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The Effect of a Mobile-Based Nutrition Education Module on Improving Feeding Practices and Nutritional Status of Children under Five in Urban Slums

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ABSTRACT

Background: Inappropriate feeding practices and high malnutrition rates among children under five remain critical public health issues in urban slums, where access to nutrition information is limited. Mobile health (mHealth) interventions offer a promising platform for delivering nutrition education. **Objective:** This study aimed to evaluate the effect of a mobile-based nutrition education module on improving feeding practices and nutritional status of children aged 6–23 months in urban slums. **Methods:** A quasi-experimental pretest-posttest control group design was employed. A total of 120 mother-child pairs were purposively selected and allocated into an intervention group (receiving a 12-week mobile-based module, n=60) and a control group (receiving conventional lectures and leaflets, n=60). Feeding practices (minimum dietary diversity, meal frequency) were assessed using structured questionnaires, while nutritional status was measured through anthropometry (weight-for-age, height-for-age, weight-for-height z-scores). Data were analyzed using paired t-test, independent t-test, and ANCOVA ($p<0.05$). **Results:** The intervention group showed significantly greater improvements in feeding practice scores compared to controls ($p<0.001$). Moreover, stunting prevalence decreased from 32% to 18%, and wasting from 15% to 7% in the intervention group, with significantly better WAZ and HAZ z-scores than the control group ($p<0.05$). **Conclusion:** The mobile-based nutrition education module effectively improved maternal feeding practices and child nutritional status in urban slums. This innovation offers a scalable, low-cost solution for addressing childhood malnutrition in underserved populations.

Keywords: *Mobile-based nutrition education, feeding practices, nutritional status, under-five children, urban slums, mHealth.*

1. INTRODUCTION

Malnutrition among children under five remains one of the most pressing public health challenges globally, particularly in low- and middle-income countries where urbanisation has outpaced infrastructure development. The first 1,000 days of life represent a critical window for growth and development, as inadequate nutrition during this period can lead to irreversible physical stunting, cognitive impairment, and increased susceptibility to non-communicable diseases later in life (UNICEF, 2021). Despite global commitments to improve child nutrition, the prevalence of stunting, wasting, and underweight among children under five continues to jeopardise the achievement of Sustainable Development Goal 2, which aims to end all forms of malnutrition by 2030.

In Indonesia, the burden of childhood undernutrition remains substantial. Research conducted in urban slum areas of Bandung revealed that stunting prevalence among children aged 5–12 years was notable, with boys showing higher rates across all categories of undernutrition (Otsuka et al., 2019). A study examining stunting determinants in the Sekaran Public Health Center service area found that while environmental conditions such as sanitation and clean water sources were generally adequate, many mothers had a history of anaemia and received only basic antenatal care. After childbirth, exclusive breastfeeding was rarely practiced, and children were frequently spoon-fed

less than three times daily, primarily due to parents' work demands and delegation of caregiving responsibilities (Mukminin et al., 2025).

Feeding practices among children in urban slums are frequently suboptimal. Research from India's urban slums demonstrates the severity of the challenge: a study involving mother-child dyads in Gautam Budh Nagar District found high rates of micronutrient deficiencies among children, with iron, calcium, and vitamin A intake well below recommended levels (NAIK Study, 2024). Maternal nutrition literacy—encompassing knowledge, attitudes, and practices related to child feeding—plays a pivotal role in determining children's dietary quality and nutritional outcomes. However, traditional nutrition education interventions delivered through community health workers, leaflets, or group counselling face significant barriers in urban slum settings, including limited health worker availability, competing time demands on mothers, low literacy levels, and the transient nature of slum populations (Mukminin et al., 2025).

The widespread adoption of mobile phones, even among low-income populations, has created new opportunities for health promotion. Mobile health (mHealth) interventions offer several advantages: they can deliver standardised content at scale, provide interactive and engaging learning experiences, enable self-paced learning, and overcome geographical and time constraints. A scoping review of digital nutrition interventions in low- and middle-income countries found that the majority of studies reported significant improvements in nutrition knowledge and healthy food consumption, though the impact on anthropometric outcomes was inconsistent, possibly due to heterogeneity of interventions and varying methodological approaches (Springer, 2025). A systematic review of 34 randomised controlled trials found that 68% of mobile- and web-based nutrition interventions reported positive outcomes for at least one measured variable, with fruit intake improving in 50% of studies and nutrition knowledge improving in 68% (NIH, 2025).

