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The effectiveness of nurse-led interventions in preventing childhood and adolescent overweight and obesity

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Abstract:-Background: Rising rates of overweight and obesity among adolescents pose serious long-term physical and psychological health risks. Nurse-led interventions are considered effective strategies for promoting healthy lifestyles and preventing obesity. ***Aim***: This study aimed to evaluate the effectiveness of nurse-led interventions in preventing childhood and adolescent overweight and obesity. ***Subjects and Method***: ***Design:*** A quasi-experimental one-group pre-, post-, and follow-up design was utilized. ***Setting***: The study was conducted in five districts of Port Said City, each with one governmental secondary school for girls. A purposive sample of 112 adolescent girls aged 15–18 years with BMI above the 85th percentile was recruited in two randomly selected governmental secondary schools. Data were collected using five ***tools***: (I) Physical Activity Level Questionnaire, (II) Food Frequency Questionnaire, (III) Screen Time Assessment, (IV) Waist Circumference Percentile Charts, and (V) BMI-for-age percentiles. ***Results***: significant improvements were observed in physical activity, dietary habits, and screen time behaviors ($p < 0.001$). healthy dietary habits increased from 19.6% pre-program to 41.1% post-program, while high physical activity rose from 29.5% to 37.5%, and healthy screen time (<2 hours/day) increased from 17.9% to 42.9%. Normal waist circumference improved from 47.3% to 58.0%, and normal BMI increased from 0% to 42.9%, with reductions in overweight and obesity. ***Conclusion***: the nurse-led intervention program was effective in preventing overweight and obesity among adolescent girls. ***Recommendations***: Nurse-led lifestyle programs should be integrated into community health services with regular follow-up, strengthened parental involvement, and expanded implementation on a larger scale to enhance adolescent obesity prevention.***Keywords:*** Effectiveness, Nurse-led interventions, preventing, childhood, adolescent, overweight, obesity

Introduction:

Childhood and adolescent overweight and obesity have emerged as major global public health concerns of the 21st century with prevalence rates continuing to rise across both developed and developing countries which, linked to long-term risks such as type 2 diabetes, cardiovascular disease, and psychological difficulties (Francis, Peterson, Peary, Estrada-Ibarra, Russell, & Schroeder, 2025). These conditions are associated with serious physical, psychological, and social consequences that often extend into adulthood. Early preventive interventions are therefore essential to interrupt the progression of obesity-related health risks. Within this context, healthcare systems increasingly emphasize prevention-focused and community-based strategies (World Health Organization, 2024).

Nurses play a pivotal role in obesity prevention due to their continuous interaction with children, adolescents, and families in schools, primary care, and community settings. Nurse-led interventions typically focus on health education, lifestyle modification, and early risk identification, allowing timely and individualized preventive care (Koh, Chua, Chan, & Shorey, 2024). Their holistic approach supports behavior change related to nutrition, physical activity, and sedentary habits. Recent evidence confirms that nurse-delivered programs can positively influence weight-related outcomes in young populations. (Schmidt, Haines, O'Brien, & Taveras, 2024).

Furthermore, recent studies have highlighted the effectiveness of nurse-led interventions that integrate behavioral counseling with digital health tools such as mobile applications and telehealth platforms. These interventions enhance engagement, self-monitoring, and adherence to healthy lifestyle behaviors among children and adolescents (García-Rodríguez, Vázquez-Rodríguez, Bellahmar-Lkadiri, Siverio-Díaz, & González-Pérez, 2024). Furthermore, family involvement and regular follow-up have been identified as critical components for sustaining positive outcomes. Such structured programs demonstrate promising results in preventing excessive weight gain (Manzano-Felipe, Ruiz-Fernández, & Fernández-Medina, 2024).

Despite promising outcomes, further high-quality evidence is needed to confirm the long-term effectiveness of nurse-led approaches versus standard care, and to identify optimal components

that drive sustained behavioral change. Ongoing research into tailored, culturally sensitive interventions will be essential to maximize impact and inform policy, training, and resource allocation in pediatric weight management. Continued evaluation will clarify how nurse leadership can best contribute to reversing the global trend of childhood overweight and obesity. (Kim & Lee, 2025)

Significance of the study:

Despite the growing body of research on childhood and adolescent obesity, limited attention has been given to the independent contribution of nurses in leading preventive interventions. Most existing programs are physician-led or multidisciplinary, with insufficient evaluation of nurse-led models, particularly in preventive and community-based settings. This gap restricts the translation of nursing expertise into structured, evidence-based practices for early obesity prevention (Spiga, Larsen, & Pérez-Escamilla, 2024).

Therefore, generating robust empirical evidence is essential to support the development of standardized nurse-led preventive programs and to strengthen the role of nurses in health promotion and early intervention. Such evidence can also assist healthcare policymakers and planners in designing effective, sustainable, and cost-efficient strategies for obesity prevention (Nygaard, Glavin, & Røysum, 2024). Accordingly, this study is significant as it evaluates the effectiveness of nurse-led interventions in preventing overweight and obesity among children and adolescents, thereby contributing to evidence-based nursing practice and preventive healthcare.

Aim of the study

The aim of this study was to evaluate the effectiveness of nurse-led interventions in preventing childhood and adolescent overweight and obesity.

