among children of the same age living in slums (13).

Infant and young child feeding (IYCF) practices that are essential during the first 1000 d are early initiation of breastfeeding (EIBF), exclusive breastfeeding (EBF), adequate complementary feeding (from 6 mo until 24 mo), adequate dietary diversity in complementary food, and adequate frequency of meals (14). Promotion of these IYCF practices is essential for optimum growth and development (15). Hospital-based services have effectively improved breastfeeding outcomes; however, community-based programs are also required. Peer counseling is a community-based approach used globally. Evidence suggests that peer counseling plays an important role in improving both EIBF and EBF practices (15). However, such interventions require a controlled and robust study design to maintain efficacy in breastfeeding practices (16). A meta-analysis showed that individual counseling significantly increased EBF in the neonatal period (15 studies; OR: 3.45;  $P < 0.0001$ ) and at 6 mo (9 studies; OR: 1.93;  $P < 0.0001$ ) (17). Moreover, poor cognitive function at school entry is associated with inferior educational attainment and, consequently, poorer job opportunities, higher fertility rates, and lower quality parenting in adult life. Data show that Bangladeshi children have substantial developmental deficits by age 18 mo and that stunting plays a major role in these deficits (18). Inappropriate breastfeeding and complementary feeding increase the risk of childhood malnutrition and morbidity, which in turn may contribute to stunting and wasting. Although strategies that promote appropriate breastfeeding have a major positive effect on infant survival, the effect of such interventions on stunting appears much smaller (1). A meta-analysis reported that complementary feeding education delivered by health care providers during a mother's routine contact with the health system increased the height-for-age  $z$  score by 0.25 SD (1, 19).

It is well established that good health and nutrition, as well as a stimulating and caring environment, are necessary for disadvantaged children to reach their developmental potential (17, 19). Long-term follow-up of the participants in early child development (ECD) programs in developed countries reported sustained benefits in adulthood, including higher scores on cognitive and academic tests (19, 20). In a time-lagged, controlled trial carried out in a nutrition rehabilitation unit in Dhaka, Bangladesh, counseling mothers significantly improved the development of severely malnourished children aged 6–24 mo (21). In another study, severely malnourished children who received nutritional supplementation and psychosocial stimulation showed

improved mental and psychomotor development and weight gain after 6 mo of intervention (22). However, very few studies have involved children aged <12 mo or women during pregnancy (23–25). In the current study, we evaluated the effects of community-based peer counseling combined with psychosocial stimulation (PC + PSC) on infant feeding practices (IFPs) and the growth and development of infants (<2 mo) in an urban slum in Dhaka, Bangladesh.

## Methods

### Study population, trial design, and randomization

The study site was Mirpur, an “auxiliary thana” or subdistrict in Dhaka Metropolitan City Corporation. In this trial, we used a subsample of 10 clusters from an earlier community-based cluster randomized control trial conducted in this area that identified 36 city-block clusters (CBCs) using geographic information system methods to map and census households (MJ Dibley, personal communication). In that study, satellite maps of the selected study areas in Mirpur thana were used to identify the clusters. All structures in the maps were physically verified through door-to-door visits. These survey data were utilized to prepare a database of the population of the study area that was linked to the mapped structures. Each of the clusters contained an average population of 5000 people and had a surrounding buffer zone of 200 m to prevent contamination.

Due to the limited number of clusters, we used restricted randomization to allocate the treatments in this trial (22, 26). We constructed a database for these CBCs using data collected in the earlier trial with 6 background variables for each cluster: maternal education, water sources, household wealth quintile, number of bedrooms, rate of low birth weight, and mean maternal BMI (in  $\text{kg}/\text{m}^2$ ). In the first step, we conducted a cluster analysis and identified the 10 most similar clusters from the 36 available clusters. In the second step, we ran an SAS macro (27) to identify all balanced combinations from these 10 clusters, with 5 intervention clusters and 5 control clusters. The intervention group received IYCF counseling, psychosocial stimulation, feeding bowl and spoon, handwashing solution, and homemade toys. The control group received the usual health and nutrition messages from the government, nongovernmental organizations (NGOs), and mass media. In total, there were 124 balanced combinations based on the 6 background variables, and we randomly selected 1 combination to allocate the trial treatments.

### Eligibility criteria

Using a house-to-house survey, we identified married pregnant women aged 16–49 y. Women with no more than 3 living children or a parity of 5 and who intended to stay in the area for at least 6 mo after delivery were included. Women with documented heart disease, insulin-dependent diabetes mellitus, eclampsia, or any obstetric complications in previous pregnancies were not eligible for enrollment; those who planned to migrate from the study area after delivery were also excluded. Mother–infant pairs who had congenital anomalies or who required intensive care were not included. Women in the third trimester of pregnancy who provided written informed consent were enrolled in the study. Enrollment took place between January 2015 and June 2015. This study (PR-1414) was approved by the Research Review Committee

and Ethical Review Committee, the 2 compulsory components of the institutional review board of the International Centre for Diarrheal Disease Research, Bangladesh (icddr, b). Written informed consent was obtained from all study participants and/or their parents/guardians prior to enrolment.

