Digital Nutrition for Children Aged 6–12: Tackling Obesity and Bullying through Personalized Diets via a Mobile Application

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Abstract

Childhood obesity is a growing global concern, particularly in children aged 6–12. Mobile health applications represent a promising tool for dietary planning, parental engagement, and behavior modification. This study reports on the development and pilot testing of a mobile application designed to promote healthy eating habits and reduce obesity risk in children. Significant improvements were observed across psychosocial and clinical outcomes. On the bullying scale, the computed T-test value (6.41, df = 29) exceeded the critical values at both the 0.05 and 0.01 levels, indicating a highly significant reduction in bullying experiences. The post-test mean score (36.73 ± 8.71) was markedly lower than the pre-test mean (44.20 ± 8.72). Family medical history analysis highlighted strong hereditary and lifestyle-related risk factors, with diabetes (73.33%), obesity and hypertension (60%), and heart disease (46.67%) most prevalent. Biochemical indicators also showed favorable trends. Total cholesterol decreased in both sexes (females: 189.60 to 177.40 mg/dL; males: 187.60 to 178.20 mg/dL), triglycerides declined (females: 140.80 to 132.20 mg/dL; males: 141.40 to 131.60 mg/dL), and High-Density Lipoprotein Cholesterol (HDL-C) levels improved modestly (females: 47.20 to 49.60 mg/dL; males: 42.20 to 45.80 mg/dL). Although sex-based differences were not statistically significant ($p > 0.05$), the overall patterns reflected metabolic improvement. These findings demonstrate the importance of mobile applications in combating childhood obesity by fostering healthier behaviors, reducing psychosocial burdens, and supporting public health strategies targeting early prevention.

Keywords: Mobile application, program, Childhood obesity, Dietary planning, Bullying Scale**,** Healthy kids application

INTRODUCTION

As awareness of the health risks associated with obesity steadily increases worldwide, it is estimated that more than 2.1 billion people are currently obese (**WHO, 2023**). Obesity contributes significantly to global morbidity and mortality, making effective weight management more critical than ever. Despite the proliferation of commercial weight loss programs, long-term sustainable lifestyle change remains a major challenge. Pharmacological treatments and surgical interventions are typically reserved for severe obesity, particularly among individuals with comorbidities such as diabetes. Alarmingly, obese children face heightened risks of metabolic syndrome, insulin resistance, and early- onset type 2 diabetes (**Weihrauch-Blüher & Wiegand, 2018**).

Beyond physical health, obesity is closely linked to psychosocial issues, with bullying emerging as a critical public health and educational concern during the formative school years (ages 6–12). Bullying encompasses verbal, physical, social, and increasingly digital aggression, repeated over time and involving a power imbalance (**Rippe, 2022**). Weight-based teasing and peer victimization are particularly common among obese children, leading to emotional distress such as anxiety, low self-esteem, and depression. These negative experiences may exacerbate health risks, as affected children often withdraw from physical activity or resort to emotional eating (**Juvonen et al., 2017**).

Given these risks, early dietary intervention is essential. Parental involvement plays a key role in shaping children's food choices and mealtime behaviors, while schools contribute through nutrition education and healthy meal standards (**Crowley & Arlinghaus, 2022**). In recent years, technology-based interventions have emerged as effective tools for addressing pediatric nutrition challenges. Mobile applications provide scalable, interactive platforms that offer dietary guidance, monitor food intake, and promote healthier behaviors. They are particularly effective when incorporating gamified learning, real-time feedback, and personalized meal planning, engaging both children and caregivers in sustainable lifestyle change (**Chai et al., 2020**).

Building on this context, the present study employs a quasi-experimental design to evaluate the effectiveness of a mobile health application developed to support dietary planning and address childhood obesity-related bullying.

Research consistently shows that children who are perceived as different, particularly those who are overweight or obese, are disproportionately targeted by bullying (**Puhl & Latner, 2007**). This study therefore explores not only nutritional outcomes but also psychosocial improvements linked to reduced bullying experiences.

Materials and Methods:

Materials:

1- Target population:

This study targeted children aged 6 to 12 years classified as obese based on the Body Mass Index (BMI) percentiles established by the Centers for Disease Control and Prevention (CDC) **(Harrington et al., 2013).** A total sample of 30 children (15 males and 15 females) was recruited from local schools in Cairo. Written informed consent was obtained from the mothers prior to participation, in accordance with ethical standards approved by the Scientific Committee at the Faculty of Specific Education, Ain Shams University (Approval No. 26-HED-11-2023).

2- Questionnaire and Assessments:

2.1. Economic and Social Status:

A structured questionnaire was designed to assess the socioeconomic background of participants. The form included questions on residence, family structure, parental marital status, income, and education level. The collected data were categorized and analyzed for potential correlations between socioeconomic status and obesity (**Sifo, 2022**).

