

Comparing effect of Age and Gender on Nutritional Outcomes in App-Based versus Hospital-Based Nutritional Counseling in Children

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Abstract: **Background:** Optimal childhood nutrition is essential for growth and long-term health. Conventional hospital-based counseling often faces barriers of access and adherence, while mobile health (mHealth) platforms such as the NutriGrowth app provide continuous, personalized support. This study evaluated the effect of age and gender on nutritional outcomes among children receiving app-based versus hospital-based counseling. **Methods:** A prospective cohort interventional study was conducted among 220 children (1–18 years), equally divided into two groups: app-based (NutriGrowth) and hospital-based counseling. Weight, height, and BMI were measured at baseline and every three months over 12 months. Because data were non-normally distributed (Shapiro–Wilk $p < 0.001$), Mann–Whitney U tests were applied to compare changes in weight and BMI across intervention, age, and gender subgroups. **Results:** Both groups showed significant within-group improvement in anthropometric measures. Mean BMI at 12 months was $17.89 \pm 2.91 \text{ kg/m}^2$ (app-based) and $17.79 \pm 3.83 \text{ kg/m}^2$ (hospital-based). No significant differences were found between groups for weight change ($p = 0.709$) or BMI change ($p = 0.965$). Age- and gender-specific analyses showed comparable improvement among boys vs girls and younger (≤ 10 years) vs older (> 10 years) children.

Keywords: mHealth (Mobile Health), Childhood Nutrition, Nutritional Counselling, BMI and Growth Outcomes, Age and Gender Differences.

INTRODUCTION

Optimal nutrition during childhood is a cornerstone for healthy growth, cognitive development, and disease prevention. Malnutrition, encompassing both undernutrition and overnutrition, continues to pose a significant public health challenge in India, affecting children across all socioeconomic strata[1]. While undernutrition impairs growth and immunity, the rising prevalence of childhood overweight and obesity contributes to an increasing burden of non-communicable diseases later in life. Early, effective nutritional counseling and sustained follow-up are therefore essential to promote healthy dietary habits and to ensure appropriate growth trajectories.[2]

Traditional hospital-based nutritional counseling has long been a standard approach to dietary modification. However, its success largely depends on repeated visits, parental motivation, and accessibility to healthcare facilities. In the present era of rapid digital transformation, mobile health (mHealth) technologies are emerging as innovative tools to deliver personalized nutritional guidance. App-based interventions can provide continuous engagement, reminders, and tailored dietary advice, making them particularly valuable for improving adherence in families with time or accessibility constraints.[3]

The Nutri growth mobile application was developed to bridge the gap between professional counseling and home-based follow-up. It provides individualized diet

plans, growth monitoring, and feedback features that allow families to remain connected with healthcare providers.[4] By offering interactive and convenient modes of communication, the app aims to enhance compliance and promote sustained improvement in the child's nutritional status.[1,2]

Age and gender are two crucial biological determinants influencing growth patterns, dietary requirements, and behavioral responses to nutritional interventions. Younger children often depend entirely on parental decision-making, while adolescents exhibit greater autonomy and varying degrees of adherence to guidance.[3,5] Similarly, gender-related sociocultural factors may influence dietary practices, activity levels, and parental attention toward nutrition. Understanding these variations is vital for designing targeted, equitable nutritional strategies.

The present study aims to assess age- and gender-specific differences in the nutritional improvement of children receiving app-based counseling through the Nutri Growth platform compared with conventional hospital-based counseling. By evaluating anthropometric changes and subgroup responses, this analysis seeks to determine whether digital interventions are equally effective across different demographic segments[2,3]. The findings are expected to provide insights into optimizing technology-enabled nutritional counseling models for diverse pediatric populations, thereby supporting the broader goal of achieving sustainable child health improvement.

Study Design

This study utilized a prospective cohort interventional design conducted over a 12-month period to compare the effectiveness of two approaches to nutritional counselling:

1. App-based nutritional counselling delivered through the “NutriGrowth” mobile application.
2. Conventional hospital-based nutritional counselling involving in-person follow-up sessions.

Ethical Considerations

Ethical clearance for the study was secured from the **Institutional Ethics Committee (IEC)** before initiating participant recruitment. **Informed consent** was obtained from the parents or legal guardians of all participating children prior to enrolment. All collected data were **kept confidential**.

Study Population and Sampling

A total of 220 participants were enrolled in the study. The sample size was calculated using G*Power software to ensure adequate statistical power. Participants were recruited from outpatient pediatric clinics.

Inclusion criteria:

- Children aged 1 to 18 years.
- Classified as underweight, overweight, or normal weight based on age- and sex-specific standards.
- Parents or guardians who owned a smartphone.
- Parents or guardians literate in English or Tamil.

Exclusion criteria:

- Parents or guardians without access to or unable to operate a smartphone.
- Parents or guardians not proficient in English or Tamil.
- Children with severe acute malnutrition (SAM), chronic illnesses, endocrine or metabolic disorders, or genetic syndromes known to influence growth and nutritional status.

