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Effectiveness of a nutrition and physical activity intervention among adolescent

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ABSTRACT

Unhealthy food intake, physical inactivity, and body image (BI) dissatisfaction could potentially lead to obesity and health problems. This cluster-randomized intervention study aimed to investigate the effectiveness of a nutrition and physical activity (PA) intervention on related knowledge, attitudes, and practices among Saudi adolescent girls (aged 13–14) living in Arar City. One hundred thirty-eight girls were selected and recruited randomly from two schools. The respondents in the intervention group (IG; n=68) received a three-month intervention program that consisted of six 90-minute sessions. The participants in the control group (CG; n=70) received only their traditional education and did not receive the intervention program. The groups' total pre-test scores for practices were significantly different; therefore, the pre-test scores were used as covariates. The IG demonstrated significant improvements in knowledge, attitudes, and practices ($p<0.001$ for all), and improvement in the IG was greater than that in the CG at the post-test and three-month follow-up time points ($p<0.001$ for both). These findings provide evidence of the significant influence of a nutrition, PA, and positive BI intervention on related knowledge, attitudes, and practices among Saudi adolescent girls.

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1. INTRODUCTION

Adolescence, the transition from childhood to adulthood, is a time of changes in an individual's body, thoughts, psyche, knowledge, and emotions [1]. Adolescents represent 1.2 billion individuals worldwide; 88% live in developing regions, including the Arab world. Saudi Arabia has a population of 33 million, with 14.5% classified as adolescents [2]. Countries of varying economic levels, including Middle Eastern countries, have faced the overweight and obesity problem in the last 30 years [3]. In the Eastern Mediterranean region, children and adolescents from ages 5 to 19 consume high levels of fats and sugary drinks and inadequate levels of fruits and vegetables. Their diets are low in nutrients and high in energy [4].

The prevalence of childhood obesity is increasing in Arab countries, including Saudi Arabia, and over 1 million children and adolescents could be obese by 2030 [5]. According to a nationwide study of 12,575 adolescents across all 13 regions of Saudi Arabia, 30% were overweight or obese; among adolescents, only 54.3% consumed fruits or vegetables daily [6]. In recent decades, Saudi Arabia's population has experienced a nutritional transition. Traditional food has given way to fast food, which is often poor in nutrients and high in energy [7]. The consumption of unhealthy foods has increased by at least three times

per week among females [7]. Moreover, Saudis' lifestyles have changed, affecting physical activity (PA) levels among children and adults [8]. A national cross-sectional study reported that 59.3% of Saudi adolescents were not practicing PA [6]. Among Saudi girls, older respondents are less active than younger ones [8]. Furthermore, almost 87% of Saudi adolescents are unhappy with their body image (BI) [9].

A lack of knowledge has led to poor diet and PA practice [10]. Unfortunately, adolescents do not have sufficient knowledge about nutrition and are unaware that they are making unhealthy selections [7]. Obesity can cause noncommunicable and psychological diseases [1]. However, more than one third of Saudi adolescents surveyed by AlBuhairan *et al*. [6] did not understand the complications of obesity. There is no curriculum regarding nutrition, PA, or BI in Saudi girls' schools (Ministry of Education KSA, 2021). Thus, BI concepts should be included in healthy lifestyle interventions for female students [11]. Education programs in schools are effective; schools provide classrooms and facilities, and teachers are available to conduct sessions for participating students [12]. The present study aimed to investigate the effectiveness of a nutrition and PA intervention on related knowledge, attitudes, and practices among Saudi adolescent girls aged 13–14 living in Arar City.

2. METHOD

2.1. Participants

Consolidated standards of reporting trials guidelines for cluster-randomized controlled trials. Data collection was performed in Arar City at the beginning and end of the three-month study period and the three-month follow-up (January to June 2020) in public schools among female intermediate-level students. The schools were selected and assigned at random. The first school included the intervention group (IG). The control group (CG), in the second school, did not receive the sessions but received all intervention materials after the study was completed. Only Saudi adolescents (13–14 years old) who submitted consent forms to participate were recruited for this study. Adolescents who were under treatment or not permitted to perform PA were excluded. The data collection took place at three time points: pre-test, post-test, and three-month follow-up.

The sample size was calculated based on the mean differences scores [13]. The mean nutrition knowledge changes for the IG and CG were taken from Harake *et al.* [12]. The result was multiplied by 2; this resulted in 68 respondents. An additional 15% was added for group out [14]. Thus, 80 respondents were needed in each group for this study.