2.2. Medical History:

A medical history questionnaire was administered to collect information on genetic conditions, previous health issues, and laboratory findings. Blood and biochemical analyses were conducted at the beginning and end of the intervention to monitor physiological changes associated with the dietary program (**Mascarenhas et al., 1998).**

Blood samples were collected from the median ulnar vein of each child at the start and end of the experiment into clean, dry centrifuge tubes. Serum was obtained by centrifugation at 3000 rpm for 15 minutes at room temperature, after which the supernatant was carefully aspirated without disturbing the cellular residue. The separated serum was analyzed for glucose concentration and lipid profile parameters, including total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides. All biochemical analyses were carried out at the Agricultural Research Center, Giza, Egypt.

Triglyceride levels were measured following the method of **Fossati and Principe (1982)**, while total cholesterol was determined according to **Allain et al. (1974).** High-density lipoprotein cholesterol (HDL-C) was assessed using the procedure described by **Burstein et al. (1970).** Low-density and very-low-density lipoprotein cholesterol (LDL-C and VLDL-C) were calculated as per **Friedewald et al. (1972),** and serum glucose was measured following the method of **Bergman and Fellig (1984).**

2.3. Anthropometric measurements:

Anthropometric measurements were recorded at three time points: baseline, mid-intervention, and post-intervention. These measurements included height, weight, and BMI, Waist circumference, hip circumference, waist-to-hip ratio used to classify obesity and track progress (**Eisenmann, 2011**).

2.4. Diet History:

Parents completed a comprehensive diet history form detailing their child’s typical food and beverage intake over the previous year. This assessment aimed to identify long-term dietary patterns and nutritional gaps (**Abd-Elqader, 2001**).

2.5. 24-hour dietary recall:

A 24-hour dietary recall form was designed to assess the children's food intake across three non-consecutive days, including one weekend day. This tool provided insight into recent eating habits and meal composition (**Bennett et al., 2009**).

2.6. InBody:

Body composition was analyzed using the InBody device at the beginning and end of the intervention. This device assessed fat percentage, muscle mass, body water content, and distribution. The results contributed to evaluating physical changes due to the nutritional intervention (**Porterfield et al., 2024**).

2.7. Bullying Scale:

The bullying scale for obese children was used to assess the psychological and social impacts of obesity. Administered at baseline and post-intervention, the scale measured the frequency and severity of bullying experiences related to weight, including verbal abuse, social exclusion, and physical aggression (**Griffiths et al., 2005**).

3- Healthy kids Application

A custom-designed mobile application, *Healthy Kids*, was developed to support caloric tracking and nutritional guidance. Built in Arabic and compatible with Android and iOS devices, the app was developed using Flutter for cross-platform functionality. Key features included:

- BMI calculator based on CDC guidelines
- Caloric requirements calculated using Recommended Dietary Allowances (RDA)
- Personalized meal planning
- Goal setting and progress tracking
- Educational guidance for parents

The user interface was designed using Figma, and Firebase was used for backend data management and analytics. The app guided users based on the child's caloric needs and provided clear instructions to maximize adherence to the nutritional plan (**Faizan & Rouster, 2023; Eisenmann, 2011**).

Methods:

1- Data Collection:

- Initial data collection involved distributing consent forms to the children's parents, along with an explanation of the research protocol. Upon receiving consent, mothers completed the initial set of questionnaires under the direct supervision of the research team to ensure accuracy and clarity.
- Children's anthropometric measurements were taken by the researcher, and InBody analyses were conducted at a certified medical lab. Mothers received educational materials, including instructional videos, to guide them in using the Healthy Kids application.
- The intervention spanned three months, during which mothers monitored their children's dietary intake using the app. The research maintained consistent communication, provided technical support, and ensured proper adherence to the nutritional regimen. Anthropometric data and InBody measurements were taken again at the midpoint and end of the intervention. The bullying scale was also re-administered post-intervention to assess psychosocial changes.

2- Healthy kids Application:

2.1 **Application Functionality**

The primary functions of the application included

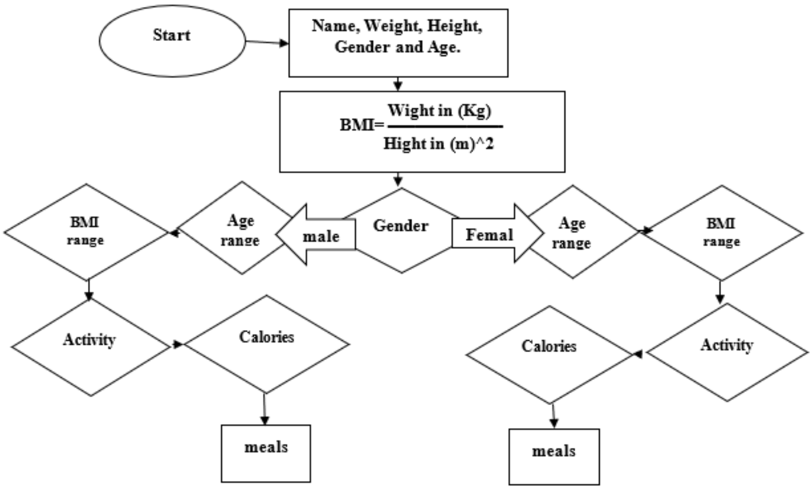
- Logging daily food intake
- Calculating total calorie consumption based on a comprehensive food database
- Providing real-time feedback on dietary goals (e.g., calorie limits, macronutrient balance)
- Offering personalized dietary suggestions based on user profile data (age, weight, height, gender, activity level, and dietary preference)

