

A Comparative Study of App-Based and Hospital-Based Nutritional Counselling on Anthropometric Outcomes in Children

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Abstract: *Background:* Childhood malnutrition, including both undernutrition and obesity, remains a major health concern, particularly in developing nations. Conventional hospital-based nutritional counselling often faces barriers such as poor accessibility and inconsistent follow-up. Mobile health (mHealth) interventions, like the NutriGrowth application, offer an innovative, accessible alternative for continuous nutrition monitoring and guidance. *Methods:* A prospective cohort interventional study was conducted among 220 children aged 1–18 years, randomly assigned to either app-based counselling (NutriGrowth) or hospital-based counselling. Baseline and 3-monthly follow-up measurements of weight, height, and BMI were recorded for 12 months. As variables showed non-normal distribution (Shapiro–Wilk $p < 0.001$), non-parametric tests (Mann–Whitney U) were used to compare anthropometric changes between groups. *Results:* Both groups demonstrated significant within-group improvement in nutritional parameters. At 12 months, mean BMI was $17.89 \pm 2.91 \text{ kg/m}^2$ in the app-based group and $17.79 \pm 3.83 \text{ kg/m}^2$ in the hospital-based group. Differences in weight change ($p = 0.709$) and BMI change ($p = 0.965$) between groups were not statistically significant. Consistent improvement was observed across all age and gender subgroups. *Conclusion:* App-based nutritional counselling using the NutriGrowth mHealth platform was as effective as traditional hospital-based counselling in improving BMI and weight trajectories in children. These findings support the integration of digital health tools into pediatric nutrition programs to enhance accessibility, adherence, and continuity of care.

Keywords: mHealth (Mobile Health), Childhood Malnutrition, Nutritional Counselling, BMI Improvement, Digital Health Intervention.

INTRODUCTION

Childhood malnutrition, encompassing both undernutrition and overnutrition, remains a critical global health challenge, particularly in low- and middle-income countries [1]. Undernutrition, characterized by conditions like stunting, has long-term detrimental effects on child development [2]. Simultaneously, the rising prevalence of childhood and adolescent obesity presents a major public health crisis [3]. This coexistence of underweight and overweight populations, often referred to as the "double burden of malnutrition," creates a complex challenge for healthcare systems [4].

While traditional hospital-based nutritional counselling is a standard approach, its effectiveness is often hindered by significant barriers. These limitations include logistical and geographic barriers, especially for rural populations [5], high patient loads, and time constraints limiting provider engagement [6]. Furthermore, the high cost and difficulty of implementing sustained, evidence-based interventions can reduce long-term success [7].

In response to these challenges, mobile health (mHealth) applications have emerged as a scalable and effective tool to improve the delivery of healthcare services [8, 9]. These digital interventions are increasingly utilized in pediatric care to bridge the gaps left by traditional

methods [10]. A primary advantage of mHealth platforms is their ability to enhance patient and caregiver adherence to medical and nutritional guidelines [11], often by providing real-time tracking, personalized feedback, and accessible education on topics like child feeding practices [12].

The effectiveness of mHealth is particularly evident in managing nutritional status, where continuous monitoring is key. For overweight and obese children, digital health interventions have been systematically reviewed and shown to be effective tools for weight management [13, 14]. For underweight children, mHealth apps facilitate crucial growth monitoring and tracking of feeding practices to ensure adequate intake [12, 15]. By promoting healthy eating behaviors [16], mHealth counselling offers a promising strategy to improve both weight and BMI trajectories across the full spectrum of pediatric malnutrition.

METHODS AND METHODOLOGY

Study Design

This study employed a prospective cohort interventional design to compare the effectiveness of two nutritional counselling methods over a 12-month period. The two methods were:

1. Mobile application-based nutritional counselling using the "Nutri Growth" app.
2. Traditional, conventional hospital-based nutritional counselling with in-person follow-up.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee (IEC) prior to any participant recruitment. Informed consent was obtained from the parents or legal guardians of all child participants before enrolment. All participant data was kept confidential and anonymized for analysis.

