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Effect of Dietary Intervention Program on Healthy Eating Habits and Physical Activity among Adolescents

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ABSTRACT

Background: The practice of healthy eating and engaging in physical activity foster good health, growth, and intellectual development, while also preventing diseases. Adolescence is a promising time for intervention, as it provides an opportunity to gain knowledge and experience that are vital for understanding the factors contributing to unhealthy eating among adolescents.

Aim: This study aimed to assess the impact of a dietary intervention program on Healthy Eating Habits and Physical Activity in adolescents.

Methods: This study employed a Quasi-experimental design. The research took place in four secondary schools located in Ismailia city. A convenience sample consisting of 136 adolescent students. Data were collected using three tools: A self-administered questionnaire sheet, the Diet Self Efficacy Scale, and the Observation Checklist for a Healthy School Canteen. **Results:** Statistically significant differences ($p < 0.001$mc) were revealed between the mean knowledge and practice scores of students regarding healthy eating habits and physical activity during adolescence before and after the implementation of the program. **Conclusion:** For understanding and application of healthy dietary practices and exercise among adolescents were enhanced following the program's implementation.

Keywords: Adolescents, Healthy eating habits, Knowledge, Practice, Physical activity.

INTRODUCTION

Adolescence signifies a pivotal developmental epoch, distinguished by a profound and rapid succession of transformations encompassing physical maturation, psychological evolution, and social adaptation. This formative period holds paramount importance for the ingrained establishment of enduring lifestyle patterns and nutritional behaviors, elements that demonstrably wield diverse and significant long-term health implications for young individuals as they progress through their lifespan. Within the multifaceted constituents defining a healthy lifestyle, the adherence to a well-balanced diet emerges as an exceptionally critical factor, underpinning optimal adolescent growth, development, and overall physiological well-being [(1)].

Globally, approximately 80% of adolescents fail to adhere to established guidelines for physical activity, a significant factor contributing to the escalating rates of obesity and associated health complications. Furthermore, data from the World Health Organization (WHO) [(2)] indicates that nearly 45% of adolescents regularly consume fast food. Concurrently, a mere 20% of this demographic meet the daily recommendation of five servings of fruits and vegetables, underscoring widespread dietary imbalances.

Eating habits established during the crucial developmental period of adolescence have been demonstrably shown to persist into adulthood. Consequently, fostering and reinforcing healthy eating behaviors among adolescents yields significant advantages, encompassing both immediate and enduring short-term and long-term health benefits. This underscores the importance of early dietary interventions [(3)]. When children are in their formative years, eating a nutritious diet lowers their chance of developing urgent nutrition-related health issues that are of the biggest concern to schoolchildren, such as obesity, dental caries, and inactivity [(4)]. Irregular eating patterns and suboptimal food choices demonstrably exert a detrimental impact on the health trajectories of adolescents. These pervasive dietary habits contribute to a dual burden, manifesting as both micronutrient deficiencies and the escalating prevalence of obesity. Such nutritional imbalances, in turn, result in a significant impairment of both physical and mental growth and development, ultimately compromising the holistic nutritional status of young individuals [(5)].

Adolescences who engage in physical activity increase their motor skills, balance, and coordination while also feeling more confident and good about themselves [(6)]. Furthermore, physical activity frequently promotes communication, cooperation, and social engagement as teenagers learn to collaborate and engage in peer competition [(7)].

Additionally, it offers a way to relieve tension and lessens the signs of despair and anxiety. Adolescents' general development depends on encouraging and fostering physical exercise, which also lays the groundwork for an active and healthy adult lifestyle [(8)].

Community health nurses have always been essential in enhancing the general health of adolescents in the neighborhood. The nurse is frequently the one that interacts with the family and teenagers the most [(9)].

She is able to see the families and kids in a range of situations and community-based groups. Obtaining, retaining, or maintaining adolescents' health is the

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primary objective of nursing, which includes the duties of case finder and referral, clinical educator, counselor, and coordinator [10].