Participants were instructed to use the application daily throughout the study period. Data recorded by the app were synchronized to a secure server and used to monitor compliance and analyze dietary behavior.

The application was validated by comparing its outputs with manual dietary recall methods over a 3-day pilot period.

- The *Healthy Kids* application allowed users to input child-specific data such as name, age, gender, weight, height, and activity level. The app calculated BMI using CDC standards and determined caloric needs based on RDA guidelines. The system then generated a personalized dietary plan tailored to each child's nutritional requirements. Mothers received daily guidance and reminders to support their child's progress.

2.2 Fundamentals of program design



3- Data Analysis:

Data were presented as the mean ± S.D. Statistical analysis was performed using GraphPad InStat version 3.10 (GraphPad Software, San Diego, CA, USA, 2025). One-way analysis of variance (ANOVA) followed by Duncan's multiple range test was used for comparisons among more than two groups. For comparisons between two related groups (pre- and post-treatment), a paired T-test was applied. Differences were considered statistically significant at $P \leq 0.0$

Results and discussion

In recent years, mobile health applications have become increasingly popular tools for dietary monitoring and nutritional self-management. These applications support users in achieving dietary goals by allowing them to log meals, track caloric intake, and receive personalized dietary advice **(Zhang & Li, 2022).**

This study demonstrated the potential of a mobile application integrating calorie tracking, personalized meal planning, and nutrition education as an effective tool for supporting healthier dietary behaviors. Specifically, the application aimed to enhance users' understanding of balanced nutrition, provide practical guidance for meal choices, and support chronic disease management through dietary control.

Carter et al. (2013) have demonstrated the effectiveness of mobile apps in promoting healthy eating behaviours and weight management. He also reported that, app-based food tracking was associated with higher adherence to dietary plans compared to paper-based methods. Moreover, mobile apps that integrate feedback mechanisms and behavior-change techniques have shown positive outcomes in supporting lifestyle modifications **(Wharton et al., 2014).**

Calorie-tracking applications, such as *Healthy Kids*, utilize food databases to calculate nutrient intake and provide progress feedback. However, others app like *My FitnessPal or Yazio* had some limitations persist, including database inaccuracies, lack of personalized recommendations, and limited support for culturally specific diets **(Nguyen et al., 2021).**

In response to these limitations, *Healthy Kids* has explored the development of customized applications tailored to specific populations or dietary goals. In agreement with **Kim et al., 2020** *Healthy Kids* often includes features such as localized food databases, adaptive meal planning, and integration with physical activity tracking.

Moreover, in line with **Chen et al. (2020)** the app’s ability to provide real-time feedback and track progress appeared to positively influence user behavior, similar to the outcomes reported. This highlights the importance of digital feedback mechanisms in shaping long-term dietary habits.

Participants who actively used the application reported improved awareness of daily caloric intake and macronutrient distribution. This aligns with prior research showing that digital tools can increase nutritional literacy and self-regulation **(Wharton et al., 2014; Chen et al., 2020).** In addition to calorie tracking, the meal planning feature helped users align food choices with dietary goals, reducing reliance on processed foods and promoting the inclusion of vegetables, whole grains, and lean proteins.

Importantly, the application also provided targeted educational content about obesity, overweight, and how to manage blood glucose levels through diet. This feature is particularly significant in light of previous studies that emphasized the role of nutrition education in improving glycemic control among diabetic patients **(Franz et al., 2010 and Powers et al., 2015).** Users with or at risk of type 2 diabetes reported that the app increased their understanding of carbohydrate counting, portion sizes, and the importance of meal timing all essential elements in diabetes management. Despite these positive outcomes, the study of the authors **Franz et al., (2010) and Powers et al., (2015)** had several limitations. First, data collected through the app were self-reported, which could introduce reporting bias or inaccuracies. Second, while the app offered culturally relevant food items, its database may still lack certain regional foods, potentially limiting its generalizability. Third, long-term behavioral change and clinical health outcomes, such as weight loss or HbA1c improvement, were not assessed due to the short study duration. Nevertheless, the findings suggest that mobile applications can serve as powerful tools not only for general dietary management but also as complementary interventions in chronic disease care. So, the *Healthy Kids* app, one of its future developments, will focus on integrating real-time glucose monitoring, adaptive meal planning based on user feedback, and broader cultural and dietary diversity within the app's database. Longer-term studies are also recommended to evaluate the app's clinical impact on diabetes control and nutritional status.