### Selection and training of peer counselors

Women with personal breastfeeding experience,  $\geq 8$  y of schooling, motivation to help other mothers breastfeed, and who resided in the intervention area were invited to become peer counselors. The peer counselors were provided a monthly salary and formal training. The WHO/UNICEF Breastfeeding Counseling Course, which was previously validated (28), was adapted to the local language and culture and used to train peer counselors. The training lasted 40 h (4 h daily for 10 d) and was delivered by an IYCF counseling expert. Counseling skills were taught to the peer counselors by demonstration and role play; these skills included listening to mothers, learning about their difficulties, assessing the position and attachment of infants during breastfeeding, building mothers' confidence, giving support, and providing relevant information and practical help when required. The short version of the stimulation curriculum was used to train the peer counselors on 3 main stimulation messages: 1) explaining how to show love, how to respond, how to facilitate communication, and so on along with the benefits of these activities for child development; 2) explaining a pictorial stimulation calendar containing 3 or 4 age-appropriate activities to be performed with the child; and 3) teaching mothers and other family members how to make toys from recycled materials (29).

A peer counselor was recruited for each cluster and was responsible for delivering the intervention to 30–35 mothers residing in that area. The performance of the peer counselors was monitored at least 3 times during the study period by an ECD expert, and quarterly monitoring was performed by a senior counselor based at the field office of the icddr, b. The senior counselor (who had a bachelor-level education in child development and also received local and overseas IYCF training) used a peer counseling monitoring form to assess the peer counselor's performance on feeding and stimulation counseling.

### Peer counseling to support appropriate IYCF

We scheduled 13 peer counselor visits for each mother: 2 before delivery, 2 during the first month after delivery, 7 monthly visits while the infant was between ages 2 and 8 mo, 1 visit when the infant was age 10 mo, and 1 visit when the infant was age 11 mo. The counseling took place at home and included the mothers and key family members (e.g., mothers-in-law and fathers). During the antenatal period, the peer counselors 1) advised mothers on the importance and methods of early initiation of breastfeeding and providing colostrum, 2) discouraged prelacteal feeds, and 3) discussed problems with breastfeeding that the mothers might encounter and how best to deal with these issues. EBF was encouraged from delivery until age 6 mo, and the peer counselors addressed each mother's specific needs related to difficulties feeding her infant.

When their child was 6 mo old, mothers were informed of the importance of complementary feeding and given a demonstration on preparation of age-appropriate and diversified complementary foods comprising at least 4 food groups (carbohydrate, protein, fat, and vitamins). We gave the mothers measuring cups and spoons and

demonstrated appropriate complementary foods, encouraging mothers to use foods normally consumed in their home.

At 10 and 11 mo after delivery, peer counselors encouraged the mothers to continue breastfeeding and provided support regarding adequate frequency of complementary feeds and appropriate, diverse foods. If necessary, peer counselors also provided further demonstrations of complementary feed preparation.

### Psychosocial stimulation

Peer counselors provided counseling on the importance of feeling well and happy during pregnancy, singing to the baby in the womb, and avoiding any harmful practices such as tobacco use. Fathers and other household members were briefed on the importance of keeping the mother happy and joyful and avoiding subjecting her to violence or any harsh treatment. ECD messages such as playing, chatting, and singing to the newborn and infant were encouraged along with feeding messages.

The peer counselors provided homemade toys such as soft balls, handmade pictorial books, blocks, and rolling cars that were made from recycled materials. During the group sessions held every 2 wk, mothers were taught how to make these toys from different types of household waste materials. Mothers were also informed about their children's future developmental needs—that is, they were encouraged to introduce more advanced toys, picture books, and toys that promote walking and running, such as balls, push-along or pull-along toys, books, and musical instruments. In this way, the mothers could continue these stimulatory activities even after the program was terminated when their children turned age 12 mo.

### Sample size

To estimate the sample size for the trial, we assumed a dropout rate of 20%, power of 80%, and 2-sided  $\alpha$  of 5%. Based on the 2014 Bangladesh Demographic Health Survey data of urban child populations, we estimated an intracluster correlation coefficient of 0.01. We hypothesized an expected difference in mental development between the PC + PCS and control groups of 0.4 SD, which is similar to the effect size reported in a previous psychosocial stimulation intervention involving young children in Bangladesh.

Using the previous assumptions and standard statistical methods, the sample size required was 350 mother–child pairs across the 5 clusters per group.

Equation 1 presents the formula for sample size calculation (30):

$$N = \frac{2(z_{\alpha/2} + z_{\beta})^2}{d^2} (1 + m - 1) \rho \delta^2 \quad (1)$$

where  $Z_{\alpha/2}$  is the critical value of normal distribution at  $\alpha$  (for 95% CI, it is 1.96),  $Z_{\beta}$  is the critical value of normal distribution at  $\beta$  (for 80% power, it is 0.84),  $d$  is the difference between 2 means,  $m$  is the cluster size,  $\rho$  is the intracluster coefficient,  $N$  is the sample size, and  $\sigma$  is the effect size.