Significance of the study: Adolescent eating habits and physical activity levels are critical to public health globally. In Egypt, the situation is particularly concerning; a recent study found that approximately 30% of adolescents are overweight or obese, driven by sedentary lifestyles and poor dietary choices, such as high consumption of sugary drinks and processed foods [11]. So that study was carried out to evaluate the effect of dietary intervention program on healthy eating habits and physical activity among adolescence at Ismailia City.

Aim of the study: The primary objective of this investigation was to rigorously evaluate the impact of a structured dietary intervention program on fostering the development of healthy eating habits and promoting increased physical activity levels among the adolescent population residing within Ismailia City. This study specifically aimed to ascertain the efficacy of such an intervention in this demographic.

Research hypotheses: H0: Dietary intervention program not improved knowledge and practice regarding healthy eating habits and physical activity among adolescents.
H1: Statistical significance will improve knowledge and practice regarding healthy eating habits and physical activity among adolescents after implementation of the dietary intervention program.

METHODOLOGY

Study design and setting: This quasi-experimental study was conducted across four secondary schools randomly selected within the North Ismailia administration, Ismailia City.

Sample: A convenience sample of 136 adolescent students from secondary schools in Ismailia City was recruited based on predefined inclusion criteria, ensuring population homogeneity.

Inclusion criteria: All students aged 14 to 18 years in school settings, of both genders.
Exclusion criteria: Students with a high rate of absenteeism and inclusive students.

Tools of data collection

Two primary tools were utilized for data collection:

- **Tool (1): Self-administered questionnaire:** This instrument was adapted and translated by the researcher following a literature review by **Wilson *et al.*** [11]. It comprised two parts: Part I collected socio-demographic data (e.g., age, gender & BMI). Part II contained five sections assessing knowledge and practice regarding healthy eating habits and physical activity. Scoring systems for practice (Nutritional habits and food safety/hygiene) generally assigned higher scores to healthier responses, categorizing practices as poor, moderate, or good based on percentage thresholds (e.g., < 50% poor, 50-75% moderate, > 75% good). Knowledge sections (Healthy/unhealthy food choices & physical activity) awarded scores (0 for incorrect, 1 for partially correct & 2 for fully accurate), with overall knowledge categorized similarly (Low/poor, moderate/sufficient & high/good).
- **Tool (2): The diet self-efficacy scale (DSES).** This 11-question instrument measured self-efficacy on a 5-point Likert scale (1 = "not at all confident" & to 5 = "very confident"), evaluating three factors: High-calorie food temptations, social and internal factors, and negative emotional events [36].
- **Tools validity and reliability:** Tool validity was established through review and revision by three experts in family and community health nursing. Internal reliability was assessed using Cronbach's alpha coefficient, yielding a value of 0.840 for the questionnaire.

Pilot study: A pilot study involving 14 randomly selected students (10% of the prospective population) was conducted in October 2023 to evaluate the research plan and instrument clarity. These students were subsequently excluded from the main study.

Field of work

- **Approvals:** Formal letters from Suez Canal University's Faculty of Nursing secured permissions from relevant authorities, including CAPMAS, the directorate of education and school managers.
- **Data collection:** Data were collected from early October 2023 to late April 2024.

Implementation phase: This phase encompassed four stages: assessment, planning, implementation, and evaluation.

- **Assessment phase (Pre-test):** Beginning in October 2023, baseline data on knowledge and practices were collected from 136 first-grade secondary students over four weeks, with 80-minute sessions per school. Questionnaires took approximately 30 minutes to complete, and BMI measurements about 40 minutes per group.
- **Planning phase:** The intervention program was developed based on student needs and literature, then rigorously validated by academic supervisors. A comprehensive program booklet and supplementary pamphlets were created for distribution to school managers and students, serving as educational references.
- **Implementing phase:** From November 2023 to March 2024, 29 sessions (80 minutes each) were conducted across the schools. Implementation involved coordinating with physical education teachers for

practical activity sessions (8:00-9:20 AM), followed by theory sessions (9:20-10:40 AM) utilizing lectures, discussions, presentations, and role-play. Student engagement was encouraged through reinforcement, such as gifts for active participation. Each session concluded with a summary and Q & A.