Family Medical History in Obese Children Participants

The results of family medical history in obese children participants illustrate the prevalence of various diseases in the family histories of the participants. The most frequently reported condition was diabetes (73.33%), followed by obesity and high blood pressure, each reported in 60% of families.

Heart disease was also common, with a prevalence of 46.67%, and high cholesterol was noted in 40% of cases. Digestive system diseases appeared in 30% of family histories, while liver disease was reported in 20%. Less frequent conditions included insulin resistance (16.67%), kidney and gall bladder diseases (10% each), and thyroid disease (3.33%). Notably, only 6.67% of families reported no relevant medical history. These findings underscore the strong familial patterns of obesity-related disorders, indicating potential genetic predisposition and shared lifestyle factors contributing to childhood obesity.

Sivakumar et al. (2024) reported that the genetic contribution to obesity ranges from 40% to 75%. Similarly, **Vourdoumpa et al. (2023)** highlighted that this link is not limited to genetic predisposition but also includes family-related behaviors and environmental conditions, which contribute to passing obesity risk across generations.

The study shows a strong familial clustering of obesity-related diseases in obese children aged 6–12, influenced by genetic and environmental factors. A high rate of diabetes (73.33%) in family history supports previous findings linking type 2 diabetes to obesity. This suggests a hereditary tendency toward insulin resistance and poor glucose metabolism **(Alberti et al., 2009 and Zhang et al., 2014).**

Obesity and hypertension were each reported in 60% of cases, emphasizing the impact of family lifestyle, including high-calorie diets and inactivity. **Biro and Wien (2010)** found that children of obese parents are more likely to become obese due to both genetic factors and shared family habits and routines.

Heart disease (46.67%) and high cholesterol (40%) in family history suggest early development of cardiometabolic risks, influenced by inherited and shared factors. Studies, such as **Lloyd-Jones (2004),** confirm that parents' cardiovascular health significantly affects their children's likelihood of developing similar conditions.

Diseases of the digestive system (30%), liver (20%), and insulin resistance (16.67%) reflect metabolic dysfunctions tied to inherited poor dietary patterns. Non-alcoholic fatty liver disease (NAFLD), common in obese children, often correlates with family history **(Anderson et al., 2015).**

Kidney and gallbladder diseases (10%) and thyroid disease (3.33%) are less common but still significant in family histories. These conditions may worsen with obesity, highlighting the need for early screening in at-risk populations **(Sinha & Kling, 2009).**

Only 6.67% of families reported no relevant medical history, indicating most obese children have at least one familial risk factor. This underscores the need for family medical history assessments in obesity prevention. **Dietz (1998)** highlights the importance of a multi-generational approach, considering genetic and environmental factors for effective intervention.

Medical History of Participants

All participants (100%) were diagnosed with obesity, as expected by the study criteria. Notably, insulin resistance was present in 23.33% of the children, which is a common metabolic disturbance associated with obesity in childhood and may serve as an early indicator of increased risk for type 2 diabetes in later life.

The results also revealed that high cholesterol levels and digestive system diseases were each reported in 10% of the participants, reflecting potential complications of poor dietary habits or metabolic imbalances. No cases of diabetes, high blood pressure, heart disease, or kidney-related conditions were recorded, which might be attributed to the relatively young age of the participants, where such complications may not yet be clinically apparent.

Interestingly, thyroid disease was not reported, although it is often evaluated in obese children to rule out hormonal contributions to weight gain. The absence of liver, spleen, and gallbladder diseases may also reflect early stages of obesity where organ involvement has not yet occurred. Overall, the findings highlight the early metabolic effects of obesity, emphasizing the importance of early screening and preventive measures to reduce future health risks in this vulnerable age group.

The medical profiles of obese children aged 6 to 12 revealed early signs of metabolic disturbance. All participants were diagnosed with obesity, the primary inclusion criterion. However, 23.33% had insulin resistance, a precursor to type 2 diabetes, often linked to excess adiposity and inflammation **(Sivakumar et al., 2024).** This highlights the need for early screening, as children with insulin resistance are at increased risk for cardiometabolic diseases later in life **(Weiss et al., 2004).**

High cholesterol and digestive system diseases (10% each) indicate early metabolic dysregulation, likely due to poor diet and inactivity. Dyslipidemia is common in obese children and is a key factor in pediatric metabolic syndrome **(Vourdoumpa et al., 2023 and Reinehr, 2013).** Additionally, gastrointestinal issues in obese children may stem from altered gut microbiota and high-fat diets, which lead to inflammation and discomfort **(Shaikh, 2021).**

The **World Health Organization (2024)** reported a significant rise in overweight and obesity among children and adolescents aged 5–19, from 8% in 1990 to 20% in 2022. The increase was similar for both boys (21%) and girls (19%) in 2022. Obesity rates also rose, with only 2% of children obese in 1990, compared to 8% in 2022.