2.2. Data gathering procedure

This intervention study was conducted in accordance with the declaration of Helsinki. Ethical approval was obtained prior to initiation (2019). The procedures were as per ethical standards of the ethics committee for research involving human subjects (JKEUPM [reference number: UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM)], Selangor, Malaysia; the local committee of bio-ethics (HAP-09-A-043 [reference number: (13/40/H)], and the Ministry of Education in Arar City, Saudi Arabia. Prior to data collection, consent forms were collected from the respondents and their parents. All respondents' information was kept confidential, and they were informed about the aim of this study.

This knowledge, attitude, and practice (KAP) intervention was developed to increase adolescents' knowledge about, attitudes toward, and practices related to healthy eating, PA, and BI. Increased knowledge can encourage adolescents to develop the skills and attitudes necessary to practice healthy lifestyle habits. The KAP intervention was applied after the study population's needs were determined based on a prior cross-sectional study [15] and previous interventions [12], [16]–[18]. The intervention was implemented following the advice of six experts from the medicine, applied medical sciences, and nutrition and food science areas, Arar, Saudi Arabia.

The intervention was developed based on social cognitive theory (SCT), which is effective among school students. This theory focuses on learning from others to acquire a new skill. The seminar for the mothers of the girls in the IG was intended to help the participants encourage and apply the behaviors they learned in that session [19]. In previous interventions, SCT helped adolescent respondents to change their lifestyle behaviors with respect to nutrition and PA [17]. Therefore, SCT played a significant role in the success of this KAP intervention.

The face-to-face intervention began with a 60-minute seminar for the mothers of the girls in the IG. The seminar promoted healthy eating, PA, and BI acceptance. In the following weeks, the respondents in the IG received the six intervention sessions (90 minutes per session, once every two weeks, over three months). The sessions included the topics of nutrition (Saudi guide pyramid, serving size of food groups, food labels, healthy food, unhealthy habits, body weight status, obesity and type 2 diabetes, main meals, changing unhealthy lifestyles to healthy habits), PA (importance, benefits, physical inactivity problems, sedentary behaviors, recommendations), and BI (description, positive BI, the disadvantages of dissatisfaction with BI,

recommendations). Educational support materials were used for each topic, and activities related to each topic were included (e.g., booklets, PowerPoint presentations, flashcards, and games).

The KAP levels were assessed at pre-test, post-test, and follow-up to evaluate the effect of the current intervention. The KAP questionnaire focused on nutrition, PA, and BI concepts. All items were reviewed by a panel of six specialists in clinical nutrition and nutrition sciences. The questionnaire was pilot tested among 30 girls between the ages of 13 and 14 years from Arar, selected at random, to ensure clarity and relevance. The KAP questionnaire consisted of 72 items adapted from previous studies and a preliminary study to determine the needs. The questionnaire contained 29 multiple-choice knowledge items, scored one for the correct answer and zero for incorrect answers; 22 attitude items with five response choices each, scored from five points for a positive attitude to one point for a negative attitude; and 21 practice items with five response choices each, scored five points for positive practices to one point for negative practices. Higher scores reflected more positive knowledge, attitudes, and practices. Cronbach's alpha coefficient indicated the internal consistency of the items as follows: knowledge, 0.88–0.92; attitudes, 0.90–0.96; and practices, 0.94–0.95. The test-retest reliability indicators were kappa=0.76–1 for knowledge, ICC=0.68–1 for attitude, and ICC=0.77–1 for practice. This indicated that the KAP questionnaire was valid among the study population.

2.3. Statistical analysis

All data were analyzed using SPSS software, version 25 (IBM, Chicago, IL, USA). Continuous variables were described as means and standard deviations (SD); categorical variables were described as percentages and frequencies. The significance level was set at <0.05. Over the three time points of this KAP intervention study, a generalized estimating equation (GEE) test was used to determine the significant changes within and between the groups with respect to knowledge, attitudes, and practices. The effect of the (group×time) interaction was determined to assess the effect of the intervention. For each group, the mean change was determined using the post-hoc Bonferroni test to compare the mean differences. The chi-square test was used to determine associations between categorical variables.

3. RESULTS

A total of 261 primary healthcare workers completed the questionnaire and the response rate for this study The IG and CG had response rates of 94.7% (n=72) and 93.5% (n=73), respectively, at the post-test time point, and 89.4% (n=68) and 89.7% (n=70) of the respondents completed follow-up, respectively. The dropout rates in each group were acceptable (approximately 10.3%); dropouts occurred due to inability to complete the study or individuals leaving the city. To ensure homogeneity across demographic variables, the IG and CG descriptive statistics were compared using independent Chi-squared tests and the Mann-Whitney U test at the pre-test time point. No significant difference was found between the groups for any socio-demographic variable except monthly income and number of siblings (Table 1).