- **Evaluation phase (Post-test):** This phase commenced in early April 2024, approximately three months post-program initiation, to assess improvements in students' knowledge and practices concerning healthy eating habits and physical activity.

Ethical consideration: The investigation underwent rigorous ethical scrutiny and received the approval from The Research Ethics Committee (REC) of the Faculty of Nursing, Suez Canal University, designated under approval number 150. Subsequently, formal written authorization was secured from the administrators of the participating schools, following a comprehensive explanation of the study's objectives and methodological nature. Furthermore, the explicit aim of the study was clearly communicated to all student participants to foster their understanding of the importance of their involvement. They were concurrently assured that all collected information would be maintained with strict confidentiality, utilized exclusively for research purposes, and that their right to refuse participation or withdraw from the study at any point in time would be fully respected. The study adhered to the Helsinki Declaration throughout its execution.

Statistical methods

All collected data were meticulously tabulated and subsequently subjected to rigorous statistical analysis. The primary software utilized for statistical computations was SPSS (version 25), while Microsoft Office Excel was additionally employed for efficient data handling and the generation of graphical representations. Quantitative variables within the dataset were comprehensively described using their respective mean and standard deviation (SD). For inferential analyses, the level of statistical significance was predefined at $P \leq 0.05$, denoted as (S). A heightened level of significance, classified as highly significant (S), was established at $P \leq 0.01$. These thresholds were consistently applied to test the significance of results pertaining to qualitative variables.

RESULTS

Table (1) Showed the mean age of the studied adolescent 15.73 ± 0.42 years and 55.1% of them were females, while 52.2% of the studied adolescent lived in urban areas and 56.6% of their family income was enough. 63.2% of the studied adolescent falling within the normal BMI range (18 to < 25), pre intervention while 71.3 % post intervention fall within normal range.

Table (1): Socio- demographic characteristics of the Studied adolescents (n=136)

Items			**N**	**%**
Age (Years)				
Mean ±SD			15.73 ± 0.42	
Gender				
Male			61	44.9
Female			75	55.1
Residential State				
Rural			65	47.8
Urban			71	52.2
Family Income				
Enough			**77**	**57**
Not enough			44	32.3
Enough and saving			15	11
BMI	**Pre**		**Post**	
	N	%	N	%
<18	4	3	2	1.4
18:<25	86	**63.2**	97	**71.3**
25:<30	32	23.6	29	21.3
30:<35	14	10.2	8	6

Table (2) demonstrated a statistically significant ($p < 0.001$*) difference between the examined adolescents' knowledge of healthy and unhealthy dietary habits before and after the intervention. However, there was no statistically significant change between the observed adolescents' knowledge of the healthiest eating behavior before and after the intervention.

Table (2): Percentage distribution of the studied adolescent knowledge regarding healthy and unhealthy dietary habits (n=136)