Research objectives

1- Assessing dietary habits which including the intensity, frequency, and duration of physical activities in childhood and adolescent

2- Identifying sedentary behaviors that contribute to overweight and obesity in children and adolescents by determining the amount of time the child spends on various screen-based activities on an average day

3- Measuring waist circumference among children and adolescents

4- Determining Body Mass Index (BMI) to assess whether children and adolescents are underweight, normal weight, overweight, or obese based on their height and weight

5- Developing nurse-led interventions program to children and adolescent for preventing overweight and obesity.

6- 5. Implementing nurse-led interventions program for children and adolescent regarding prevention of overweight and obesity.

7- Evaluate the effectiveness of nurse-led interventions program for children and adolescent regarding prevention of overweight and obesity..

Subjects and methods

A. Technical design:

Research Design:

A quasi-experimental research design (One group pre, posttest and follow up on the study subjects) was utilized to conduct the study.

Settings:

The study was conducted in five primary districts of Port Said City: Al Sharq, Al Arab, Al Manakh, Al Zohur, and Al Dawahi. Each district included one governmental secondary school for girls, namely Al Sharq Secondary School for Girls, Al-Qanah Secondary School for Girls, Al-Elm El-Din Secondary School for Girls, Al-Zohour Secondary School for Girls, and Om El-Momenin Secondary School for Girls, respectively. Two schools were randomly selected to participate in the study, where the nurse-led intervention program was implemented, including educational sessions and guided visits to the gym to promote healthy lifestyle behaviors.

Subjects:

A purposive sample of 112 adolescent attended in the previously mentioned setting was included in the study after fulfilling the following **:**

Inclusion Criteria:

- Students aged 15 –18 years.
- Female students.
- Adolescent who's BMI was more than 85th percentile according to WHO/CDC growth charts

Sampling technique:

A multistage sampling technique was used, including cluster sampling at the first stage (selection of schools and choosing one school from each district (cluster sampling), followed by purposive or stratified sampling to select overweight adolescents.

Sample Size:

The sample size was calculated using the formula described by Sahai and Khurshid (1996), based on a prevalence of overweight among adolescents in Egypt of 20% (World Obesity Federation, 2023), a confidence level of 95% (Zα/2 = 1.96), and a margin of error of 7.4%. Using the equation $n = \frac{(z\alpha 2)\times pq}{d}$, where n = sample size, Zα/2 = standard normal value for a 95% confidence level = 1.96, p = expected proportion in the population = 0.20, q = 1 – p = 0.80, and d^2 = accuracy of estimate = 0.074^2, the calculated sample size was n= $(1.96)^2$ * 0.20*0.80/ $(0.074)^2$= 112 adolescents. Therefore, the total sample included in the study was 112 adolescents.

Tools of data collection:

Data was collected using the following five tools:

Tool I: A Self- administered Questionnaire about Adolescent Demographic Characteristics and Physical Activity Level:

This tool was adapted from Bajamal, Robbins, (2023) and translated by researcher into an Arabic language to collect the required data from the study subjects. It consisted of two parts:

Part (1): Adolescent Demographic Characteristics:

It was included essential demographic characteristics of adolescent, including age, female student, school name, educational grade, birth order, residence, living status and socioeconomic status.

Part (2): Adolescents Physical Activity Level (PAL) Questionnaire:

It aimed to assess the intensity, frequency, and duration of physical activities in individuals, often through self-reporting or observational methods that categorize participants' physical activity levels.

Scoring system

The scoring system for assessing adolescents' physical activity level is based on evaluating frequency, duration, and intensity as indicated in the questionnaire items.

- **Frequency** was determined by the number of days per week in which the adolescent engages in moderate or vigorous physical activity, where practicing activity for 0–2 days per week reflects a low activity level, while, 3–4 days per week indicates a moderate level, and 5–7 days per week represents a high level.
- **Duration** was assessed according to the amount of time spent during each activity session, with less than 30 minutes corresponding to low activity, and 30 minutes or more reflecting moderate to high activity.
- **While, intensity** was evaluated based on the physical sensations experienced during activity such as sweating, increased heart rate, or the need to stop to catch breath which help determine whether the activity is light, moderate, or vigorous.
- By integrating these three components frequency, duration, and intensity, the overall physical activity level is classified into low, moderate, or high, where low activity reflects minimal or no engagement, moderate activity indicates practicing activity 3–4 times per week with adequate duration and moderate intensity, and high activity corresponds to engaging in physical activity 5–7 days per week for 30 minutes or more at moderate to vigorous intensity.

Tool II: A Self- administered Questionnaire about Food Frequency:

This tool was designed by the researcher based on review of relevant literatures (Canto-Cetina et al., 2018; Wei, Zhang, Zhou, Ge, & Tian, 2023; White, Barquera, & Rivera, 2017) in a simple Arabic language. It was a commonly used to assess dietary habits by collecting information on how often specific foods and beverages are consumed over a certain period in which participants should report how often the adolescent consumes each food item or group over a specified period (e.g., the past week or month). It includes 16 questions regarding dietary habits.