Al-Beltagi et al., (2022) found that pediatric obesity is linked to abnormal lipid levels, indicating that obese children should be screened for hypercholesterolemia. Abnormal lipid levels were common among obese children, suggesting obesity itself is a risk factor for hypercholesterolemia.

Calcaterra et al. (2025) found a link between obesity and functional gastrointestinal disorders, as both share common characteristics such as high prevalence in children, dietary and lifestyle risk factors, gut microbiome imbalance, and psychological challenges. Managing this dual condition in children is difficult, especially due to poor adherence to conventional treatments.

Anthropometric measurements of Participants

Table (1) displays the anthropometric measurements of obese children aged 6 to 12 years before, during, and after the implementation of the program. The primary parameters measured include weight, height, BMI, waist circumference, hip circumference, and waist-to-hip ratio.

Weight: The average weight decreased significantly from 41.307 kg before the program to 38.053 kg at the end. The data indicates a gradual reduction, with the midpoint weight being 39.793 kg. This suggests that the program was effective in reducing the children's body weight. The notable weight decrease over time highlights the success of the intervention in addressing obesity.

Height: Height measurements remained consistent throughout the study, with a slight increase from 1.3280 meters before the program to 1.3337 meters at the end. This minimal change likely reflects normal growth in children rather than any substantial impact from the program

BMI: A significant reduction in BMI was observed, decreasing from 23.16 before the program to 21.07 at the end, indicating a clear improvement in body composition. This reduction highlights the program's effectiveness in reducing body fat and enhancing overall health. The midpoint measurement of 22.21 also shows a downward trend, further supporting the overall success of the program.

Waist Circumference: The average waist circumference decreased from 77.10 cm before the program to 73.20 cm at the end, with the midpoint measurement being 74.80 cm. This reduction is a significant indicator of decreased visceral fat, which plays a key role in managing obesity-related health risks.

Hip Circumference: The average hip circumference decreased from 83.70 cm before the program to 79.90 cm at the end, with the midpoint measurement being 81.93 cm. While the change is less pronounced than the reduction in waist circumference, it still suggests a reduction in fat accumulation in the hip area.

Waist-to-Hip Ratio: The waist-to-hip ratio remained largely stable, with a slight decrease from 0.9213 before the program to 0.9167 at the end. Although the change was minimal, it still indicates a modest improvement in the distribution of fat between the waist and hips.

Table (1) Anthropometric measurements of obese children aged 6 to 12 years before, midway through, and after program implementation:

		N	Mean	Std. Deviation	Std. Error
Weight	Pre	30	41.307	9.2361	1.6863
	Med.	30	39.793	9.2848	1.6952
	End	30	38.053	9.1787	1.6758
Height	Pre	30	1.3280	0.11961	0.02184
	Med.	30	1.3297	0.11938	0.02180
	End	30	1.3337	0.11752	0.02146
BMI	Pre	30	23.1617	2.47946	0.45269
	Med.	30	22.2147	2.46593	0.45022
	End	30	21.0733	2.38149	0.43480
Waist circumference	Pre	30	77.10	6.525	1.191
	Med.	30	74.80	6.037	1.102
	End	30	73.20	6.718	1.227
hip circumference	Pre	30	83.70	6.954	1.270
	Med.	30	81.93	6.664	1.217
	End	30	79.90	7.112	1.298
Waist to hip Ratio	Pre	30	0.9213	0.03665	0.00669
	Med.	30	0.9140	0.03909	0.00714
	End	30	0.9167	0.03818	0.00697

BMI: Body Mass Index
All parameters are represented as a means of replicates ± standard deviation.
Means with different small superscript letters in the same column are significantly different at $p \leq 0.05$.

The reductions in weight, BMI, waist circumference, and hip circumference are significant, with the most notable changes observed in weight and BMI, indicating that the program was effective in addressing obesity. Height and waist-to-hip ratio showed minimal or no significant changes, which was expected, as these measures typically do not undergo substantial changes in the short term unless there are significant alterations in body composition.

In conclusion, the results indicate that the program had a positive impact on improving the anthropometric measurements of obese children, particularly in reducing body weight, BMI, and waist circumference, which are key indicators of obesity.