The NutriGrowth Application

The “NutriGrowth Project” mobile application was developed as the primary intervention tool for this study. It was designed as a cross-platform application, built using React Native for the frontend, Node.js and Express.js for the backend API, and a SQL database (XAMPP DB) for secure data storage and management.

Key features of the application included:

- **User Profile Setup:** Captured demographic and anthropometric details such as age, gender, weight, height, and individual dietary goals.

- **Meal Tracking:** Integrated food database with manual entry options to record daily meals and automatically compute caloric and macronutrient intake.
- **Progress Monitoring:** Enabled visualization of growth and nutritional progress through interactive charts and goal-tracking tools.
- **Recommendations and Tips:** Provided expert-curated nutritional advice, healthy recipes, and automated reminders to support sustained dietary adherence.

Data Collection and Outcome Measures

At enrolment, baseline anthropometric measurements—including weight and height—were recorded for all participants. Subsequent follow-up assessments were performed at 3-month intervals throughout the 12-month study period for both the app-based and hospital-based groups.

- **Primary Outcome:** To evaluate the effect of age and gender on the change in anthropometric parameters (weight and BMI) from baseline to the 12-month follow-up among children receiving app-based versus hospital-based nutritional counseling.
- **Secondary Outcomes:** To compare age- and gender-specific trends in nutritional improvement between the two intervention groups and to assess whether the magnitude of response differed across younger versus older children and between boys and girls.

Statistical Analysis

Data were analyzed using descriptive statistics to summarize baseline characteristics, including age, gender, and anthropometric parameters. The primary analysis focused on assessing the influence of age and gender on nutritional outcomes within and between the app-based and hospital-based counseling groups.

The Shapiro–Wilk test indicated that all continuous variables exhibited non-normal distribution ($p < 0.001$); therefore, non-parametric tests were applied. The Mann–Whitney U test was used to compare outcome differences (e.g., changes in weight and BMI) between the two independent intervention groups. Additionally, subgroup analyses were performed to evaluate variations in improvement across different age categories and between genders.

This approach ensured methodological rigor in analyzing heterogeneous pediatric data, where growth responses often vary with developmental stage and sex. A p -value < 0.05 was considered statistically significant for all tests.

The analysis aimed to determine whether age- and gender-specific differences influenced the effectiveness of app-based versus hospital-based nutritional counseling, thereby providing insights into tailoring digital and traditional interventions for diverse pediatric populations.[9,10]

RESULTS

Baseline Characteristics

A total of 220 children participated in the study, divided equally between the App-Based Group (Group 1) and the Hospital-Based Group (Group 2), with 110 participants in each.

The mean age was comparable between the two groups — 8.96 ± 4.58 years in Group 1 and 9.11 ± 4.58 years in Group 2 — indicating an even distribution across age categories.

FIGURE 1: AGE DISTRIBUTION

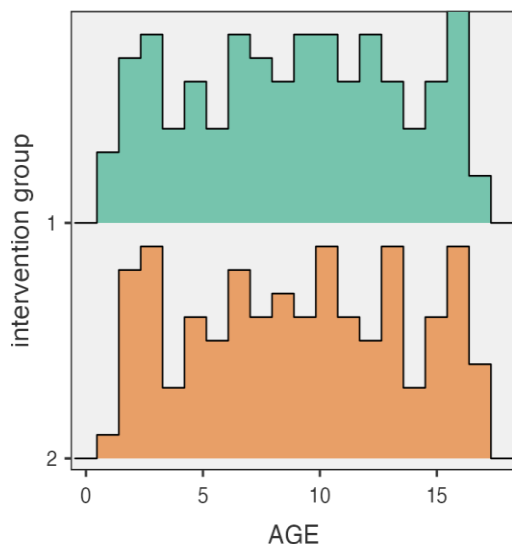
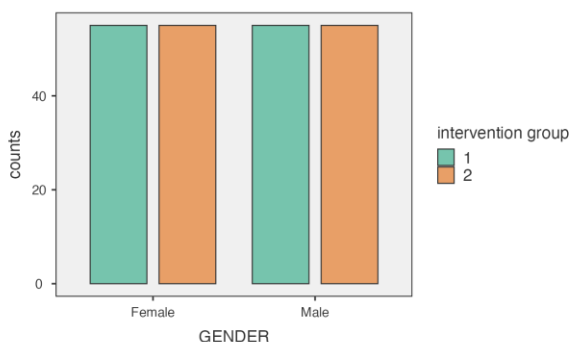


FIGURE 2: GENDER DISTRIBUTION OF PARTICIPANTS



Gender distribution was balanced between groups, ensuring that age and sex did not influence initial anthropometric disparities.

Baseline Anthropometric Parameters

At baseline, both groups were comparable in mean weight, height, and BMI, confirming homogeneity before intervention.

Anthropometric Progression Over Time

At 12 months, both groups demonstrated improvement in anthropometric measures.