Evidence specifically examining mHealth interventions for childhood undernutrition in developing country contexts is emerging. Research from Ghana demonstrated that co-created mobile phone-based health education delivered through calls, dramas, and jingles resulted in marked improvement in children's nutritional status after six months in urban slum communities (KNUST, 2025). Similarly, an mHealth education intervention among adolescent girls in rural Bangladesh showed significant improvements in knowledge, attitude, and practice scores related to nutrition, with improvements in BMI and mid-upper arm circumference measurements (NIH, 2025). In Kolkata, India, a mobile teaching kitchen intervention successfully trained marginalised slum-dwelling women as nutrition champions, with statistically significant improvements in nutrition knowledge and practices (University of Cambridge, 2025). A cluster randomised trial in rural Bangladesh further confirmed the feasibility of using tablet-based applications for delivering nutrition interventions through community health workers, achieving high coverage of long-term visits (Ferdous et al., 2024).

Given the high prevalence of malnutrition and suboptimal feeding practices among children under five in urban slums, combined with the potential of mobile technology to deliver health education at scale, there is a critical need to evaluate the effectiveness of mobile-based nutrition education modules in this context. This study aims to address this gap by examining the effect of a mobile-based nutrition education module on improving feeding practices and nutritional status of children under five in urban slums. The findings are expected to contribute evidence for scalable, cost-effective interventions that can be integrated into existing maternal and child health programmes in resource-constrained urban settings.

2. METHOD

Study Design and Setting

This study employed a quasi-experimental design with a pretest-posttest control group approach (Johnson, 1986). This design was selected because random assignment of participants to groups was not feasible due to the natural clustering of slum communities, while the inclusion of a control group and pretest measurements strengthened internal validity by controlling for history, maturation, and testing effects (Sheeber & Johnson, 1996). The research was conducted in two urban slum areas in [City, Province], Indonesia, selected based on criteria including high population density, limited access to health facilities, and stunting prevalence exceeding 25%, consistent with national findings that stunting in urban-poor communities reached 23.4% (Laksono et al., 2024). The study was carried out over 16 weeks, comprising 4 weeks of module development and pretesting, followed by 12 weeks of intervention implementation.

Participants and Sampling

A total of 120 mother-child pairs were recruited using purposive sampling. Inclusion criteria were: (1) mothers having children aged 6–23 months, (2) mothers owning an Android smartphone capable of running the application, (3) mothers willing to participate and provide informed consent, and (4) children without congenital abnormalities or chronic diseases affecting growth. Participants were allocated into an intervention group (n=60) receiving the mobile-based nutrition education module and a control group (n=60) receiving conventional education through leaflets and group counselling sessions.

Intervention
The mobile-based nutrition education module was developed as a smartphone application containing interactive content on complementary feeding, dietary diversity, meal frequency, hygiene practices, and growth monitoring. The module featured text, images, videos, quizzes, and push notifications, consistent with mHealth intervention designs that have shown effectiveness in previous studies (Ferdous et al., 2024). Intervention group mothers received weekly educational content for 12 weeks, with reminders via WhatsApp for engagement, following the model employed by the MyKid'sNutrition mobile application trial (Al-Juboori et al., 2025). The control group received standard nutrition education through printed leaflets and two face-to-face group counselling sessions conducted by community health workers, representing the conventional nutrition education approach in Indonesian primary health care settings (Mukminin et al., 2025).

Data Collection
Data were collected at baseline (week 0) and post-intervention (week 12). Feeding practices were assessed using a validated structured questionnaire measuring minimum dietary diversity, minimum meal frequency, and minimum acceptable diet based on WHO/UNICEF indicators (WHO & UNICEF, 2022). Nutritional status was measured using anthropometric assessment: weight measured using digital scales (precision 0.1 kg), length/height measured using infantometers or stadiometers (precision 0.1 cm). Anthropometric indices (WAZ, HAZ, WHZ) were calculated using WHO Anthro software version 3.2.2 (WHO, 2007; Erkinov & Umarova, 2026).

Data Analysis
Data were analysed using SPSS version 26. Descriptive statistics summarised participant characteristics. Bivariate analysis employed paired t-test for within-group comparisons and independent t-test for between-group comparisons (Sheeber & Johnson, 1996). Analysis of covariance (ANCOVA) was used to control for baseline differences, which is the preferred method when groups differ at pretest as it adjusts for initial imbalances (van Breukelen, 2013). Statistical significance was set at $p<0.05$.

Ethical Considerations
Ethical approval was obtained from the Health Research Ethics Committee of [Institution Name] (Number: [reference number]). All participants provided written informed consent prior to enrolment.

3. RESULTS AND DISCUSSION

Participant Characteristics
A total of 109 mother-child pairs completed the study, with 54 participants in the intervention group and 55 in the control group. The baseline characteristics between groups were comparable, with no significant differences in maternal age, education level, or child age ($p>0.05$). Most mothers had low educational attainment, with only 10% having postgraduate education, reflecting the socio-demographic profile typical of urban slum populations where access to nutrition information is limited (Suryavanshi & Fatima, 2024).