Scoring system

Based on WHO criteria, the dietary scoring system assesses students' eating habits by evaluating the frequency, quantity, and balance of healthy and unhealthy food intake. High scores reflect healthy habits, characterized by frequent consumption of at least three types of healthy foods (fruits, vegetables, whole grains, healthy proteins) 4–6 times per week in portions of 80–100 g, with unhealthy foods consumed rarely (1–2 times/week). Poor dietary habits are indicated by intake of unhealthy foods such as sweets, fast foods, and sugary drinks more than four times per week in large portions (≥100 g), together with consuming healthy foods fewer than three times per week. A balanced diet lies between these two patterns, defined by eating 2–3 types of healthy foods 3–4 times per week, moderate consumption of unhealthy foods (1–2 types up to 3–4 times/week), and portion sizes of 60–100 g.

Tool III: A Self-administered Questionnaire about Screen Time Assessment:

This tool was designed by (Lindsay et al., 2018; Sutherland, and Sutherland, 2023; World Obesity Federation, 2023) and translated by researcher into an Arabic language to determine students' daily living activity on electronic screens to assess daily living activity on electronic screens among adolescent students. It consisted of six questions related to the most used electronic devices, the number of hours spent on social media, watching TV or videos and playing video games. It will be used as a pre-test only. The questions were formulated as multiple-choice questions with no correct or incorrect options. The student's responses will reflect his/her point of view.

Scoring system

The scoring system for screen time assesses adolescents' total daily non-educational screen use by summing the hours reported in relevant questions. Based on this total: less than two hours per day is considered a healthy and recommended screen time; two to four hours per day reflects moderate usage; and more than four hours per day is classified as excessive, which is associated with a higher risk of sedentary behavior and obesity.

Tool IV: Waist Circumference Percentile Charts:

The Waist Circumference Percentile Charts, which assess abdominal fat a key indicator of obesity and related health risks in adolescents were developed by the World Health Organization

(WHO, 2011) and translated into Arabic by the researcher. These charts allow for the classification of adolescents' waist circumference according to age- and sex-specific percentiles, providing a reliable tool for identifying those at higher risk of obesity-related health problems.

Scoring system

Waist circumference percentiles are used to categorize adolescents' risk levels for obesity-related health issues. A waist circumference below the 85th percentile is considered normal and indicates low risk. Measurements between the 85th and 95th percentiles suggest the adolescent is at risk for overweight, while a waist circumference at or above the 95th percentile indicates central obesity and a higher risk of metabolic and other obesity-related health problems.

Tool V: Body Mass Index (BMI) for Age Percentiles:

It is a widely used to assess adolescents are underweight, normal weight, overweight, or obese based on their height and weight. The percentiles are determined based on growth charts provided by the Centers for Disease Control and Prevention (CDC, 2022) or World Health Organization (WHO, 2007), which take into account age and sex. BMI is calculated using the following formula: Body Mass Index (BMI) = body weight (kg) ÷ height (meter)^2

Scoring system:

BMI Percentile Categories (for children aged 2 to 19):

- **Underweight:** BMI less than the 5th percentile.
- **Normal weight:** BMI between the 5th and 85th percentiles.
- **Overweight:** BMI between the 85th and 95th percentiles.
- **Obese:** BMI at or above the 95th percentile.

B- Operational design

Validity of tools

The content validity of the study tools were tested and revised by a panel of seven academic staff experts, in the field of community health nursing from the faculty of nursing, Port Said University for its clarity, content, sequence of items and relevance or irrelevance of content, comprehensiveness, and applicability. Based on their feedback, minor modifications such as

"adding an interpretation at the end of the tool (I) for assessing adolescents' physical activity level

Reliability of the study tools

The reliability of the study tools was assessed to ensure consistency and accuracy of measurements. The internal consistency reliability for tool I, was tested using Cronbach's Alpha, with values 0.827 while, the reported Cronbach's Alpha for tools II, III, IV&V were 0.834,0.790, 0.886 & 0.856 indicating high internal consistency, and the Arabic version's reliability was re-evaluated using the same test.

The pilot study

A pilot study was undertaken before starting data collection phase. It was carried out on 10% of the total number of the study sample (11 adolescent). It was excluded from the study. The pilot study took 15 day. The purpose of the pilot study was to test feasibility and applicability of the tool. It also helped to find out any obstacles and problems that might interfere with data collection.

II –Methods

Field work

- Before starting any step in the study, an official letter from the dean of the faculty of nursing, Port Said University was sent to the educational directorates of the above-mentioned setting requesting their permission and cooperation to conduct the present research after explaining the intention of the study
- Data collection started, and continued for a period of 6 months from the beginning of February to the end of July.
- the researcher visited the previously mentioned study settings three days/a week in the morning from 9 a.m. to 1 p.m to collect data and introduced herself to adolescent and gave them a brief idea about the aim and nature of the study.

- Each adolescent was interviewed individually after taken their oral consent to contribute in the study. data collection conducted through four phases (assessment phase, planning phase, implementation phase and evaluation phase)

1) Assessment phase

- Each adolescent student was assessed individually to collect baseline data of demographic and personal information, using (Part 1 Tool I)
- Assessing of physical activity level using (Part 2 Tool).
- Evaluating students' eating habits by evaluating the frequency, quantity, and balance of healthy and unhealthy food intake using tool (II).
- Assessing adolescents' total daily non-educational screen use by using tool (III)
- Determining students' overweight risk level using (Tool IV & V), which includes BMI-for-age percentile calculations and waist circumference percentiles.