### Collection of data and quality control

Eight trained field research assistants (FRAs) used structured, precoded, closed questionnaires to collect data. We obtained data on socioeconomic and demographic variables, pregnancy-related events, and modes of previous infant feeding at enrollment. Within 72 h of birth,

interviewers collected the details of delivery and early feeding, including breastfeeding initiation and status, prelacteal feeding, and feeding of colostrum.

To collect dietary recall data, we used UNICEF's Indicators for assessing IYCF practices (31). The questionnaire covered current breastfeeding status, current use of other liquids and solid foods, and timing of the introduction and frequency of other liquids and solid foods (31). In addition, we included some variables on the use of bottle feeding and information on individuals within the mother's family and friends who provide advice on infant feeding. The FRAs collected data at 2-mo intervals from birth until age 9 mo and at 12 mo. We also collected 24-h and 1-mo dietary recalls at birth and at 1, 3, 7, 9, and 12 mo of life. For the quality control of data collection by the interviewers, the supervisor observed 5% of the interviews directly and reinterviewed 5% of all participants.

### Anthropometry

Anthropometric measurements were collected soon after birth (within 72 h) and at 2-mo intervals until 12 mo using established methods (32). We recorded recumbent length using a locally made wooden length board and weight with a digital weighing scale (SECA 847) that were calibrated both before and during data collection. The 2006 WHO Growth Standards were used to construct anthropometric indices, and standard WHO-recommended indicators were used to assess stunting (height-for-age  $z$  score  $< -2$  SD) at every time point.

### Infant feeding scales

We adapted previously reported infant feeding scales using data collected from birth until 12 mo of age (33). We adopted 2 different scales for the 0–5 mo and 7–12 mo age groups. Variables such as early initiation of breastfeeding, any prelacteal feeding, giving colostrum and exclusive breastfeeding, bottle feeding, and providing any complementary food were used to create the score for the 0–5 mo group. For the 7–12 mo group, scoring was based on the continuation of breastfeeding, bottle feeding, introduction of complementary feeding, minimum dietary diversity (MDD), minimal meal frequency (MMF), and minimum acceptable diet (MAD) (33). The higher scores were better for MDD, MMF, and MAD.

We scored a “yes” response as 1 and “no” as 0 for each age-appropriate practice based on the current infant feeding recommendations of the WHO and UNICEF (34, 35). To assess EBF, we included only infants not receiving any food other than breast milk during the past month. We conducted monthly recall at 2-mo intervals from birth until age 5 mo. Due to the longitudinal nature of data, we captured and used information regarding whether a new food was introduced to a child for the first time in the previous month. Any child who was introduced to any new food was excluded from the EBF calculation. Therefore, the approximation of the duration of EBF was close to real practice in the community.

We calculated individual scores at 1, 3, 5, 7, 9, and 12 mo of age, contrary to what Saha and colleagues (35) reported in their cross-sectional study. Furthermore, we computed cumulative feeding scales for 0–12 mo by adding both the feeding scales for breastfeeding and complementary feeding.

### Developmental assessment

The children's cognitive development was assessed at 12 mo by a trained psychologist using the Bayley Scales of Infant and Toddler Development—Third edition (BSID-III). This internationally recognized tool is used to assess children's cognitive development between ages 1 and 42 mo (22). The subscales of the BSID-III are Cognitive, Motor (fine and gross motor), Language (expressive and receptive), and Social-Emotional. In the current study, we converted the raw scores for each subscale into their respective  $z$  scores. A specialist psychologist trained the resource person from the icddr, b. After week-long training, the newly trained resource person pilot tested the BSID-III questionnaire in local language in the hospital setting of the icddr, b and then used this questionnaire in the field without any modification. This BSID-III questionnaire has been used previously in Bangladeshi studies (36, 37) and has shown good interobserver reliability and short-term test–retest stability. The assessment of cognitive development began when the intervention was completed at 12 mo, and none of the peer counselors were in operation in the field. These precautions were strictly maintained to ensure the assessor was not aware of the group assignments.