Anthropometric measurements are non-invasive tools widely used in pediatrics to assess growth and nutritional status. According to the CDC, they help evaluate overall health, diagnose obesity, and predict future health risks through body composition analysis **(Casadei & Kiel, 2022).**

Monitoring changes in body size during weight loss programs is crucial for ensuring adherence. While body weight is strongly associated with other anthropometric and body composition indicators, few studies have expressed these links through mathematical models. A low-calorie diet led to significant reductions in weight, waist and hip circumference, body fat percentage, WHtR, ABSI, and AVI. These changes, except for WHR, were strongly correlated with the percentage change in body weight. Overall, healthy weight loss is linked to reduced body fat, smaller body size, and lower health risk **(Attari et al., 2024).**

A low-calorie diet significantly reduces body weight and fat. After 18 weeks, BMI decreased by 3.2 units and waist circumference by 8 cm **(Andreou et al., 2011).** Similarly, BMI, body weight, and WC are reliable indicators of changes in total and truncal fat mass **(Aslam et al., 2009).**

Lipid Profile and Serum Glucose between Participants

Table (2) presents a comparative analysis of lipid profile parameters and serum glucose levels in obese male and female children aged 6 to 12 years before and after the implementation of a nutritional or lifestyle intervention program.

Before the program, total cholesterol (Cho. Pre) levels were slightly higher in females (mean = 189.60 mg/dL) than males (mean = 187.60 mg/dL). After the program (Cho. Post), both groups showed a slight reduction, with females reaching a mean of 177.40 mg/dL and males 178.20 mg/dL. However, the differences between sexes were not statistically significant ($p > 0.05$).

Triglyceride (Tg) levels also showed minor improvements post-intervention. Females reduced from a pre-intervention mean of 140.80 mg/dL to 132.20 mg/dL, while males decreased from 141.40 mg/dL to 131.60 mg/dL. Again, no significant sex-based differences were observed ($p > 0.05$).

High-density lipoprotein cholesterol (HDL-C), which is considered protective against cardiovascular disease, increased in both sexes post-intervention. Females showed an increase from 47.20 to 49.60 mg/dL, and males from 42.20 to 45.80 mg/dL. Despite this positive trend, the p-values indicate no statistically significant differences between male and female children.

Low-density lipoprotein cholesterol (LDL-C) levels decreased in both groups, with females showing a reduction from 114.20 to 101.40 mg/dL and males from 117.20 to 106.20 mg/dL. Although the values moved in a favorable direction, the sex-based comparison remained statistically non-significant.

For VLDL-C levels, both males and females showed identical baseline means of 28.20 mg/dL prior to the intervention, with no observed difference between the sexes ($p > 0.05$). Following the program, there was a slight reduction in VLDL-C levels for both groups females decreased to 26.40 mg/dL and males to 26.20 mg/dL. Despite this mild improvement, the changes were not statistically significant, suggesting a limited short-term effect of the intervention on this parameter.

Regarding fasting blood glucose (FBG), pre-intervention levels were similar between females (mean = 95.60 mg/dL) and males (mean = 96.60 mg/dL). After the intervention, both groups showed a slight decrease in their FBG levels, with females reaching 93.20 mg/dL and males 94.40 mg/dL. However, the differences between groups remained statistically insignificant ($p > 0.05$).

Total cholesterol levels significantly decreased from 188.60 mg/dL to 177.80 mg/dL ($p < 0.001$), aligning with findings by **Bay, (2024) and Clavero-Jimeno, (2024)**, who observed similar reductions through dietary and lifestyle interventions in obese children. Such reductions are clinically significant, as elevated cholesterol is a key risk factor for cardiovascular diseases, as noted by **Sami et al. (2017)**. Early intervention is crucial in mitigating these risks and preventing long-term health complications.

Table (2) Comparative Analysis of Lipid Profile and Serum Glucose in Obese Male and Female Children Aged 6–12 Years Before and After Program Implementation

	Sex	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Cho. Pre	Female	15	189.60	8.649	3.868	0.252	8	1
	Male	15	187.60	15.534	6.947			
Cho. Post	Female	15	177.40	12.779	5.715	-0.091	8	1
	Male	15	178.20	14.822	6.629			
Tg. Pre	Female	15	140.80	19.486	8.714	-0.044	8	1
	Male	15	141.40	23.480	10.500			
Tg. Post	Female	15	132.20	17.768	7.946	0.046	8	1
	Male	15	131.60	23.287	10.414			
HDL-C Pre	Female	15	47.20	3.962	1.772	1.482	8	0
	Male	15	42.20	6.419	2.871			
HDL-C Post	Female	15	49.60	3.782	1.691	1.457	8	0
	Male	15	45.80	4.438	1.985			
LDL-C Pre	Female	15	114.20	8.526	3.813	-0.335	8	1
	Male	15	117.20	18.144	8.114			
LDL-C Post	Female	15	101.40	12.116	5.418	-0.548	8	1
	Male	15	106.20	15.401	6.888			
VLDL-	Female	15	28.20	4.207	1.881	0.000	8	1

C Pre	Male	15	28.20	4.712	2.107			
VLDL-C Post	Female	15	26.40	3.362	1.503	0.078	8	1
	Male	15	26.20	4.604	2.059			
FBG Pre	Female	15	95.60	7.057	3.156	-0.201	8	1
	Male	15	96.60	8.591	3.842			
FBG Post	Female	15	93.20	7.727	3.455	-0.249	8	1
	Male	15	94.40	7.537	3.370			

FBG: Fasting blood glucose, **HDL-C:** High-density lipoprotein, **LDL-C**: Low-density cholesterol, **VLDL-C:** Very Low-density cholesterol
All parameters are represented as a means of replicates ± standard deviation.
Means with different small superscript letters in the same column are significantly different at $p \leq 0.05$.