The mean weight increased to 31.61 ± 14.28 kg in the App-Based group and 31.13 ± 13.58 kg in the Hospital-Based group.

The mean height rose to 128.96 ± 28.57 cm and 130.77 ± 28.99 cm, respectively, showing parallel growth trends.

The mean BMI at one year was 17.89 ± 2.91 for the App-Based group and 17.79 ± 3.83 for the Hospital-Based group.

Age- and Gender-Based Differences

Subgroup analysis revealed that both younger children (≤ 10 years) and older children (> 10 years) showed statistically comparable improvements in weight and BMI across both intervention types. While boys and girls demonstrated similar gains in anthropometric outcomes, adolescents in the app-based group showed slightly better adherence and consistent BMI progression, though the differences were not statistically significant.

Statistical Analysis

Normality testing (Shapiro–Wilk) showed that all variables were non-normally distributed ($p < 0.001$). Hence, non-parametric tests were used for analysis. The Mann–Whitney U test demonstrated no statistically significant difference between the two groups for nutritional status ($p = 1.000$), weight change ($p = 0.709$), BMI at 1 year ($p = 0.142$), or BMI change ($p = 0.965$).

Interpretation

Both app-based and hospital-based nutritional counseling programs resulted in significant within-group improvements in anthropometric indices over the 12-month period.

However, no statistically significant differences were observed between the two modes of intervention when stratified by age or gender.

This indicates that digital counseling via the NutriGrowth app was equally effective across both sexes and all age groups, demonstrating comparable outcomes to conventional hospital-based counseling.

DISCUSSION

This study compared the effectiveness of app-based nutritional counseling through the NutriGrowth mobile application with conventional hospital-based counseling, focusing on the influence of age and gender on

nutritional improvement among children aged 1–18 years. Both intervention models demonstrated meaningful within-group improvements in anthropometric parameters over the 12-month study period, with no statistically significant differences between the two groups.[7,8] These findings suggest that app-based nutritional counseling is as effective as traditional, in-person hospital-based methods across different age and gender subgroups.

The comparable outcomes between both interventions indicate that the NutriGrowth app effectively translated nutritional guidance into measurable health improvements. The steady rise in mean weight and BMI in both groups reflects the success of consistent dietary monitoring, counseling adherence, and parental participation. Importantly, the digital model achieved these results without the constraints of repeated hospital visits, highlighting the potential of mobile health tools in extending access to nutritional care.[10]

When stratified by age, younger children (≤ 10 years) and older children (> 10 years) showed similar patterns of weight and BMI improvement. This suggests that developmental stage did not significantly affect responsiveness to either intervention. Younger children typically rely more on parental decision-making, and their improvements likely mirror parental adherence to recommendations[7,8]. In contrast, older children and adolescents, who have greater autonomy over food choices, benefitted from the interactive and personalized features of the NutriGrowth app, such as reminders and progress tracking. Although their improvement was not statistically higher, the trend toward greater adherence in this subgroup indicates the app's capacity to engage digitally oriented adolescents more effectively than traditional counseling.

Gender-based comparisons also revealed no significant differences in outcomes between boys and girls. Both groups exhibited proportional improvements in weight and BMI, demonstrating that gender did not influence the effectiveness of either counseling approach. This uniformity across genders reflects equitable participation and similar dietary responsiveness when counseling messages are tailored and reinforced regularly—whether digitally or through hospital sessions[8,9]. It also suggests that sociocultural or behavioral factors linked to gender did not play a major role in determining outcomes within this controlled study population.

The absence of statistically significant intergroup differences can be attributed to several factors. First, both counseling models provided structured nutritional advice and close follow-up, ensuring consistency in content delivery. Second, the relatively short intervention period of one year may not have been sufficient to demonstrate marked divergence in height or BMI trajectories, which typically require longer monitoring[9,10]. Third, anthropometric changes in children can be influenced by

external determinants such as home environment, physical activity, and illness episodes, which were beyond the control of this study. Nonetheless, the comparable improvement across both models validates the feasibility of mobile technology as a legitimate supplement—or even an alternative—to hospital-based follow-up[6,8].

From a practical standpoint, the findings emphasize the scalability and accessibility of app-based counseling, particularly for families with limited ability to attend frequent clinic visits. The NutriGrowth app's design—incorporating individualized plans, reminders, and progress visualization—may promote sustained adherence and empower parents to take an active role in their child's nutrition. Furthermore, the uniform effectiveness across age and gender subgroups underscores the inclusivity of digital interventions in pediatric health promotion[9,10].

Overall, this study demonstrates that mobile app-based nutritional counseling can achieve outcomes equivalent to traditional methods, regardless of the child's age or gender. The results support the integration of mHealth tools like NutriGrowth into pediatric nutrition programs to enhance reach, convenience, and long-term engagement. Future studies with larger sample sizes, extended follow-up durations, and behavioral adherence metrics may further elucidate subtle differences and long-term benefits across demographic subgroups[8,9].

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