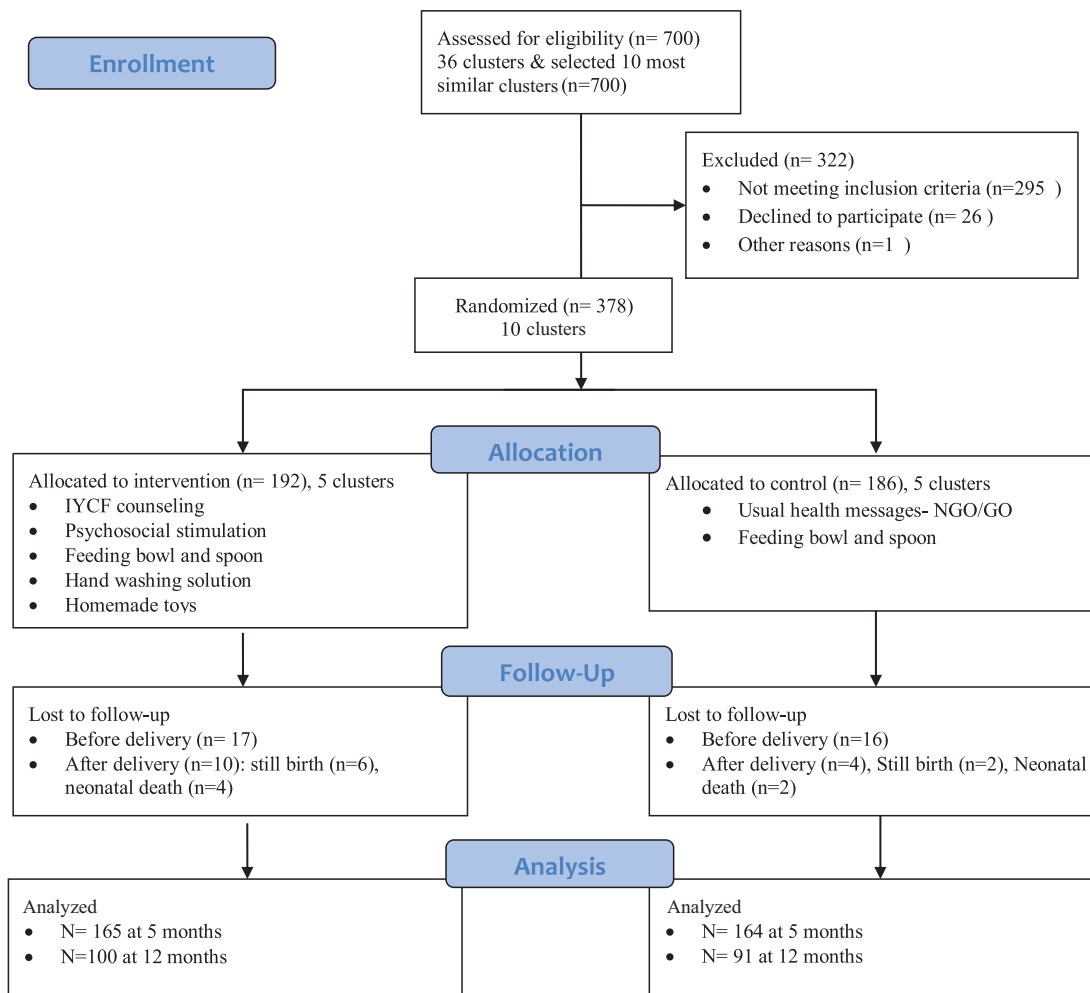
### Statistical analysis

Data analysis was conducted at the mother–infant dyad level with adjustment for community-cluster randomization (38). To assess the effectiveness of randomization, we examined the baseline characteristics of the individual mother–infant dyads across treatment groups. STATA software version 14 (2008; Stata Corporation) was used for all analyses. For multivariable analysis, we used the “xtmixed” command to fit linear mixed models.

We used these models to investigate the association between infant feeding score and growth in children from ages 0 to 12 mo. We also adjusted for the following confounding factors: sex, birth weight, birth length, infant morbidity, as well as the age, weight, and education of the mothers in the regression analysis. Initially, we examined the association between IFPs (0–5 mo and 0–12 mo) and gain in length at 7 and 12 mo, respectively. For complementary feeding, we reported adjusted ORs (aORs) and their 95% CIs adjusted for within-person correlation and time of measurement using a liner regression model. For the developmental assessment, we used externally standardized scores. We converted all scores of the developmental domain with a focus on cognitive, receptive, and expressive language and also fine and gross motor development to standard scores using the mean and SD of the total sample (38). We examined the differences in cognitive scores at each test by group controlling for age, gender, wealth quintiles, mother's education and height for age  $z$  score at 12 mo for all available subjects using multiple regressions. We selected variables based on previous studies (21, 39).

### Results

From January 2015 to June 2015, we screened 700 participants for eligibility and recruited 378 participants based on the predetermined inclusion and exclusion criteria. The participants were assigned to the intervention or control groups. Seventeen participants in the intervention group and 16 in the control group were lost to follow-up



**FIGURE 1** CONSORT flow diagram. GO, governmental organization; IYCF, infant and young child feeding; NGO, nongovernmental organization.

due to stillbirths and neonatal deaths. At the end of the study, 165 dyads in the intervention group and 164 in the control group were included in the analyses. **Figure 1** shows a flow diagram of the participants according to the CONSORT guidelines.

### Baseline characteristics

The mean age of the mothers was comparable between groups (**Table 1**). The mean number of years of schooling for the mothers was  $4.88 \pm 3.8$  y in PC + PCS group and  $5.57 \pm 3.4$  y in the control group. The average BMI of the mothers was similar between groups. Approximately half of the mothers in both groups delivered their infants in health facilities (52.6% compared with 51.8% for PC + PCS and control, respectively), approximately one-fourth had a home delivery, and the remainder (20.6%) delivered at an NGO delivery center. More than half of the mothers had normal deliveries, and 31% in both groups delivered their child by cesarean section. The average birth weights of the newborns in the PC + PCS and control groups were  $2.90 \pm 0.46$  kg and  $2.94 \pm 0.50$  kg, respectively. The

corresponding birth lengths were  $48.58 \pm 2.06$  cm and  $48.8 \pm 1.75$  cm, respectively. Overall, 13% of infants had a low birth weight (<2500 g; **Table 1**).