2) Planning phase

- Based on the findings of the assessment phase, goals, priorities, and expected outcomes were formulated to guide the nurse-led intervention program for preventing adolescent overweight.
- In this phase, the researcher planned a series of three sessions targeting adolescents to enhance their knowledge, attitudes, and practices regarding healthy eating, physical activity, screen time use
- The first session focused on collecting detailed baseline information and introducing the concept of adolescent overweight, its causes, risks, and the importance of healthy lifestyle habits.
- While, the second session emphasized practical strategies for maintaining a healthy diet and regular physical activity, including meal planning, exercise routines, and behavior modification techniques.
- Whereas the third session included interactive demonstrations, group discussions, and scenario-based activities, during which the researcher taught adolescents the nurse-led intervention program for preventing adolescent overweight, then took them to the gym to practically apply the learned activities, allowing them to share experiences, identify barriers, and develop problem-solving strategies.

3) Implementation phase

- The nurse-led intervention program was implemented through a multidisciplinary approach. The nutritional component of the program was designed and supervised by a specialized dietitian, who developed balanced meal plans, provided dietary education, and offered nutritional counseling based on the educational booklet and adolescents' nutritional assessment
- The physical activity component was designed and guided by a certified fitness trainer, who planned and supervised appropriate exercises and training activities suitable for adolescents' age and health status.
- During the implementation phase, the researcher was responsible for follow-up and supervision of the program. Monthly follow-up visits were conducted to monitor adolescents' adherence to the program, measure body weight, and assess progress throughout the intervention period.

- Each session lasted 30–45 minutes to discuss its items, considering adolescents' attention span and school schedule.
- The researcher used interactive teaching methods such as discussion, demonstration, role-play, and case-based scenarios to enhance engagement and comprehension.
- adolescents were divided into small groups of 10–12 participants to facilitate participation and effective assessment.
- Sessions were conducted three days per week during morning hours (9 a.m. to 1 p.m.)
- During each session, simple language and visual aids were used, followed by group discussions to reinforce learning. At the end of each session, a brief summary was provided, and participants were encouraged to ask questions for clarification.

4) Evaluation Phase (Post-test and Follow-up)

- Every adolescent was interviewed separately after the intervention program was conducted in order to evaluate their practical behavior, regarding healthy eating, physical activity, screen time use and risk for overweight by using the same tools used in the assessment phase at pre test (Tool I,II, III, IV, V)

- Post-test assessment tools were conducted immediately after the intervention, and a follow-up evaluation was carried out after 3 months from the immediate post test to assess retention of knowledge, sustainability of behavior changes
- Comparison between adolescent' pre, post and follow up test finding were done to determine the effect of nurse-led intervention program on their physical activity level, dietary habits, screen time use and risk for overweight.

C- Administrative design

Ethical considerations

The researcher followed ethical research principles as the following:

Following an explanation of the study's goal ,each participant gave their oral consent before the trial began. The researchand ethical committeeof the Faculty of Nursing; Port Said Universitygave its approval No( )to the study protocol .While adolescent girls were informed of their right torefuse participation or withdraw from the study at any time without providing areason or facing any consequences. The study was designed to cause no physical ,psychological, or occupational harm to the participants. Throughout the study ,the privacy and confidentiality of all collected data were strictly maintained. Every adolescent retained the freedom to withdraw from the study at anypoint without incurring any liability.

D. Statistical design:

Statistical Analysis

The collected data were coded, entered, and analyzed using SPSS version 26.0. Descriptive statistics (frequency, percentage, mean, and standard deviation) summarized adolescents' demographic characteristics and main study variables. Inferential statistics included Chi-square tests for categorical variables, Friedman and Cochran's Q tests for repeated measures across pre, post, and follow-up assessments, and Wilcoxon Signed Rank tests for pairwise comparisons. A p-value ≤ 0.05 was considered statistically significant, and results were presented in tables and figures.

Result

Table (1) indicates that 25.9% of adolescents were at age 15 to less than 16 years. Regarding school grade, 34.8% of them were in the first grade. For birth order, 26.8% were the third-born. Concerning residence, 59.8% of adolescents lived in urban areas. As for living status, 75.0% lived with their parents. In terms of socioeconomic status, 50.0% were of medium level**.** Regarding father's education, 40.2% had secondary education, and for mother's education, 40.2% also had secondary education**.**

Figure (1) clarifies that, low activity decreased from 30.3% of adolescent pre-program to 17.9% of them post-program implementation. While, moderate activity rose slightly to 44.6%, post-program implementation and high activity increased from 29.5% pre-program to 37.5% post-program implementation, indicating overall improvement after the program.

Table (2) shows the distribution of adolescents' total score of dietary habits before, after, and at follow-up of the program implementation. Before the program, only 19.6% of adolescents had a healthy dietary habit, which increased to 41.1% post-program and slightly decreased to 35.7% at follow-up. While, the balanced dietary habit category remained relatively stable, with a slight increase from 34% pre-intervention to 38.4% at follow-up. Conversely, unhealthy habits decreased from 46.4% pre-program to 24.1% post-program and 25.9% at follow-up with a very high statistical significant differences at $p<0.001$.