Triglyceride (TG) levels also significantly declined from 141.10 mg/dL to 131.90 mg/dL (p < 0.001), reflecting improved lipid metabolism. This reduction aligns with the work of **Buga, (2022),** who demonstrated that low-fat, high-fiber diets effectively reduce TG levels in children. Elevated TG is a known cardiovascular risk factor, particularly in obese individuals, as highlighted by **Gholamzad et al. (2023).** Similarly, very low-density lipoprotein cholesterol (VLDL-C) decreased from 28.20 mg/dL to 26.30 mg/dL (p < 0.001), showing further improvements in lipid regulation, which supports findings by **Buga, (2022) and Fernandez & Murillo (2022).**

Additionally, high-density lipoprotein cholesterol (HDL-C) levels significantly increased from 44.70 mg/dL to 47.70 mg/dL (p = 0.001), providing enhanced cardiovascular protection. HDL-C helps remove excess cholesterol and prevents atherosclerosis, as supported by **Chen et al. (2023).** Low-density lipoprotein cholesterol (LDL-C) also significantly decreased from 115.70 mg/dL to 103.80 mg/dL (p < 0.001), further underscoring the intervention's positive impact on lipid metabolism. These findings, consistent with the results of **Lesani, (2023),** highlight the potential of early lifestyle modifications to improve lipid profiles and reduce cardiovascular risk in children.

Fasting blood glucose (FBG) levels also showed a modest but statistically significant decrease, from 96.10 mg/dL to 93.80 mg/dL ($p = 0.002$). Although the change in blood glucose was modest, it suggests improved glycemic control. Elevated FBG levels are often an early indicator of insulin resistance, which can lead to type 2 diabetes if left unmanaged. The reduction in FBG observed in this study aligns with other research that has demonstrated the positive effects of dietary and lifestyle interventions on blood glucose control in children **(Lesani, 2023).** Given the increasing prevalence of type 2 diabetes in children, early intervention programs targeting obesity and metabolic health are crucial for preventing the development of this condition **(Chen et al., 2023).**

In contrast, **Clavero-Jimeno (2024)** emphasized that interventions focused on improving dietary choices and altering lifestyle are essential for effectively managing these conditions.

Bullying Scale

The bullying scale for obese children was used to evaluate the psychological and social consequences of obesity, focusing on weight-based teasing, social exclusion, and peer victimization. This tool provided valuable insight into the relationship between childhood obesity and bullying, helping to quantify the extent to which obese children are exposed to psychosocial stressors that may further influence their health behaviors and emotional well-being. The results of the bullying scale are shown in table (3).

Analysis of the bullying scale revealed a statistically significant reduction in bullying behaviors following the intervention. The computed t-value (6.41, df = 29) exceeded the critical values at both the 0.05 (2.04) and 0.01 (2.76) significance levels, indicating a highly significant difference between pre- and post-test scores ($p < 0.01$). The mean score decreased from 44.20 (SD = 8.72) in the pre-test to 36.73 (SD = 8.71) in the post-test, demonstrating the effectiveness of the counseling program in reducing bullying experiences among the children.

These findings confirm that the program provided measurable improvements in social outcomes, underscoring the value of counseling interventions in addressing bullying among obese children. The results highlight the importance of parental involvement, as a supportive home environment can mitigate the negative impacts of school bullying. Parents should be encouraged to participate in educational courses that equip them with strategies to support their children effectively. Similarly, empowering children through education about bullying, self-expression, and assertive communication can enhance resilience, foster a positive self-image, and promote healthier lifestyle behaviors.

The present results align with those of **Yasra (2019)**, who found that cognitive-behavioral counseling significantly reduced irrational beliefs related to bullying, leading to improved peer interactions. Similarly, **Shetgiri et al. (2020)[a]** emphasized the critical role of family engagement and emotional regulation in sustainable anti-bullying interventions. Together, these findings reinforce the value of combining emotional, cognitive, and familial support mechanisms in tackling bullying.