### First feeds for infants

In both groups, more than 95% of mothers gave colostrum to their infants as the first food. A significantly higher proportion of mothers in the PC + PCS group compared with the control group reported early initiation of breastfeeding (within 1 h of birth; PC + PCS group: 89.1%; 95% CI: 83.5, 92.9; control group: 77.4%; 95% CI: 69.5, 86.2). A higher proportion of control neonates (12.2%) received any kind of prelacteal feed compared with PC + PCS neonates (4.2%). The median duration of EBF (recorded after 5 mo) was 98 d in the PC + PCS group and 56 d in the control group ( $P < 0.000$ ). The median duration of any breastfeeding (partial breastfeeding; recorded after 12 mo) was 275 d in the PC + PCS group and 218 d in the control group ( $P < 0.001$ ; **Table 2**).



**TABLE 1** Characteristics of the mothers and children<sup>1</sup>

Characteristics	PC + PCS (n = 175)	Control (n = 170)
Mother's age, y	23.38 ± 4.00	23.54 ± 4.32
Mother's mean years of schooling	4.88 ± 3.89	5.57 ± 3.43
Husband's mean years of schooling	5.86 ± 4.24	6.38 ± 3.76
Parity, n (%)		
1	62 (75.61)	60 (75.00)
2	17 (20.73)	16 (20.00)
≥3	3 (3.66)	4 (5.00)
Mother's weight, kg	55.41 ± 9.85	54.63 ± 9.04
Mother's height, cm	151.19 ± 6.24	150.24 ± 5.42
Mother's BMI, kg/m <sup>2</sup>	24.21 ± 3.92	24.19 ± 3.80
Gestational age, mean ± SD	38.76 ± 2.4	38.68 ± 2.3
Birth weight of infants, kg	2.90 ± 0.46	2.94 ± 0.50
Birth length of infants, cm	48.58 ± 2.06	48.8 ± 1.75
Low-birth-weight infants, n (%)	21 (12.00)	25 (14.71)
Place of delivery, n (%)		
Home delivery	47 (26.9)	47 (27.6)
Delivery at a health care facility	92 (52.6)	88 (51.8)
Delivery at an NGO facility	36 (20.6)	35 (20.6)
Type of delivery, n (%)		
Normal	101 (58.7)	9 (53.9)
Caesarian	54 (31.4)	52 (31.1)
Assisted vaginal delivery	17 (9.9)	25 (15.0)
Delivery assisted by, n (%)		
Qualified doctor	83 (48.3)	73 (43.7)
Nurse/midwife/paramedic	16 (9.3)	31 (18.6)
Trained birth attendant	40 (23.3)	37 (22.2)
Untrained birth attendant	33 (19.2)	26 (15.6)
Delivery complications, n (%)		
Excessive bleeding	1 (0.6)	1 (0.6)
Prolonged labor	12 (7.0)	6 (3.6)
Ruptured uterus	2 (1.2)	0 (0.0)
High blood pressure	2 (1.2)	5 (3.0)
Infant given medical checkup after delivery, n (%)	91 (55.1)	107 (65.2)

<sup>1</sup>Values are means ± SDs or n (%). NGO, nongovernmental organization; PC + PCS, peer counseling + psychosocial stimulation.

### Exclusive breastfeeding practice

The proportion of infants in the PC + PCS group who were exclusively breastfed decreased from 86% at 1 mo to 64% at 5 mo; in the control group, the corresponding decline in EBF was 71% to 19%. EBF practices were significantly different between the PC + PCS and control groups at 5 mo ( $P < 0.001$ ). This comparison was made on the basis of monthly recall. When the 24-h recall data were used, a significant difference was

still observed between the 2 groups with regard to the decrease in EBF at 5 mo (Table 3).

### Complementary feeding

The PC + PCS group had nearly 2 times higher likelihood (aOR: 1.98; 95% CI: 1.37, 2.87;  $P = 0.000$ ) of achieving minimum dietary diversity compared with the control group at 7–12 mo. We did not find any improvement in terms of minimum meal frequency and minimum acceptable diet in the intervention group. Between ages 7 and 12 mo, infants in the PC + PCS group were 1.95 times more likely to consume fleshly foods compared with the control group (aOR: 1.38; 95% CI: 1.38, 2.77;  $P = 0.000$ ). Moreover, the frequency of egg consumption was significantly higher among infants in the PC + PCS group than in the control group (aOR: 1.42; 95% CI: 1.00, 2.77;  $P = 0.045$ ). The total frequency of protein consumption (egg, flesh food, and organs) was more than 2 times higher for the infants in the PC + PCS group (aOR: 2.08; 95% CI: 1.39, 13.11;  $P = 0.000$ ; Table 4).