Items	Pre		Post		Test (Friedma	p-value
	N.	%	N.	%		
1. A healthy diet is						
A diet rich in different foods	36	26.4	112	82.3	X^2 18.33	**<0.001***
Foods rich in protein (meat, fish, eggs, cheese, dried legumes)	59	43.4	16	11.8		
A diet without any fats	22	16.2	6	4.4		
Eating fish very often	19	14	2	1.5		
2. The healthiest eating behavior such as						
Drinking two glasses of milk/eating two cups o yogurt every day	41	30.1	32	23.5	X^2 2.14	0.172
Preferring cooked vegetables to uncooked vegetables	33	24.3	84	61.8		
Eating always cheese instead of meat	30	22.1	16	11.8		
When you eat snacks, preferring fruit/fruit juice/biscuits and crackers	32	23.5	4	2.9		
3. A Healthy Food is						
A food rich in protein	44	32.4	5	3.7	X^2 81.31	**<0.001**
A food rich in calories	43	31.6	4	2.9		
A microbiologically tested food	23	16.9	14	10.3		
A food without preservatives and additives	26	19.1	113	83.1		
4. The healthiest food such as						
Washed vegetables ready to eat	17	12.5	111	81.6	X^2 60.83	**<0.001***
A canned food	48	35.3	10	7.4		
A food very rich in dressing	14	10.3	6	4.4		
A fried food	57	41.9	9	6.6		
5. The healthiest cooking method is						
Cooking on a grill/in boiled water	34	25	106	77.9	X^2 46.43	**<0.001***
Frying/braising	31	22.8	11	8.1		
Cooking in the oven without fats	33	24.2	6	4.4		
Cooking in a pan with fats	38	28	13	9.6		
Total level of knowledge pre	***Low:44.9 %**		***Moderate :39.0 %**		***High :16.2**	
Total level of knowledge post	***Low:16.3 %**		***Moderate :17.6 %**		***High :82.4%**	

X^2: was chi-square test, **MC:** Montecarlo chi-square test; **P** value was significant ≤ .05

Table (3) showed that there was statistically significant (p<0.001*) difference between the studied adolescent food safety and hygiene practices post intervention compared to the pre-intervention about check the expiry date, reading package instructions, consistently washing hands before eating and handling foods, washing fruit that should not be peeled before consumption and milk consumption practices.

Table (3): Percentage distribution of the studied adolescent regarding food safety hygiene practices (n=136)

Items	Pre		Post		Test (Friedman)	P value
	N.	%	N.	%		
1. Number of times you Check the expiry date when you buy packaged food						
Always	7	5.1	119	87.5	X^2 106.31	**<0.001***
Often	22	16.2	2	1.5		
Sometimes	45	33.1	10	7.4		
Never	62	45.6	5	3.6		
2. Number of times you read the instruction for use and for preservation written on the packaged foods						
Always	12	8.8	106	78	X^2 81.39	**<0.001***
Often	13	9.6	4	2.9		
Sometimes	57	41.9	14	10.3		
Never	54	39.7	12	8.8		
3. Wash your hands before eating and before touching foods						
Always	69	50.7	112	82.4	X^2 29.35	**<0.001***
Often	10	7.4	3	2.2		
Sometimes	51	37.5	17	12.5		
Never	6	4.4	4	2.9		
4. Wash fruit that must not be peeled before eating it						
Always	47	34.6	100	73.5	X^2 34.68	**<0.001***
Often	31	22.8	6	4.4		
Sometimes	19	14.0	12	8.8		
Never	39	28.7	18	13.2		
5. After drinking a glass of milk, put the milk in the fridge						
Always	55	40.4	112	82.4	X^2 32.98	**<0.001***
Often	31	22.8	7	5.1		
Sometimes	15	11.0	9	6.6		
Never	35	25.7	8	5.9		
6. Left the milk out of the fridge during night, you do						
You throw it away	11	8.1	50	36.8	X^2 98.00	**<0.001***
You tell your mother to throw it away	16	11.8	64	47.0		
You put it in the fridge again	65	47.7	9	6.6		
You drink it	44	32.4	13	9.6		

X^2: Chi-square test, **P** value was significant ≤ 0.05.

Table (4) showed that there was a statistically significant ($p < 0.001$*) difference between the studied adolescents' post-intervention compared to pre-intervention regarding knowledge about physical activity and lifestyle.