Study Population and Sampling

A total of 220 participants were recruited for the study. The sample size was determined using G*Power software. Participants were recruited from outpatient clinics.

Inclusion criteria for participation were:

- Children aged 1 to 18 years.
- Classified as underweight, overweight, or normal weight for their age and sex.
- Parents or guardians who owned a smartphone.
- Parents or guardians who were literate in either English or Tamil.

Exclusion criteria were:

- Parents or guardians unable to use or lacking access to a smartphone.
- Parents unable to read or understand English or Tamil.
- Children diagnosed with severe acute malnutrition (SAM), chronic illnesses, endocrine disorders, metabolic conditions, or genetic syndromes that could affect growth and nutrition.

Randomization and Intervention Groups

Participants were randomly allocated into two groups (n=110 each) using simple random sampling.

- Group 1 (Intervention Group): This group received nutritional counselling via the Nutri Growth mobile application. The app was installed for the participants, and counselling was provided on an as-needed (SOS) basis through the app.
- Group 2 (Control Group): This group received conventional hospital-based nutritional counselling. Participants attended monthly in-person counselling sessions during their outpatient visits.

The Nutri Growth Application

The "Nutri Growth Project" app was developed as the intervention tool. It was designed as a cross-platform mobile app using React Native for the frontend, Node.js and Express.js for the backend API, and a SQL database (XAMPP DB) for data storage.

Key features of the app included:

- **User Profile Setup:** Collection of age, gender, weight, height, and dietary goals.
- **Meal Tracking:** A food database and manual entry system to log meals and calculate calories and macronutrients.
- **Progress Monitoring:** Tracking of nutritional health and goals.
- **Recommendations & Tips:** Expert-driven nutrition advice, recipes, and reminders.

Data Collection and Outcome Measures

At enrolment, baseline anthropometric assessments (weight, height) were conducted for all participants. Follow-up assessments were conducted for both groups at 3-month intervals over the 12-month study period.

- **Primary Outcome:** The primary measure was the mean weight change from baseline to the 12-month follow-up between the two groups.
- **Secondary Outcomes:** These included the mean Body Mass Index (BMI) change from baseline to 12 months.

Statistical Analysis

Data was analysed using descriptive statistics to summarize baseline characteristics. The primary statistical analysis involved comparing outcomes between the two groups.

The Shapiro-Wilk test was performed and confirmed that all study variables exhibited a skewed distribution ($p < 0.001$), violating the assumptions of normality. Consequently, non-parametric tests were employed for the analysis. The Mann-Whitney U test was used to compare the differences in outcomes (e.g., weight change, BMI change) between the two independent intervention groups. Such methodological rigor is necessary when analyzing heterogeneous pediatric populations where data may not conform to a normal distribution [19].

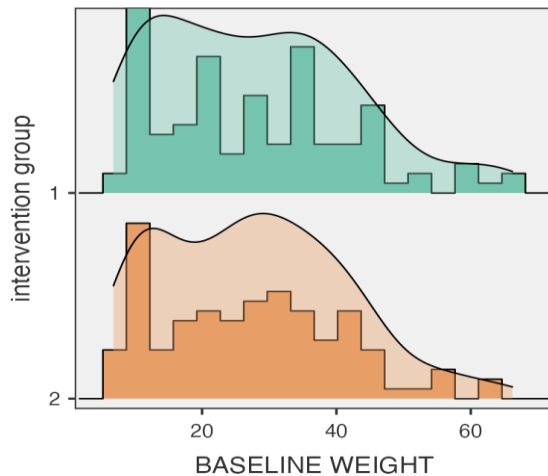
A p-value of < 0.05 was considered statistically significant for all tests. The study's findings on adherence align with previous research indicating that digital tools can effectively support dietary compliance [17], while the observations on height progression confirm that longitudinal growth is less responsive to short-term interventions compared to weight or BMI [18].