### Associations between peer counseling and subsequent gain in length

Mothers in the intervention group were more likely to report recommended feeding practices compared with the control group when their infants were ages 1, 3, 5, 7, 9, and 12 mo. The results of the linear regression models for the impact of the intervention on height gain showed that peer counseling was positively associated with the change in the length of the infants (coefficient, 0.82; 95% CI: 0.15, 1.48;  $P = 0.021$ ). Moreover, the strongest association was found between maternal height and infant length gain. Maternal height was significantly associated with child length gain (coefficient, 0.14; 95% CI: 0.009, 0.19;  $P = 0.000$ ). We also found that girls' length increased less than that of boys (Tables 5 and 6).

### Child development at 12 mo.

Children in the PC + PCS group had higher scores for expressive communication (standardized score: 0.0614 compared with  $-0.0813$ ;  $P < 0.001$ ) and social-emotional activities (standardized score: 0.165 compared with  $-0.219$ ;  $P = 0.004$ ) compared with infants in the control group at 12 mo. We did not observe any significant between-group differences in the cognitive or fine and gross motor domains (Figure 2).

We used multivariable linear regression to identify the effect of PC + PCS on the children's social-emotional score. We observed a significant association between PC + PCS and social-emotional score (adjusted coefficient: 9.38; 95% CI: 0.28, 18.47;  $P = 0.044$ ) after adjusting

**TABLE 2** Infant feeding patterns<sup>1</sup>

	PC + PCS (n = 165)	95% CI	Control (n = 164)	95% CI
Colostrum and prelacteal feeding				
Early initiation of breastfeeding, n (%)	147 (89.09)	83.5, 92.9	127 (77.44)	69.5, 86.2
Received colostrum, n (%)	163 (98.79)	94.5, 99.7	159 (96.95)	87.9, 99.1
Prelacteal food given, n (%)	7 (4.24)	1.19, 8.44	20 (12.20)	7.9, 18.2
Median duration of EBF, d	98 (range: 1–150)	62.7, 117	56 (range: 1–150)	5.33, 54.6
Median duration of any breastfeeding, d	275 (range: 1–365)	0.3	218 (range: 1–365)	0.050 <sup>2</sup>

<sup>1</sup>EBF, exclusive breastfeeding; PC + PCS, peer counseling + psychosocial stimulation.

<sup>2</sup>Mann-Whitney U test.

**TABLE 3** Age-specific exclusive breastfeeding rate by group (24-h compared with monthly recall)<sup>1</sup>

	24-h recall			1-mo recall		
	PC + PCS n (%)	Control n (%)	P value	PC + PCS n (%)	Control n (%)	P value
Month 1	121 (86.0)	107 (72.79)	0.007	121 (86.13)	104 (71.20)	<0.05
Month 3	108 (83.08)	73 (52.03)	<0.001	99 (76.43)	55 (39.27)	<0.001
Month 5	92 (73.02)	34 (27.0)	<0.001	81 (64.0)	25 (19.0)	<0.001

<sup>1</sup>Adjusted for cluster. PC + PCS, peer counseling + psychosocial stimulation.

for the child’s age and sex and the mother’s age and history of low birth weight. Low birth weight was negatively associated with social-emotional score compared with that of children with normal birth weight (adjusted coefficient: -9.13; 95% CI: -17.63, -0.64; *P* = 0.0037) after adjusting for other factors (Table 7).

**TABLE 4** Effect of peer counseling and psychosocial stimulation on complementary feeding practices between 7 and 12 mo of age using multilevel mixed effects logistic regression<sup>1</sup>

Indicators	aOR (95% CI)	P value
Minimum dietary diversity	1.98 (1.37, 2.87)	0.000
Minimum meal frequency	1.03 (0.60, 1.76)	0.916
Minimum acceptable diet	1.30 (0.85, 2.01)	0.228
Flesh foods	1.95 (1.38, 2.77)	0.000
Egg	1.42 (1.00, 2.77)	0.045
Total protein (egg + flesh food + organs) consumption	2.08 (1.39, 3.11)	0.000

<sup>1</sup>Model adjusted for group, child’s age and sex, history of diarrhea in past 2 wk, breastfeeding status, mother’s age, mother’s education, father’s education, and household size. aOR, adjusted OR.

**Discussion**

The current study was conducted to investigate the ability of a combined infant feeding counseling and psychosocial stimulation program to improve children’s cognitive, motor, and language development along with growth and child-feeding practices compared with the usual health messages only. The improved infant feeding scores, higher rates of animal protein intake, and significantly higher standardized scores for expressive language communication in the PC + PCS group indicate that the combination of peer counseling feeding support and

psychosocial stimulation effectively promoted appropriate IFPs and improved infant growth and development, especially linear growth.