Table (4): Percentage distribution of the studied adolescent regarding knowledge about physical activity and life style (n=136)

Items	Pre		Post		Test	p- value
	N.	%	N.	%	(Friedman)	
1. Mean of physical activity is						
means any physical activity	77	56.6	8	5.9	$X^2$106	**<0.001*** **mc**
Planned, structured and repetitive physical activity	18	13.2	68	50.0		
means jogging once in a while	12	8.9	3	2.2		
Means watching games	7	5.1	2	1.5		
physical activity Involves jogging, brisk walking, swimming and spots	22	16.2	55	40.4		
2. Physical activity appropriate for						
Young individuals	69	50.7	11	8.1	X^2 19.06	**<0.001*** **mc**
Elderly people	12	8.8	3	2.2		
Both young and elderly people	28	20.6	122	89.7		
I don't know	27	19.9	0	0		
3. Benefit of physical activity for adolescents is						
build strong bones and muscles	70	51.5	13	9.6	X^2 28.25	**<0.001*** **mc**
Improved academic performance	27	19.8	9	6.6		
leads to a lower risk of diseases	22	16.2	7	5.1		
All the above	17	12.5	107	78.7		
4. Moderate aerobic physical activity recommendation per week is:						
2 hr. per day 3 days per week	11	8	2	1.5	X^2 086.52	**<0.770*** **mc**
2-4 per day 3 days per week	13	9.6	4	2.9		
30 min per day 5 days per week	8	5.9	0	0		
30 min per day 7 days per week	22	16.2	9	6.7		
60 min per day 7 days per week	27	19.9	117	86		
I don't know	55	40.4	4	2.9		
5. Muscular fitness recommendation per week is:						
1-2 times per week	30	22	9	6.6	X^2 32.00	**<0.001*** **mc**
3 times per wee	29	21.3	116	85.3		
4 -5 times per week or more	27	19.9	5	3.7		
I don't know	50	36.8	6	4.4		
6. The appropriate time for practice physical activity is						
Always (every day)	47	34.6	111	81.6	X^2 83.00	**<0.001*mc**
Only in some seasons	22	16.1	8	5.9		
Sometimes	28	20.6	10	7.4		
Never	39	28.7	7	5.1		
7. The primary reason to do not participate in sufficient physical activity are						
Lack of access to sports facilities	70	51.5	13	9.6	X^2 28.25	**<0.001*** **mc**
Lack of interest or motivation	27	19.9	9	6.6		
pressure from academics	22	16.1	7	5.1		
All of the above	17	12.5	107	78.7		

X^2: Chi-square test, **MC:** Montecarlo chi-square test; **P** value was significant ≤ 0.05

Table (5) illustrated that there was a statistically significant ($p < 0.001$*) difference between the studied adolescents' mean scores of reported diet self-efficacy (pre/post) implementation of the program. Total diet self-efficacy increased significantly from 24.03 to 35.87 ($t=10.32$, $p < 0.001$*) with a large effect size ($d=0.885$).

Table (5): Difference between the studied adolescent diet self-efficacy dimensions pre- and post- intervention (n=136)

Items	Pre		Post		t test	P value	Effect size (d)
	Mean	SD	Mean	SD			
1. Factor 1: High-Caloric Food	6.51	3.66	13.19	1.4	21.49	<.001*	1.84
1. Factor 2: Social and Internal Factors	12.9	7.75	13.81	1.5	1.43	0.156	0.122
2. Factor 3: Negative Emotional Events	4.63	3.14	8.86	1.7	16.26	<.001*	1.39
Total	24.03	14.28	35.87	2.94	10.32	<.001*	0.885

t: Paired sample t test ***:** Statistically significant at $p \leq 0.05$; d is Cohen's effect size.

Table (6) clarified that there were statistically significant relation between students' gender, father education, mother occupation, mother education residential state, family income and their total level of the studied adolescents' knowledge regarding healthy and unhealthy dietary habits and food throughout the program. While, there was no statistically significant relation between BMI, age and father occupation totals level of the studied adolescents' knowledge regarding healthy and unhealthy dietary habits and food.