RESULTS

Baseline Characteristics

The study included a total of 220 participants, who were randomized into two groups of 110 participants each: Group 1 (Mobile Application-Based Follow-Up) and Group 2 (Hospital-Based Follow-Up).

FIGURE 1: BASELINE WEIGHT DISTRIBUTION

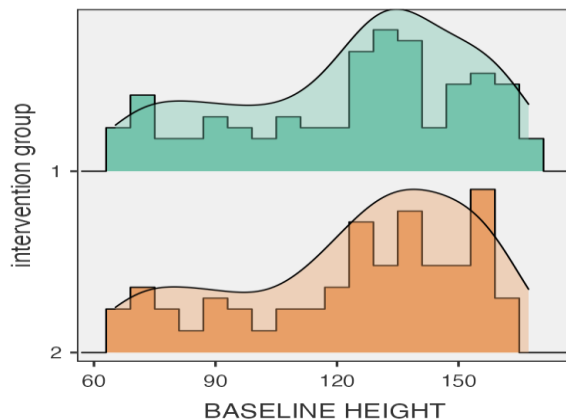


The baseline characteristics of both groups were comparable. The mean age was 8.96 years (SD = 4.58) in Group 1 and 9.11 years (SD = 4.58) in Group 2. Gender distribution was equal across both groups. Anthropometric measurements at baseline were also similar:

- **Baseline Weight:** Mean 27.9 kg (SD = 14.66) for Group 1 vs. 27.4 kg (SD = 13.63) for Group 2.
- **Baseline Height:** Mean 123.8 cm (SD = 28.90) for Group 1 vs. 124.5 cm (SD = 28.48) for Group 2.
- **Baseline BMI:** Mean 16.9 (SD = 3.62) for Group 1 vs. 16.4 (SD = 3.27) for Group 2.

Socioeconomic status (SES) and locality scores were nearly identical between the two groups, indicating comparable external influences. Baseline parental involvement scores were slightly higher in Group 1 (Mean = 2.10) compared to Group 2 (Mean = 2.03), consistent with literature highlighting parental engagement as a key factor in mHealth interventions [23].

FIGURE 2: BASELINE HEIGHT DISTRIBUTION

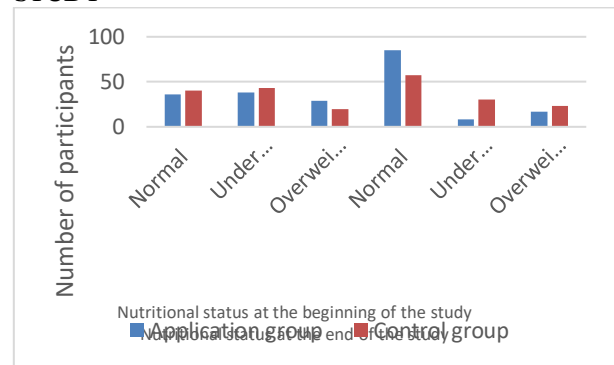


Both intervention groups demonstrated improvements in all anthropometric parameters over the one-year study period.

- **Weight:** At one year, the mean weight was 31.61 kg (SD = 14.28) in Group 1 and 31.13 kg (SD = 13.58) in Group 2. Weight progression and percentage change in weight were found to be slightly higher in the app-based group, aligning with research suggesting that digital tools can enhance dietary adherence [21].
- **Height:** Both groups exhibited parallel growth trajectories. The mean height at one year was 128.96 cm (SD = 28.57) in Group 1 and 130.77 cm (SD = 28.99) in Group 2. This finding supports previous observations that longitudinal height progression is primarily influenced by long-term nutritional status rather than the specific mode of short-term intervention [22].
- **BMI:** BMI progression was comparable between the groups. The mean BMI at one year was 17.89 (SD = 2.91) in Group 1 and 17.79 (SD = 3.83) in Group 2.