Psychosocial stimulation combining with IYCF counseling during infancy was one of the most important components of this study. The sample size calculation was based on the assumption that feeding and stimulation would have an impact on mental development, as reported in a previous study (39, 40). We did not observe any difference in motor development between groups, although the children in the intervention group had higher social-emotional and expressive scores. Our results are comparable to those of other studies of younger children (<12 mo) in Bangladesh. In the study by Hamdani et al. (36), malnourished children received food packets and twice-weekly psychosocial stimulation at home for 12 mo, and their mothers attended weekly group meetings at community nutrition centers during the same period. A higher Mental Development Index (effect size = 0.34 SD) in terms of vocalization, cooperation, and response to examiner’s emotional tone was observed among the children in the intervention group compared with the control group. However, no differences in motor development or nutritional status were observed (41). Nahar et al. (21) conducted a study in the slums of Dhaka focusing on severely underweight children (weight-for-age *z* score < -3) aged 6–24 mo. The children were attending 4 community clinics in Dhaka after being discharged from the icddr, b hospital. The PC + PCS group received food supplementation plus psychosocial stimulation, whereas the control group received follow-up care at the community clinic without supplementation or psychosocial stimulation. Children receiving any stimulation had a higher Mental Development Index (effect size = 0.37 SD), but there was no effect on motor development (18, 36, 37). Similar findings were observed in a study conducted by Aboud et al. (42). In the current study, we observed a positive association between height-for-age *z* score at 12 mo and the social-emotional score, but we cannot compare our findings with those of other studies due to the unavailability of similar research. We also observed that the infants in the PC + PCS group were more socioemotionally interactive. This

**TABLE 5** Infant feeding scale

Month	Possible scores	PC + PCS <sup>1</sup>	95% CI	Control	95% CI	P value <sup>2</sup>
0–1	0–10	9.14 ± 1.46	8.85, 9.43	8.51 ± 1.78	8.08, 8.93	0.011
0–3	4–13	11.59 ± 2.05	11.19, 11.99	10.35 ± 2.46	9.75, 10.94	0.004
0–5	4–16	13.89 ± 2.55	13.39, 14.39	11.77 ± 3.16	11.01, 12.53	<0.001
0–7	7–20	16.67 ± 3.02	16.07, 17.26	14.26 ± 3.60	13.39, 15.13	<0.001
0–9	7–24	19.38 ± 3.85	18.63, 20.14	17.01 ± 4.15	16.02, 18.01	0.0002
0–12	7–28	22.02 ± 4.72	21.09, 22.95	19.88 ± 4.63	18.77, 20.99	0.0039

<sup>1</sup>PC + PCS, peer counseling + psychosocial stimulation.

<sup>2</sup>*t* test.

**TABLE 6** Effect of peer counseling on child height<sup>1</sup>

Variables	Unadjusted coefficient (95% CI)	P value	Adjusted coefficient (95% CI)	P value
Group				
Control	Reference		Reference	
Intervention	0.91 (0.16, 1.66)	0.021	0.82 (0.15, 1.48)	0.021
BMI of mother, kg/m <sup>2</sup>	-0.01 (-0.12, 0.10)	0.845	-0.02 (-0.14, 0.09)	0.700
Mother height, cm	0.15 (0.10, 0.20)	0.000	0.14 (0.09, 0.19)	0.000
Sex of child				
Male	Reference		Reference	
Female	-1.50 (-2.32, -0.69)	0.002	-1.5 (-2.04, -0.74)	0.002

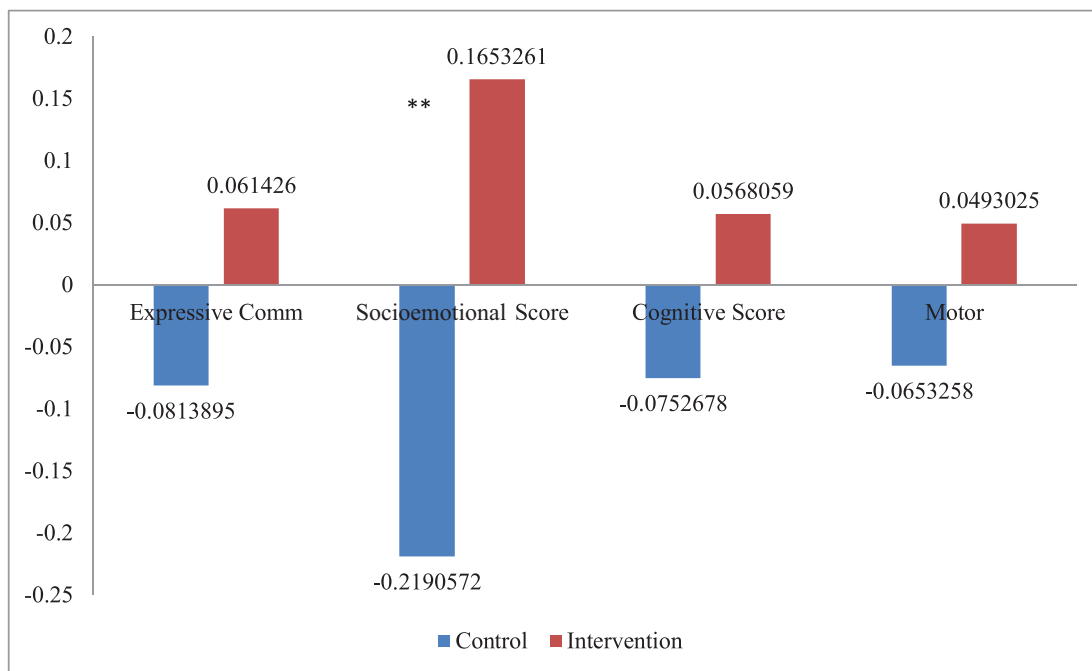
<sup>1</sup>Adjusted for cluster.

provides evidence that peer counseling improves IFPs and contributes to a greater gain in length in subsequent months and also that the intervention is beneficial for child development.