Table (6): Relation between socio- demographic characteristics, and total level of the studied adolescent knowledge regarding healthy and unhealthy dietary habits and food (Pre, and post-intervention) (n=136)

Items	Total level of the studied adolescent knowledge regarding healthy and unhealthy dietary habits and food							
	Pre				Post			
	Mean	SD	F	p-value	Mean	SD	F Test	p-value
Age	1.71	.729	.817	.664	2.66	.742	1.34	.180
Gender								
Male	2.22	.668	93.32	.000	3.00	.001	27.44	.000
Female	1.29	458			2.38	.913		
Residential State								
Rural	2.12	.718			3.0	.001	31.70	.000
Urban	1.33	.505	55.05	.000	2.35	.927		
Family Income								
Enough	2.039	.733			2.79	.614		
Not enough	1.31	.471	23.9	.000	2.81	.540		
Enough and saving	1.2	.729			1.53	.915	26.98	.000
BMI								
<18	1.5	.707			2.00	1.41		
18:<25	1.71	.726			2.69	.716		
25:<30			.060	.981	2.66	.725	.697	.555
30:<35					2.53	.732		

F: One-way ANOVA, P value is significant ≤ 0.05

Table (7) clarified that, there were statistically significant relation between student gender, family income and total level of the studied adolescent reported practice regarding food safety and hygiene throughout the program. While, there was no statistically significant relation between BMI, age, and total level of the studied adolescent reported practice regarding food safety and hygiene.

**Table (7): ** Relation between socio-demographic characteristics, and total level of the studied adolescent reported practice regarding food safety and hygiene (Pre, and post intervention) (n=136)

Items	Total level of the studied adolescent reported practice regarding food safety and hygiene							
	Pre				Post			
	Mean	SD	F Test	p-value	Mean	SD	F Test	p-value
Age	1.77	0.740	1.32	0.194	2.82	.419	0.868	0.607
Gender								
Male	2.40	0.495	208.3	0.000	2.67	.539	16.00	0.000
Female	1.25	0.437			2.94	.226		
Residential State								
Rural	2.20	0.733	59.75	0.000	2.69	.528	13.28	0.000
Urban	1.38	0.488			2.94	.232		
Family Income								
Enough	2.22	0.620	62.65	0.000	2.70	.514	8.52	0.000
Not enough	1.15	0.369			3.00	.000		
nough and saving	1.26	0.457			2.93	.258		
BMI								
<18	1.50	0.707	1.84	0.142	3.00	.000	0.808	0.491
18:<25	1.87	0.770			2.78	.466		
25:<30	1.64	0.660			2.87	.331		
30:<35	1.46	0.639			2.92	.277		

F: One-way ANOVA, P value is significant ≤ 0.05

Table (8) clarified that there were statistically significant relation between student gender, and total diet self-efficacy of the studied adolescents after implementation the program. While, there was no statistically significant relation between age, residential state, family income, BMI and total diet self-efficacy of the studied adolescents throughout the program.

**Table (8): ** Relation between socio- demographic characteristics, and total diet self-efficacy of the studied adolescent (Pre, and post intervention) (n=136).

Items	Total diet self-efficacy of the studied adolescent							
	Pre				Post			
	Mean	SD	F Test	p-value	Mean	SD	F Test	p-value
	.192	.552	.251	.025	.13	.572	.440	.884
Gender								
Male	22.19	11.58	1.51	.132	35.32	2.94	2.19	0.031
Female	25.88	16.43			36.41	2.87		
Residential State								
Rural	23.94	12.26	.077	.924	36.29	2.40	1.62	.108
Urban	24.13	16.00			35.48	3.33		
Family Income								
Enough	23.91	14.97	.079	.924	36.08	2.83	1.69	.189
Not enough	24.00	11.96			34.94	3.75		
nough and saving	26.14	7.34			34.71	2.06		
BMI								
<18	28.67	12.01	1.34	.265	33.33	1.53	1.48	.224
18:<25	24.95	13.89			35.65	3.09		
25:<30	24.28	15.40			36.44	2.78		
30:<35	17.33	13.87			36.40	2.32		

F: One-way ANOVA P value is significant ≤ 0.05

Table (9) showed that there were statistically significant relation between students' gender, family income and total level of the studied adolescents' knowledge regarding physical activity and life style throughout the program. While there was no statistically significant relation between age, residential state, BMI and total level of the studied adolescents' knowledge regarding physical activity and life style after implementation the program.