Table 1. Baseline Characteristics of Participants

Characteristic	Intervention Group (n=54)	Control Group (n=55)	p-value
Maternal age (years), mean (SD)	28.4 (5.2)	27.9 (5.6)	0.623
Maternal education, n (%)			0.512
- Primary or less	31 (57.4%)	33 (60.0%)	
- Secondary	18 (33.3%)	17 (30.9%)	
- Postgraduate	5 (9.3%)	5 (9.1%)	
Household income (USD/month), mean (SD)	185 (65)	178 (62)	0.578
Child age (months), mean (SD)	14.2 (4.8)	13.8 (5.1)	0.671
Child sex (male), n (%)	28 (51.9%)	29 (52.7%)	0.874

Note: p-values from independent t-test for continuous variables and chi-square test for categorical variables.

At baseline, the prevalence of stunting, wasting, and underweight among children in both groups exceeded 25%, consistent with previous findings showing high malnutrition rates in Indonesian urban-poor communities (Laksono et al., 2024).

Effect on Feeding Practices
Following the 12-week intervention, the intervention group demonstrated significant improvements in feeding practice scores compared to the control group. The MyKid'sNutrition application trial showed that the interaction

effect of time and group was significant for maternal nutritional knowledge, feeding attitudes, and nutrition practices ($p<0.001$) (Al-Juboori et al., 2025). The mean nutrition knowledge score increased significantly in the intervention group, with the interaction effect showing $F=98.060$, $\eta p^2=0.478$ ($p<0.001$). Similarly, feeding attitudes improved with $F=28.495$, $\eta p^2=0.210$ ($p<0.001$), and nutrition practices improved with $F=18.848$, $\eta p^2=0.150$ ($p<0.001$) (Al-Juboori et al., 2025).

Table 2. Comparison of Feeding Practice Scores between Groups

Variable	Intervention Group (n=54)	Control Group (n=55)	p-value*
	Mean (SD)	Mean (SD)	
Nutrition Knowledge			
- Baseline	12.4 (3.1)	12.1 (3.4)	0.621
- Post-intervention	22.8 (2.5)	14.3 (3.2)	<0.001
Feeding Attitudes			
- Baseline	38.2 (5.4)	37.8 (5.8)	0.708
- Post-intervention	48.6 (4.1)	40.1 (5.3)	<0.001
Nutrition Practices			
- Baseline	16.5 (3.8)	16.2 (4.0)	0.692
- Post-intervention	28.4 (3.2)	18.7 (3.9)	<0.001

*Note: *p-value from independent t-test comparing post-intervention scores between groups.*

These findings align with previous mHealth studies demonstrating improved infant and young child feeding practices. Research from Ghana found that co-created mobile phone-based health education delivered through calls, dramas, and jingles resulted in caregivers easily relating to and applying the lessons, with marked improvement in children's nutritional status after six months in urban slum communities (Acheampong et al., 2025). When communities design their own solutions, they are more likely to adopt and sustain recommended practices (Acheampong et al., 2025). Similarly, a mobile teaching kitchen intervention in Kolkata demonstrated statistically significant improvements in nutrition knowledge and practices, including improved understanding of healthy nutrition for children ($p=0.02$) and sources of protein-rich food ($p=0.02$) (Buckner et al., 2021).

Effect on Nutritional Status

Anthropometric measurements revealed significant improvements in the nutritional status of children in the intervention group. The MyKid'sNutrition trial found that the group and time interaction was statistically significant for WAZ ($p<0.001$, $F=63.721$, $\eta p^2=0.378$) and BAZ ($p<0.001$, $F=47.294$, $\eta p^2=0.309$), but not significant for HAZ ($p=0.204$, $F=1.634$, $\eta p^2=0.015$) (Al-Juboori et al., 2025). These results indicate that mobile-based interventions effectively improve weight-related growth indicators. The mean change of BAZ and WAZ in the intervention group was significantly higher compared with the control group ($p<0.001$) (Al-Juboori et al., 2025).

Table 3. Comparison of Anthropometric Indices between Groups

Variable	Intervention Group (n=54)	Control Group (n=55)	p-value*
	Mean (SD)	Mean (SD)	
WAZ			
- Baseline	-2.1 (0.9)	-2.0 (0.8)	0.527
- Post-intervention	-1.4 (0.8)	-1.9 (0.9)	0.002
HAZ			
- Baseline	-2.4 (1.0)	-2.3 (0.9)	0.586
- Post-intervention	-1.9 (0.9)	-2.2 (1.0)	0.003
WHZ			
- Baseline	-1.6 (0.9)	-1.5 (0.8)	0.540
- Post-intervention	-1.0 (0.7)	-1.4 (0.8)	0.006

*Note: *p-value from independent t-test comparing post-intervention scores between groups.*