Table 1. Socio-demographic variables in both groups

Variables		IG (n=68) Median (IQR)	CG (n=70) Median (IQR)	Z/χ2	p-value
Age		13 (1)	13 (1)	-0.493[a]	0.622
No of siblings		5 (14)	6 (2)	-2.009[a]	0.045*
No household		8 (12)	9 (2)	-0.746[a]	0.456
Monthly income (SAR)		3[c] (2)	2[d] (1)	2.778[a]	0.005*
		n) %)	**n) %)**		
Mother's education	Intermediate or lower	11 (14.5)	21 (26.9)	4.306[b]	0.116
	High school	13 (17.1)	15 (19.2)		
	Undergraduate degree or higher	52 (68.4)	42 (53.8)		
Father's education	Intermediate or lower	5 (6.6)	9 (11.5)	2.657[b]	0.265
	High school	17 (22.4)	23 (29.5)		
	Undergraduate degree or higher	54 (71.1)	46 (59)		

Interquartile range (IQR); (a) U Mann Whitney test (z); (b) Chi-square test (χ2); (*) significant at p<0.05; (c) ≥15,000; (d); 5,000-14,999; Saudi Riyal (SAR) 3.75=1 USD

The GEE test was applied to determine the effectiveness of the intervention on KAP. The difference between the scores for practice at pre-test between the IG and the CG was significant; thus, these scores were considered covariates. Table 2 shows the mean score development of KAP for each group across time

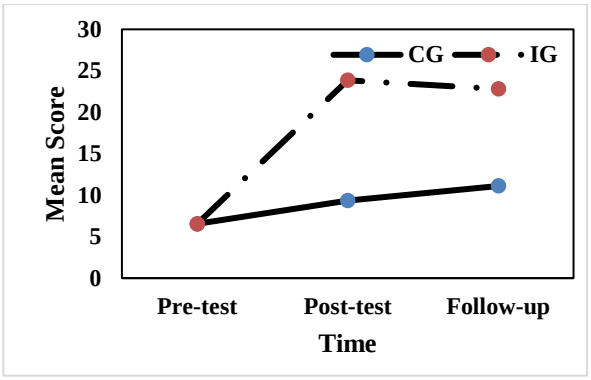
For the IG, the mean (SD) score for knowledge increased from 6.49 (2.8) at pre-test to 22.76 (1.94) at follow-up. For attitude, the mean score increased from 32.68 (6.1) at pre-test to 84.01 (7.91) at follow-up. For practice, the score increased from 26.16 (4.84) at pre-test to 61.54 (4.46) at follow-up. For the CG, the mean scores for knowledge were 6.6 (1.91) at pre-test and 11.1 (2.09) at follow-up. For attitude, the scores

were 31.97 (6) at pre-test and 37.47 (4.46) at follow-up. For practice, the scores were 23.77 (2.78) at pre-test and 25.31 (3.09) at follow-up. According to these findings, the biggest change was observed among the individuals in the IG. As can be seen in Figure 1, the changes in these variables for both groups over time.

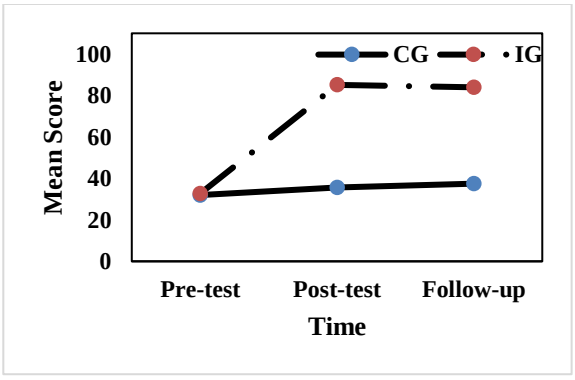
Table 2. KAP for both groups across the time

Group	Variables	Pre-test mean (SD)	Post-test mean (SD)	Follow-up mean (SD)
IG (n=68)	Knowledge	6.49 (2.8)	23.82 (1.65)	22.76 (1.94)
	Attitude	32.68 (6.1)	85.12 (7.71)	84.01 (7.91)
	Practice	26.16 (4.84)	62.68 (4.39)	61.54 (4.46)
CG (n=70)	Knowledge	6.6 (1.91)	9.44 (2.1)	11.1 (2.09)
	Attitude	31.97 (6)	35.62 (4.91)	37.47 (4.46)
	Practice	23.77 (2.78)	24.49 (3.02)	25.31 (3.09)