Table (3) presents adolescents' score of total screen time categories before, after, and at follow-up of the program. The proportion of adolescents with healthy screen use (<2 hours/day) increased markedly from 17.9% pre-program to 42.86% post-program, slightly decreasing to 37.5% at follow-up. While, 39.29% of them used moderate screen (2–4 hours/day) pre-program slightly decreasing to 35.71 & 37.50% at post and follow-up respectively. Those with excessive screen use (>4 hours/day) decreased from 42.9% pre-program to 21.4% post-program and slightly rose to 25.0% at follow-up with a very high statistical significant differences at $p<0.001$

Table (4) highlights the distribution of adolescent girls according to total waist circumference risk levels before, after, and at follow-up of the program. About 47.3% of girls had normal waist circumference (<85th percentile) pre-program improved to 58.0% of them post-program and at

follow-up respectively. While, Those at risk of overweight decreased from 33.0% pre-program to 26.8% post-program and at follow-up respectively, and 19.7% of them with central obesity pre-program decreased to 15.2% post-program and at follow-up respectively with a very high statistical significant differences at $p<0.001$

Table (5) displays the distribution of students adolescent girls according to their total BMI for -age categories before, after, and at follow-up of the program. The percentage of girls with normal BMI increased from 0.00% pre-program to 42.86 & 49.11% at post and follow-up of the program respectively, while underweight cases increased from 0.00% pre-program to 11.61 % post program implementation. Overweight and obesity rates among adolescents showed decreases from 60.71% and 39.29% pre-program to 23.21% and 18.75% at follow-up, respectively, with a very high statistically significant difference (Friedman $\chi^2 = 28.73$, $p < 0.001$).

Table (6) exhibits that there was no significant relationship between physical activity levels and dietary habits during the pre-program phase ($p = 0.427$). However, a significant association emerged post-program ($p = 0.015$)**,** indicating that increased physical activity was linked to healthier dietary habits following the program implementation. By the follow-up phase, the association was no longer statistically significant ($p = 0.085$**)**

Table (7) explains that before the program, there was no statistically significant relationship between physical activity level and screen time category ($p = 0.191$). However, a statistically significant association was observed post-program ($p = 0.018$), where participants with higher physical activity levels tended to report healthier screen time use (<2 hours/day). By the follow-up phase, the relationship was no longer statistically significant ($p = 0.093$).

Table (8) shows that after the program, dietary habits were significantly associated with age ($p = 0.047$) and socioeconomic status ($p = 0.023$), while school grade, residence, and parents' education had no significant effect. Older adolescents and those from lower-income families were more likely to have unhealthy dietary habits.

Table (1): Distribution of the studied student adolescents girls according to their demographic characteristics (n=112)

Characteristics	No.	%
Age (years)		
15 <16	29	25.9
16 <17	28	25.0
≥17	55	49.1
X ± SD	**16.6 ± 0.9**	
School Grade		
First	39	34.8
Second	37	33.0
Third	36	32.1
Birth Order		
First	28	25.0
Second	26	23.2
Third	30	26.8
Fourth or more	28	25.0
Residence		
Urban	67	59.8
Rural	45	40.2
Living Status		
With parents	84	75.0
With one parent	11	9.8
With relatives	9	8.0
Others	8	7.1
Socioeconomic Status		
Low	31	27.7
Medium	56	50.0
High	25	22.3
Father's Education		
Illiterate	11	9.8
Read and Write	17	15.2
Secondary	45	40.2
University	39	34.8
Mother's Education		
Illiterate	17	15.2
Read and Write	22	19.6
Secondary	45	40.2
University	28	25.0

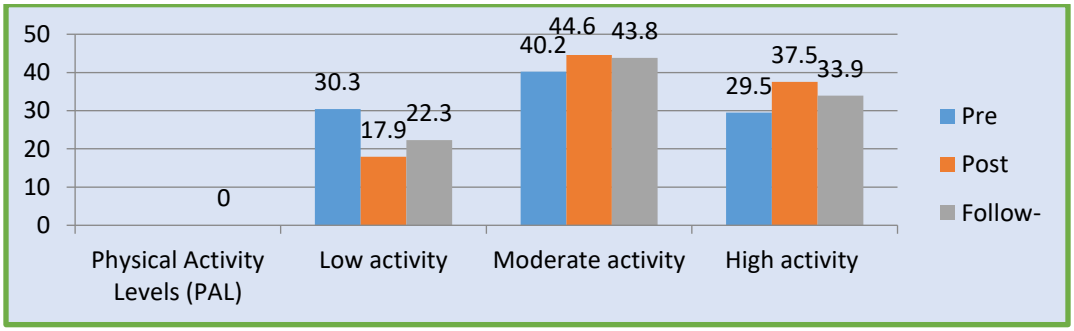

Figure (1): Distribution of Student Adolescent Girls' Physical Activity Level (PAL) Pre, Post, and Follow-Up (n=112)

Table (2): Distribution of Student Adolescent Girls' total score of Dietary Habits Pre, Post, and Follow-Up (n=112)