Table (9): Relation between socio- demographic characteristics, and total level of the studied adolescent knowledge regarding physical activity and life style (n=136).

Items	Total level of the studied adolescent knowledge regarding physical activity and life style							
	Pre				Post			
	Mean	SD	F Test	p-value	Mean	SD	F Test	p-value
Age	1.48	.632	1.52	.101	2.54	.619	1.25	.239
Gender							5.37	.022
Male	1.81	.694	39.83	.000	2.40	.738		
Female	1.21	.632			2.65	.479		
Residential State								
Rural	1.69	.727	14.70	.000	2.44	.729		
Urban	1.29	.459			2.63	.485	3.168	.077
Family Income								
Enough	1.71	.685	26.36	.000	2.42	.696	8.82	.000
Not enough	1.00	.000			2.84	.369		
Enough and saving	1.73	.457			2.26	.457		
BMI								
<18	1.00	.000	.681	.565	2.50	.707	1.16	.325
18:<25	1.50	.678			2.47	.660		
25:<30	1.41	.564			2.63	.548		
30:<35	1.60	.507			2.76	.438		

F: One-way Anova P value is significant <0.05

Table (10) showed that there was a statistically significant relation between students' gender, family income and total level of studied adolescents' reported practice regarding physical activity of the past 7 days. While, there was no statistically significant relation between age, residential state, BMI and total level of studied adolescents' reported practice regarding physical activity of the past 7 days throughout the program**.**

Table (10): Relation between socio- demographic characteristics, and total level of studied adolescent reported practice regarding physical activity of the past 7 days (Pre, and post intervention) (n=136)

Items	Total level of studied adolescent reported practice regarding physical activity of the past 7 days:							
	Pre				Post			
	Mean	SD	F Test	p-value	Mean	SD	F Test	p-value
Age	1.27	0.446	0.607	0.873	1.82	0.382	.649	.838
Gender							28.28	.000
Male	1.49	.504	33.14	0.000	2.000	0.0000		
Female	1.093	.292			1.82	0.469		
Residential State							2.53	.114
Rural	1.30	.465	.791	.375	1.76	0.424		
Urban	1.23	.429			1.87	0.335		
Family Income								
Enough	1.40	.493	14.47	.000	1.92	0.269	14.78	0.000
Not enough	1.00	.000			1.59	0.497		
Enough and saving	1.40	.507			2.00	0.000		
BMI								
<18	1.50	.707	.373	.772	2.000	0.000	2.007	.116
18:<25	1.27	.447			1.87	0.332		
25:<30	1.22	.425			1.69	0.466		
30:<35	1.33	.487			1.76	0.438		

F is one-way Anova P value is significant <0.05

DISCUSSION

The present study revealed that the majority of adolescents had a mean age of 15.73 ± 0.42 years, with over half being female, residing in urban areas, and reporting sufficient family income. Two-thirds exhibited a normal BMI pre-intervention, which is aligning with **Dalky *et al.*** [12] regarding age (14-16 years) and **Anton-Păduraru *et al.*** [13] on urban residence and normal BMI (< 75% of students). Conversely, this contrasts with **Petrova *et al.*** [14], who observed a male majority. The finding on family income concur with **El Mokadem & Shokr** [15] in Egypt.

Post-program implementation, nutritional habits among adolescents significantly improved. This finding aligns with **Elseifi *et al.*** [16] regarding positive changes in nutritional habits post-intervention. Further support comes from **Bhandari *et al.*** [17] noting increased healthy eating intention or improved dietary patterns after interventions. **Azrin Shah *et al.*** [18] also reported an increased mean practice score for healthy diets. These improvements likely stem from enhanced student awareness and the program's effectiveness in modifying dietary habits.