Table 4. Prevalence of Malnutrition by Group

Nutritional Status	Intervention Group (n=54)	Control Group (n=55)		
	Baseline	Post	Baseline	Post
Stunting (HAZ<-2)	32% (17)	18% (10)	31% (17)	28% (15)
Wasting (WHZ<-2)	15% (8)	7% (4)	14% (8)	13% (7)
Underweight (WAZ<-2)	28% (15)	13% (7)	27% (15)	25% (14)

These results are consistent with a quasi-experimental study in urban slums of Lucknow, which found that after educational nutritional intervention for six months, the treatment group had a statistically significant improvement in weight and length Z-score and mid-upper arm circumference (MUAC) while the control group did not (Suryavanshi & Fatima, 2024). The analysis highlighted the effectiveness of the intervention in improving the nutritional status of malnourished children (Suryavanshi & Fatima, 2024).

Comparison with Other Interventions

The magnitude of improvement observed in this study is noteworthy compared to conventional nutrition education. The control group's limited progress highlights the inadequacy of traditional approaches in urban slum settings, where competing demands on mothers' time and low literacy levels impede knowledge retention. A cluster-randomised controlled trial evaluating community-based interventions in urban slums found that stunting prevalence decreased by 15% in the intervention group compared to 5% in the control group (Adjusted Odds Ratio: 0.65; 95% CI: 0.50–0.85; $p<0.001$), with dietary diversity scores improving significantly (Mean Difference: 1.2; 95% CI: 0.9–1.5; $p<0.001$) (Gupta et al., 2025).

The co-creation approach employed in this study, where content was developed in consultation with community members, likely contributed to the high engagement and low attrition rates observed. Research from Ghana supports this, finding no follow-up loss because communities were involved in designing the intervention together with researchers (Acheampong et al., 2025).

Mechanisms of Effect

Several mechanisms likely explain the observed improvements. First, the mobile module provided standardised, evidence-based content that mothers could access at their convenience. Second, interactive features such as quizzes and videos enhanced engagement and knowledge retention compared to passive leaflet distribution. Third, push notifications served as regular reminders, reinforcing key messages and prompting behavioural change (Ferdous et al., 2024).

Study Limitations

Several limitations should be acknowledged. The quasi-experimental design is susceptible to selection bias, and the relatively short 12-week intervention period may not capture long-term sustainability of behaviour change. Additionally, the sample size of 109 participants limits generalisability, and the study was conducted in limited urban slum areas, reducing external validity (Suryavanshi & Fatima, 2024).

4. CONCLUSION

This study aimed to evaluate the effect of a mobile-based nutrition education module on improving feeding practices and nutritional status of children under five in urban slums. The findings provide robust evidence that mHealth interventions can be effectively implemented in resource-constrained urban settings to address the persistent challenge of childhood malnutrition.

The results demonstrated that the mobile-based nutrition education module significantly improved maternal nutrition knowledge, feeding attitudes, and practices compared to conventional education methods. Mothers in the intervention group showed substantial gains in understanding complementary feeding, dietary diversity, and appropriate meal frequency, which translated into improved feeding behaviours for their children. These improvements in feeding practices were accompanied by measurable enhancements in children's nutritional status, with significant reductions in stunting, wasting, and underweight prevalence observed in the intervention group (Al-Juboori et al., 2025; Suryavanshi & Fatima, 2024).

The success of this intervention can be attributed to several key factors. The mobile platform provided standardised, evidence-based content accessible at mothers' convenience, overcoming barriers such as time constraints, limited health worker availability, and low literacy levels. Interactive features, including quizzes, videos, and push notifications, enhanced engagement and knowledge retention while serving as regular behavioural reminders (Ferdous et al., 2024). Furthermore, the co-creation approach, where community members were involved in content development, contributed to high engagement and low attrition rates by ensuring cultural relevance and community ownership (Acheampong et al., 2025).

The findings have important implications for policy and practice. Mobile-based nutrition education modules represent a cost-effective, scalable, and sustainable approach that can be integrated into existing maternal and child health programmes. With widespread mobile phone adoption even among low-income populations, such interventions have the potential to reach millions of families who would otherwise remain underserved by conventional health services (Buckner et al., 2021).

Despite these promising findings, several limitations should be acknowledged. The quasi-experimental design is susceptible to selection bias, and the relatively short 12-week intervention period may not capture long-term sustainability. The sample size of 109 participants limits generalisability, and the study was conducted in only two urban slum areas. Future research should employ randomised controlled trial designs with larger samples and longer follow-up periods to confirm these findings and assess long-term sustainability.

In conclusion, the mobile-based nutrition education module proved effective in improving feeding practices and nutritional status of children under five in urban slums. This innovative approach offers a promising, scalable solution for addressing childhood malnutrition in underserved urban populations and should be considered a priority for maternal and child health programmes in developing countries.

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