Dietary Habit Category	Pre		Post		Follow-Up		Friedman χ^2
	No.	%	No.	%	No.	%	$\chi^2 = 16.824$ p<0.001*
Healthy Dietary Habit	22	19.6	46	41.1	40	35.7	
Balanced Dietary Habit	38	34	39	34.8	43	38.4	
Unhealthy Dietary Habit	52	46.4	27	24.1	29	25.9	
Total	112	100%	112	100%	112	100%	

Friedman χ^2: **Friedman Chi-square** test *: Statistically significant at $p \leq 0.05$

Table (3): Distribution of Student Adolescent Girls according to total score of Screen Time Categories Pre- Post- and Follow-Up (n = 112)

Screen Time Category	Pre		Post		Follow-Up		Cochran's Q χ^2
	No.	%	No.	%	No.	%	$Q\chi^2 = 22.87$ p<0.001*
Healthy Use(<2 hrs/day)	20	17.86	48	42.86	42	37.50	
Moderate Use(2–4 hrs/day)	44	39.29	40	35.71	42	37.50	
Excessive Use(>4 hrs/day)	48	42.86	24	21.43	28	25.00	
Total	112	100.00	112	100.00	112	100.00	

Cochran's Q χ^2: Cochran's Q test *: Statistically significant at $p \leq 0.05$

Table (4): Distribution of Student Adolescent Girls according to their total Waist Circumference Risk Levels Pre, Post-, and Follow-Up Phases (n = 112)

Waist Circumference level	Pre		Post		Follow-Up n		Friedman χ^2
	No.	%	No.	%	No.	%	
Normal (< 85th percentile)	53	47.3	65	58.0	65	58.0	**$\chi^2 = 18.62$, p = 0.001***
At Risk of Overweight (85th – <95th)	37	33.0	30	26.8	30	26.8	
Central Obesity (≥ 95th percentile)	22	19.7	17	15.2	17	15.2	
Total	112	100.00	112	100.00	112	100.00	

Table (5): Distribution of Student Adolescent Girls according to their total BMI for age Category Pre, Post-, and Follow-Up Phases (n = 112)

BMI Category	Pre		Post		Follow-Up n		Friedman χ^2
	No.	%	No.	%	No.	%	
Underweight (<5%)	0	0.00	13	11.61	10	8.93	$\chi^2 = 28.73$ (p = 0.001**)
Normal (5%–85%)	0	0.00	48	42.86	55	49.11	
Overweight (85%–95%)	68	60.71	28	25.00	26	23.21	
Obese (≥95%)	44	39.29	23	20.54	21	18.75	
Total	112	100.00	112	100.00	112	100.00	

Table (6): Relationship Between Physical Activity Levels and Dietary Habits at Pre-, Post-, and Follow-Up Phases (n = 112)

Dietary Habit Category	Pre						Post						Follow-up					
	Low activity (34)		Moderate activity(45 n=)		High activity(n=33)		Low activity(n=20)		Moderate activity(n=50)		High activity(n=42)		Low activity(n=25)		Moderate activity(n=49)		High activity (n=38)	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Healthy Diet	6	17.6	8	17.8	8	24.2	5	25.0	20	40	21	38.2	4	16.0	19	38.8	17	44.7
Balanced Diet	10	29.4	18	40.0	10	30.3	6	30.0	14	28	19	34.5	8	32.0	20	40.8	15	39.5
Unhealthy Diet	18	52.9	19	42.2	15	45.5	9	45.0	16	32	15	27.3	13	52.0	10	20.4	6	15.8
χ^2 (p-value)	3.85 (0.427)						18.95 (0.015*)						8.17 (0.085)					

** Statistically significant at **p ≤ 0.01** **χ^2 = Chi-square test**

Table(7): Relationship Between Physical Activity Level and Screen Time Category at Pre-, Post-, and Follow-Up Phases (n = 112)

Screen Time Category	Pre						Post						Follow-up					
	Low activity (34)		Moderate activity(45 n=)		High activity(n=33)		Low activity(n=20)		Moderate activity(n=50)		High activity(n=42)		Low activity(n=25)		Moderate activity(n=49)		High activity (n=38)	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Healthy Use (<2 hrs)	4	11.8	7	15.6	9	27.3	6	30.0	20	40.0	22	52.4	6	24.0	18	36.7	18	47.4
Moderate Use (2–4 hrs)	12	35.3	20	44.4	12	36.4	8	40.0	20	40.0	12	28.6	10	40.0	20	40.8	12	31.6
Excessive Use (>4 hrs)	18	52.9	18	40.0	12	36.4	6	30.0	10	20.0	8	19.0	9	36.0	11	22.5	8	21.0
χ^2 (p-value)	6.12 (0.191)						16.84 (0.018*)						9.45 (0.093)					

** Statistically significant at **p ≤ 0.01** **χ^2 = Chi-square test**

Table (25): Association Between Adolescents' Demographic Characteristics and Dietary Habits post program implementation (n = 112)