Furthermore, the results must be considered within the broader context of the bidirectional relationship between obesity and bullying. Obese children are at increased risk of weight-based teasing, social exclusion, and verbal or physical victimization due to stigma and unrealistic body image ideals **(Puhl & Latner, 2007)**. This peer victimization has been linked to psychological consequences including low self-esteem, anxiety, depression, and poor academic performance **(Pearce et al., 2020; Juvonen et al., 2017)**. In turn, these psychological stressors may foster maladaptive coping behaviors such as emotional eating, withdrawal from physical activity, and social isolation, thereby perpetuating obesity **(Faith et al., 2002)**.

Thus, interventions that simultaneously address bullying and obesity are essential to breaking this vicious cycle. Integrated approaches that combine nutritional education, psychosocial counseling, and resilience training particularly when delivered through digital platforms hold promise for reducing both the physical and emotional burdens of childhood obesity **(Shetgiri et al., 2020)[b]**.

Table (3) Comparison between Pre-test and Post-test Application of the Bullying Scale Using the t-Formula

Groups	Mean	N	Standard Deviation	Error Factor	t-value	Degrees of Freedom	Significance
Pre-test Application	44.2±8.72	30		1.59	6.41	29	0.01
Post-test Application	36.73±8.71	30		1.59			

Conclusion:

The Healthy Kids mobile application proved effective in supporting caregivers in managing childhood obesity through structured dietary planning and monitoring. Beyond addressing nutritional awareness and behavior change, the app also targeted psychosocial challenges such as weight-related bullying. By integrating educational content to enhance self-esteem and strengthen child–caregiver communication, the application demonstrated potential as a holistic tool for improving both physical health and emotional well-being.

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الملخص العربي

التغذية الرقمية للأطفال من سن ٦ إلى ١٢ عامًا: معالجة السمنة والتنمر من خلال أنظمة غذائية مخصصة عبر تطبيق جوال

تُعد السمنة في مرحلة الطفولة قضية متزايدة على مستوى العالم، خاصةً بين الأطفال الذين تتراوح أعمارهم بين ٦ إلى ١٢ عامًا. تمثل تطبيقات الصحة للهواتف المحمولة أداة واعدة للتخطيط الغذائي، والمشاركة الأبوية، وتعديل السلوك. تُبين هذه الدراسة التطوير والاختبار الأولي لتطبيق هاتف محمول مصمم لتعزيز عادات الأكل الصحية وتقليل مخاطر السمنة لدى الأطفال. لوحظت تحسُنات كبيرة في النتائج النفسية والاجتماعية والسريرية. على مقياس التنمر، تجاوزت قيمة اختبار T المحسوبة (٦,٤١، درجات الحرية = ٢٩) تجاوزت القيم الحرجة عند كلا المستويين ٠,٠٥ و٠,٠١، مما يشير إلى انخفاض كبير جدًا في اختبار التنمر. كان متوسط درجة الاختبار بعد التدخل (٣٦,٧٣ ± ٨,٧١) أقل بكثير من متوسط درجة الاختبار قبل التدخل (٤٤,٢٠ ± ٨,٧٢). أظهر تحليل التاريخ الطبي العائلي وجود عوامل الخطر القوية المرتبطة بالوراثة ونمط الحياة، حيث كان داء السكري (٧٣,٣٣٪)، والسمنة وارتفاع ضغط الدم (٦٠٪)، وأمراض القلب (٤٦,٦٧٪) الأكثر شيوعًا. كما أظهرت المؤشرات البيوكيميائية اتجاهات مواتية. انخفض مستوى الكوليسترول الكلي في كلا الجنسين (الإناث: من ١٨٩,٦٠ إلى ١٧٧,٤٠ ملجم/ديسيلتر؛ الذكور: من ١٨٧,٦٠ إلى ١٧٨,٢٠ ملجم/ديسيلتر)، وانخفضت مستويات الدهون الثلاثية (الإناث: من ١٤٠,٨٠ إلى ١٣٢,٢٠ ملجم/ديسيلتر؛ الذكور: من ١٤١,٤٠ إلى ١٣١,٦٠ ملجم/ديسيلتر)، وتحسنت مستويات HDL-C بشكل طفيف (الإناث: من ٤٧,٢٠ إلى ٤٩,٦٠ ملجم/ديسيلتر؛ الذكور: من ٤٢,٢٠ إلى ٤٥,٨٠ ملجم/ديسيلتر). على الرغم من أن الفروق بين الجنسين لم تكن ذات دلالة إحصائية ($p > 0.05$)، إلا أن الأنماط العامة عكست تحسنًا في التمثيل الغذائي. تُظهر هذه النتائج أهمية تطبيقات الهواتف المحمولة في مكافحة السمنة في مرحلة الطفولة من خلال تعزيز سلوكيات أكثر صحة، وتقليل الضغوط النفسية والاجتماعية، ودعم استراتيجيات الصحة العامة التي تستهدف الوقاية المبكرة.

الكلمات المفتاحية :تطبيق هاتف محمول، برنامج، سمنة الطفولة، التخطيط الغذائي، مقياس التنمر، تطبيق الأطفال الأصحاء.