A higher proportion of mothers in the PC + PCS group initiated breastfeeding within 1 h, and a lower proportion of mothers gave prelacteal feeding to their neonates, confirming that peer counseling effectively promoted EIBF and helped mothers initiate breastfeeding in a timely manner. Furthermore, the prevalence of EBF at 5 mo was significantly higher among the intervention group in the current study. This comparison was based on longitudinal monthly recall data. Evaluation of 24-h recall data also indicated that the EBF rate at 5 mo was significantly better among children from the intervention group. Our findings are consistent with those of a randomized controlled evaluation conducted by Haider et al. (39), which suggested that peer counseling may be an effective intervention to improve breastfeeding practices in Bangladesh.

Previous studies that aimed to investigate the association between IFPs and growth considered infant or child growth in relation to breastfeeding and the introduction of complementary food. For instance, Saha et al. (35) constructed a cumulative infant feeding scale that captured infant feeding scales in the early months of life. In the current study, we used a similar approach to analyze the association between infant feeding and growth. The infant feeding scores were significantly higher in the PC + PCS group compared with the control group during the entire intervention period. This improvement in correspondence to the theoretical scale was due to the improvements in the rate of EBF, continuation of breastfeeding, initiation of complementary feeding at an appropriate age, and achievement of minimum dietary diversity in the PC + PCS group.

In the current study, peer counseling was significantly associated with increased infant length. A few studies have reported that peer counseling alone has a positive impact on improving length (40).



\*\*  $P < 0.001$

**FIGURE 2** Development levels in SD score by groups.



**TABLE 7** Regression coefficient for the effect of variables on expressive communication and social–emotional behavior (z scores) at 12 mo<sup>1</sup>

Variables	Unadjusted coefficient (95% CI)	P value	Adjusted coefficient (95% CI)	P value
Group				
Control	Reference		Reference	
Intervention	9.02 (−0.71, 18.77)	0.067	9.38 (0.28, 18.47)	0.044
Child sex				
Male	Reference		Reference	
Female	2.67 (−6.25, 11.60)	0.526	4.30 (−3.92, 12.53)	0.227
Child age, mo	6.18 (2.30, 10.05)	0.005	6.54 (2.62, 10.46)	0.003
Mother age, y	−0.64 (−1.52, 0.22)	0.134	−0.68 (−1.62, 0.25)	0.141
Low birth weight, kg	−8.29 (−16.45, −0.14)	0.047	−9.13 (−17.63, −0.64)	0.037

<sup>1</sup>n = 186. Adjusted for cluster.

Correlations between maternal height and child length were also observed in our study. This effect may be expected to be strongest among individuals whose stature likely reflects their genetic potential; it may be expected to be lowest among mothers whose adult height largely reflects the experience of poor nutrition and/or environment during gestation and/or childhood yet whose progeny experience conditions supportive of healthy growth (43).

### Strengths and limitations of this study

One of the important strengths of this study is the use of longitudinal data collected between 0 and 12 mo. We believe that this approach makes our findings more reliable than those of other studies that used cross-sectional data to explore the associations between IFPs and growth (44). We accounted for maternal behavior regarding infant feeding recommendations because our intervention involved feeding counseling that was intended to improve IFPs and growth. Another important strength of our study is the comparison of the EBF rate using 2 different dietary recall methods. We observed overestimation of EBF rates using 24-h recall data, the technique suggested by the WHO recommendations, because the EBF rate in the control group was lower when estimated using longitudinal data at 5 mo. The feeding scale that we created captured various aspects of recommended infant feeding indicators.

However, the constructed feeding scale was mainly based on recommended IFPs, as reported by mothers and caregivers; we did not capture the infants' actual food consumption. Furthermore, we could not estimate the micronutrient content of the complementary foods using this feeding scale. One of the limitations of the study was the high dropout rate in both groups. However, infant mortality is relatively high among the slum-dwelling population. Finally, we were not able to conduct reliability tests for the cognitive testing due to time and funding constraints, and the interviewers were not blinded to the group allocations.

### Conclusions

This study indicates that combining peer counseling and psychosocial stimulation has positive effects on IFPs and growth at 12 mo as well as on social–emotional development of young children. The intervention by

locally recruited peer counselors also promoted appropriate IYCF practices. Policymakers should incorporate counseling on infant feeding and psychosocial stimulation into regular health programs. Indeed, this intervention could be scaled within Bangladesh and to other developing countries.

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