Demographic Characteristic	Healthy Dietary Habit (n=46)	Balanced Dietary Habit (n=39)	Unhealthy Dietary Habit (n=27)	χ^2 (p-value)
Age (years)				$\chi^2 = 6.12$ (p =0.047*)
15< 16 (n=29)	12 (26.1%)	10 (25.6%)	3 (11.1%)	
16< 17 (n=28)	12 (26.1%)	10 (25.6%)	6 (22.2%)	
≥17 (n=55)	22 (47.8%)	19 (48.7%)	18 (66.7%)	
School Grade				$\chi^2 = 0.14$ (p = 0.997)
First (n=39)	16 (34.8%)	13 (33.3%)	10 (37.0%)	
Second (n=37)	15 (32.6%)	13 (33.3%)	9 (33.3%)	
Third (n=36)	15 (32.6%)	13 (33.3%)	8 (29.6%)	
Residence				$\chi^2 = 3.21$ (0.201)
Urban (n=67)	28 (60.9%)	23 (59.0%)	16 (59.3%)	
Rural (n=45)	18 (39.1%)	16 (41.0%)	11 (40.7%)	
Socioeconomic Status				$\chi^2 = 7.55$ (p = 0.023*)
Low (n=31)	8 (17.4%)	8 (20.5%)	15 (55.6%)	
Medium (n=56)	28 (60.9%)	22 (56.4%)	6 (22.2%)	
High (n=25)	10 (21.7%)	9 (23.1%)	6 (22.2%)	
Father's Education				$\chi^2 = 6.67$ (0.248)
Illiterate (n=11)	3 (6.5%)	4 (10.3%)	4 (14.8%)	
Read & Write (n=17)	6 (13.0%)	5 (12.8%)	6 (22.2%)	
Secondary (n=45)	20 (43.5%)	18 (46.2%)	7 (25.9%)	
University (n=39)	17 (37.0%)	12 (30.7%)	10 (37.0%)	
Mother's Education				$\chi^2 = 8.14$ (0.087)
Illiterate (n=17)	5 (10.9%)	4 (10.3%)	3 (11.1%)	
Read & Write (n=22)	6 (13.0%)	6 (15.4%)	5 (18.5%)	
Secondary (n=45)	22 (47.8%)	18 (46.2%)	5 (18.5%)	
University (n=28)	13 (28.3%)	11 (28.1%)	14 (51.9%)	

** Statistically significant at **p ≤ 0.01** **χ^2 = Chi-square test**

Discussion

Nurse-led interventions play a key role in preventing childhood and adolescent overweight and obesity by promoting healthy eating, physical activity, and behavioral change in school and community settings. Recent 2024 evidence indicates that while these programs improve nutritional knowledge and lifestyle behaviors, their impact on reducing BMI and weight outcomes remains inconsistent and need for stronger evidence to confirm long-term effectiveness (Whitehead et al.,2021) .

Concerning the socio-demographic characteristics of the studied staff nurses, the present study revealed that most adolescents were older (≥17 years), evenly distributed across school grades, predominantly from urban areas, and came from families with medium socioeconomic status and relatively high parental education. These findings were not consistent with a study conducted by Cai et al., (2023) on "Influence of adolescents' and parental dietary knowledge on adolescents' body mass index (BMI), overweight/obesity in 2004–2015: A longitudinal study", which reported that higher proportion of adolescents were young adolescents, from urban residence and with higher socioeconomic status. The predominance of urban residents in the current result may be due to higher population density in cities and greater access to schools located within urban centers, while the relatively high parental education levels may reflect ongoing improvements in educational attainment over recent decades, which could also influence adolescents' awareness and engagement in health-promoting behaviors

The current study demonstrated a statistically significant improvement in total PAL following program implementation, with a marked reduction in low physical activity and a noticeable shift toward moderate and high activity levels among higher percentage of adolescents. This improvement was most evident post the program and was partially sustained at follow-up. These findings corresponded with Lubans, Smith, Morgan, Beauchamp, Miller, Lonsdale, & Plotnikoff, (2022), who conducted a systematic review titled "School-based physical activity interventions for adolescent girls" and reported that structured, theory-based programs significantly increase moderate-to-vigorous physical activity among the majority of adolescent girls, with sustained benefits observed beyond the intervention period. From the researcher's point of view, the improvement in physical activity levels in the present study may be related to increased peer support and social motivation created during the program, which encouraged adolescents to engage more actively in physical activity.

In relation to the distribution of adolescents' total dietary habit scores before, after, and at follow-up of the program, the current findings demonstrated a statistically significant positive change following the program, where less than one-fifth of the girls exhibited healthy dietary habits before the program, but this proportion more than doubled after the program and remained higher at follow-up. The proportion with balanced dietary habits showed a modest increase over time, while more than two fifths of them with unhealthy dietary habits sharply decreased after the program and remained lower at follow-up compared to pre- program levels. These findings were inconsistent with Raut, Singh, Dhungana, Pradhan, & Sunuwar, (2024), who conducted a study on "Effect of nutrition education intervention on nutrition knowledge, attitude, and diet quality among school-going adolescents: A quasi- experimental study" and found that the minority of adolescents exhibited healthy dietary habits after the educational session. From the researcher's point of view, the observable improvement in this study may be due effective therapeutic communication, which enhanced trust, reassurance, adherence to healthier food choices, and reinforcement strategies, which increased nutrition awareness

With reference to adolescents' total screen time categories across the pre, post, and follow-up phases, the current study revealed a statistically significant improvement in adolescents' screen time patterns after the program. The proportion of adolescents with healthy screen use (<2 hours/day) increased and remained higher at follow-up, while excessive screen use (>4 hours/day) decreased and stayed lower compared to pre-program levels, indicating a sustained positive behavioral change. These findings were in harmony with Xu, Wang, & Liu, (2023), who conducted a study titled "Effects of digital literacy and health promotion interventions on adolescents' screen behaviors" and reported significant increases in healthy screen use and reductions in excessive screen time following structured educational interventions among most of adolescents. The researcher attributed the improvements in healthy screen use to increased awareness and self-regulation skills, which helped adolescents limit screen time and adopt balanced habits.