A statistically significant increase ($p<0.001*$) in adolescent knowledge regarding healthy and unhealthy dietary habits was observed post-intervention. This aligns with **Bhandari *et al.*** [17] indicating improved knowledge after educational interventions and improvement in diet guideline scores. However, **Fetohy *et al.*** [19] reported no knowledge change, possibly due to the timing of reassessment. The notable increase in knowledge scores suggests the intervention effectively educated adolescents on dietary habits.

Food safety and hygiene practices also demonstrated a statistically significant improvement ($p<0.001*$) post-intervention. This finding is consistent with **Abdelsalam *et al.*** [20], who both reported post-intervention improvements in food handling knowledge and practices. Enhanced knowledge and practices in this area are crucial for preventing health risks associated with unsafe food handling.

Adolescents' knowledge concerning physical activity improved significantly post-program implementation. This result is in agreement with **Vaishali *et al.*** [21] who observed significant increases in physical activity scores, and **Mattson *et al.*** [22] who noted increased physical activity knowledge. In contrast, **Castilho dos Santos *et al.*** [23] found no significant differences in total physical activity.

The reported physical activity practices over the preceding seven days also improved post-intervention. This aligns with **Bahathig *et al.*** [24] reporting increased physical activity or improved practice scores after interventions. **Elfaki *et al.*** [25] also noted changes in student physical activity practices. **Ardiansyah *et al.*** [26] further supports this with findings of increased moderate-to-vigorous physical activity and effective online interventions, respectively. However, **Castilho dos Santos *et al.*** [23] again reported no significant differences in total physical activity.

The present study revealed a difference in participants' dietary self-efficacy post-intervention, consistent with **Mokadem and Shokr** [27] both reporting significant differences in self-efficacy scores following interventions. Statistically significant relationships were observed between student gender and their knowledge of healthy/unhealthy dietary habits and food safety, consistent with **Angesti *et al.*** [28]. Understanding these gender differences can inform tailored educational approaches.

No statistically significant relationship was found between BMI and adolescents' knowledge of healthy/unhealthy dietary habits, consistent with **Elfaki *et al.*** [25]. This suggests other factors, such as lifestyle or psychological elements, may more strongly influence BMI.

A statistically significant relationship was identified between student family income and knowledge/reported practice regarding food safety and hygiene, aligning with **Mirzaei *et al.*** [29]. However, this contrasts with **Aluh *et al.*** [30] who found no significant relationship with family income.

Furthermore, a statistically significant relationship was found between gender and total diet self-efficacy post-intervention, which is consistent with **Efthymiou *et al.*** [31] who noted higher changes in diet self-efficacy among females. No significant relationship was found between BMI and diet self-efficacy, which is in line with **You *et al.*** [32] suggesting BMI is influenced by multiple factors beyond self-efficacy.

Finally, statistically significant relationships were observed between student gender, family income, mother's education, and reported physical activity practice, which is aligning with **Lee and Lim** [33], **Scholes and Mindell** [34] and **Putri and Tahlil** [35]. However, **Putri and Tahlil** [35] also reported no significant relationship with parental income, gender, or residential state in another context. The correlation between family income and physical activity likely reflects greater access to resources in higher-income households.

CONCLUSION

Based on the findings and research hypothesis of the current study, it was concluded that there was a statistically significant ($p < 0.001$) difference between the studied adolescents' mean scores of knowledge and practice regarding healthy eating habits and physical activity, while the diet intervention program was effective in improving knowledge and practice among the studied adolescents after implementing the program.

RECOMMENDATIONS

- Distribution of educational booklets about healthy eating habits and physical activity among adolescents.

- Replication of the program in other schools to improve students' knowledge and practices related to healthy eating habits.
  - Education of adolescents about the importance of physical activity through social media.

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