Overall nutritional status improved significantly across the entire cohort. The mean nutritional status score (where 1=Normal, 2=Underweight) improved from 1.87 at baseline to 1.48 at the end of the study, indicating a shift toward normal nutritional status.

FIGURE 3: NUTRITIONAL STATUS AT END OF STUDY



Statistical Analysis

A Shapiro-Wilk test was conducted and confirmed that all outcome variables exhibited a skewed distribution ($p < 0.001$), necessitating the use of non-parametric tests for analysis.

The Mann-Whitney U test was used to compare the outcomes between Group 1 and Group 2. This analysis revealed no statistically significant differences between the app-based intervention and the conventional hospital-based follow-up. Key non-significant p-values included:

- Nutritional Status at end of study ($p = 1.000$)
- Percentage Change in Weight ($p = 0.709$)
- Weight at 1 Year ($p = 0.399$)
- BMI at 1 Year ($p = 0.142$)

Anthropometric Progression Over 12 Months

- Change in BMI ($p = 0.965$)

While between-group differences were not significant, within-group comparisons confirmed that participants in both groups experienced significant positive growth over the 12-month period. The findings demonstrate that app-based follow-up has a comparable effectiveness to traditional hospital-based counselling and is a feasible tool for nutritional monitoring.

DISCUSSION

This study found that app-based nutritional counselling, facilitated by the Nutri Growth app, is as effective as traditional hospital-based follow-ups in improving anthropometric and nutritional outcomes in children. The findings indicate that both intervention groups showed comparable and significant improvements in weight, height, BMI, and overall nutritional status over the 12-month period, with no statistically significant differences between the two methods.

Although not statistically significant, the percentage change in weight was slightly higher in the app-based group. This suggests that features integral to mHealth, such as real-time meal tracking, automated reminders, and instant dietary feedback, may contribute to better adherence to nutritional guidelines [21]. In contrast, height progression was steady and comparable across both groups. This aligns with the clinical understanding that longitudinal height is a long-term nutritional marker, primarily influenced by overall nutritional adequacy rather than the specific mode of a short-term intervention, responding less rapidly than weight or BMI [22].

Parental engagement was identified as a key factor in both groups. The mean involvement score was slightly higher in the app-based group, suggesting that digital tracking and a structured logging system may encourage more active and frequent caregiver participation [23]. Interestingly, overall engagement levels remained stable across both modalities. This implies that parents who are already motivated to engage in their child's nutritional management will do so consistently, regardless of whether they use an app or attend in-person hospital follow-ups.

A key methodological finding was that all variables followed a skewed distribution, necessitating the use of non-parametric statistical tests like the Mann-Whitney U test. This approach is crucial for ensuring a robust analysis and generating valid conclusions when working with heterogeneous pediatric populations where data often does not conform to normality [24].

A primary advantage of mHealth interventions highlighted by this study is their scalability. Traditional counselling requires frequent clinic visits, which poses significant time, cost, and geographical barriers for many families. mHealth applications address these challenges

by providing a flexible, cost-efficient, and accessible alternative without compromising effectiveness [25].

While this study demonstrated app-based tracking as an effective standalone intervention, future research should explore hybrid models. An approach that combines the convenience of digital monitoring with periodic in-person consultations could enhance long-term engagement and adherence [26]. Sustainability remains a critical challenge, as user engagement with digital programs can decline over time. Future iterations of such apps may benefit from strategies like gamification and behavioral reinforcement techniques to sustain adherence [27].

Furthermore, the integration of Artificial Intelligence (AI) represents a promising frontier. AI-powered systems can provide highly customized meal plans, predict dietary lapses, and offer real-time, personalized coaching at scale through tools like virtual chatbots [28]. Finally, these findings have important policy implications. Integrating proven digital tools like the Nutri Growth app into routine clinical practice could significantly improve access to nutritional counselling, especially in underserved or remote areas [25]. Healthcare systems and policymakers should explore standardized protocols and reimbursement models for app-based nutritional counselling to incentivize wider adoption and ensure equitable access to effective dietary support [29].

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