Besides, the results of the current study revealed a statistically significant improvement in total waist circumference risk levels among adolescent girls across the pre, post, and follow-up phases of the program with more girls achieving normal waist circumference and fewer at risk of overweight or central obesity,with these improvements sustained at follow-up. These results were in

accordance with van den Berg & Chinapaw, (2024), who studied " Waist circumference as a parameter in school-based interventions to prevent overweight and obesity: A systematic review and meta-analysis" and reported that school-based lifestyle interventions combining nutrition education and physical activity effectively reduced waist circumference and central adiposity in most overweight or obese adolescents. From the researcher's perspective, the observed improvement in waist circumference risk levels may be attributed to increased awareness of healthy lifestyle behaviors, variations in individual adherence to dietary and lifestyle recommendations,

The present study revealed statistically significant improvements in adolescents' total BMI categories after the program, with a substantial proportion achieving normal weight post-intervention and further improvement at follow-up , with reductions in overweight and obesity, and only a small, slightly decreasing proportion becoming underweight. The current findings were not similar to the result of Mwangi, Muthuri, & Onywera, (2023), who studied "Impact of brief health education on adolescent BMI: A school-based evaluation" and reported that, none of the adolescents were classified as having normal weight post the program and at follow up and more than half of them were overweight after health education implementation. The researcher attributed the shift to normal BMI and reduced overweight/obesity to increased physical activity and regular follow-up, which promoted healthier lifestyle habits.

Furthermore, the current findings demonstrated a significant association between physical activity levels and dietary habits among adolescent girls after the program implementation, while no significant relationships were observed at the pre- program or follow-up phases. These results coordinated with Smith, Brown, & Lee, (2023), who studied "Synergistic effects of physical activity and nutrition education on adolescent health behaviors: A controlled intervention study " and reported in their study on adolescent health behaviors that lifestyle interventions combining physical activity promotion with nutrition education led to significant improvements in both activity levels and diet quality immediately after the program. The significant association post-program in the present study may be explained by the structured guidance and monitoring provided during the intervention.

Furthermore, the current findings indicated that before the program, there was no significant relationship between physical activity levels and screen time among adolescent girls.

Whereas, after the program, a significant association emerged, showing that adolescents who engaged in higher levels of physical activity were more likely to have healthier screen time habits, with more than half of highly active participants limiting screen use to less than two hours per day. While, at the follow-up phase, this relationship was no longer statistically significant. These results were in harmony with Saint-Maurice, Welk, & Kim, (2023), who conducted study about " The dynamic interplay of physical activity and sedentary behavior in adolescents: Implications for health promotion" and reported that interventions promoting physical activity can temporarily reduce sedentary behaviors, including screen time, among adolescents. From the researcher's perspective, the weakening of this association at follow-up may reflect that, beyond the program, adolescents' screen time is influenced by other environmental and social factors, such as peer norms, academic demands, and digital accessibility, which may override the initial program effects.

Pertaining to the association between adolescents' demographic characteristics and dietary habits after program implementation, the present study revealed that, after the program, dietary habits were associated with both age and socioeconomic status that continued to show a statistically significant relationships with adolescents' eating behaviors." These findings corresponded with Colillas- Malet et al ., (2023), who studied "Relationship between diet quality and socioeconomic and health-related factors in adolescents by gender after lifestyle intervention program.*"* and found that socioeconomic status was a significant predictor of dietary quality in adolescents after lifestyle intervention program, with lower- income groups showing higher prevalence of unhealthy habits

Conversely, the present results differ from Ahmed, Kolbe-Alexander, & Khan, (2023), who conducted "Efficacy of a school- based education intervention on the consumption of fruits, vegetables and carbonated soft drinks among adolescents" and found no significant association between age or socioeconomic background and dietary outcomes post of intervention. From the researcher's perspective, the observed associations suggest that age and socioeconomic circumstances continued to shape dietary behavior even after intervention, possibly because older adolescents have greater autonomy over food choices and lower- income families may face financial and environmental barriers to adopting consistent healthy eating habits.

Conclusion:

The present study concluded that the nurse-led intervention program was effective in preventing overweight and obesity among adolescent girls, as evidenced by the statistically significant improvements in physical activity levels, dietary habits, and screen time behaviors ($p < 0.001$), along with measurable reductions in BMI and waist circumference, with many participants shifting from overweight/obese to normal weight.

Recommendation:

The study recommended Nurse-led lifestyle programs should be integrated into community health services with regular follow-up, strengthened parental involvement, and expanded implementation on a larger scale to enhance adolescent obesity prevention

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