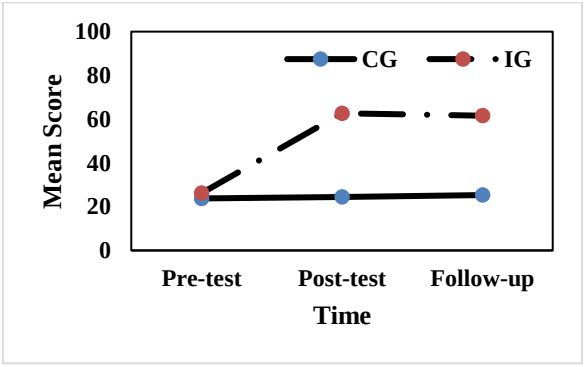
Standard deviation (SD)



The level of knowledge



The level of attitude



The level of practice

Figure 1. The level of KAP for the two groups over the study periods

The GEE results (Table 3) showed that the time had a significant effect on the participants' knowledge and attitudes. The pre-test scores for practices were considered covariates. There were significant differences over time with regard to knowledge (χ^2=2742.467, p<0.001), attitudes (χ^2=1709.871, p<0.001), and practices (χ^2=3216.142, p<0.001). There were significant differences based on the effect of group for knowledge (χ^2=969.015, p<0.001), attitudes (χ^2=1601.141, p<0.001), and practices (χ^2=1925.596, p<0.001). Finally, the time*group interactions over the three time points for knowledge, attitudes, and practices were (χ^2=1396.75, p<0.001), (χ^2=1284.936, p<0.001), and (χ^2=1795.919, p<0.001), respectively. Therefore, the two groups did not share same trends during the study period.

Table 4 illustrates the effects of the intervention within the IG and the CG. Both groups demonstrated significant changes in knowledge, attitudes, and practices throughout the study. The change in each group was identified using a post-hoc Bonferroni test. Initially, the differences for knowledge between the two groups across the three time points were statistically significant (p<0.001 for all). Moreover, the differences between the groups for attitudes across the three time points were significant (p<0.001 for all). In the IG, the differences for practice at all three time points were significant (p<0.001). A significant change

was reported among the CG from pre-test to follow-up (p<0.001). However, based on Cohen's (2013) work, the effect size during the study time for knowledge in the IG (d=6.75) was greater than that in the CG (d=2.25). For attitudes, that in the IG (d=7.27) was seven times greater than that in the CG (d=1.04). For practices, that in the IG (d=7.60) was larger than that in the CG (d=0.52). Table 5 demonstrates the effect of this intervention on knowledge, attitudes, and practices between the IG and CG based on the Bonferroni test at the three time points. There was no significant difference for knowledge (p=0.760) or attitudes (p=0.46) at pre-test.

Table 3. Results of GEE on KAP

Variables	Source	Wald chi-square	df	p-value
Knowledge	Time	2742.467*	2	<0.001
	Group	969.015*	1	<0.001
	Time*group	1396.75*	2	<0.001
Attitude	Time	1709.871*	2	<0.001
	Group	1601.141*	1	<0.001
	Time*group	1284.936*	2	<0.001
Practice[a]	Time	3216.142*	2	<0.001
	Group	1925.596*	1	<0.001
	Time*group	1795.919*	2	<0.001
	Practise_pre-test	44.44*	1	<0.001

Degree of freedom (df); (*) significant at p<0.05; (a) pre-test score considered as a covariate

Table 4. Pairwise comparison of KAP mean score across time for both groups

Variables	Group	(I) test	(C) test	Mean difference (I-C)	SE	*P*-value	95% CI for difference LB	UB	*d*
Knowledge	IG (n=68)	Pre-test	Post-test	-17.33*	0.32	<0.001	-18.17	-16.50	6.75
		Pre-test	Follow-up	-16.27*	0.35	<0.001	-17.16	-15.40	
		Post-test	Follow-up	1.05*	0.16	<0.001	0.70	1.41	
	CG (n=70)	Pre-test	Post-test	-2.83*	0.22	<0.001	-3.49	-2.19	2.25
		Pre-test	Follow-up	-4.49*	0.24	<0.001	-5.19	-3.81	
		Post-test	Follow-up	-1.66*	0.17	<0.001	-2.14	-1.19	
Attitude	IG (n=68)	Pre-test	Post-test	-52.44*	1.27	<0.001	-55.91	-48.97	7.27
		Pre-test	Follow-up	-51.33*	1.29	<0.001	-54.79	-47.87	
		Post-test	Follow up	1.11*	0.25	<0.001	0.50	1.72	
	CG (n=70)	Pre-test	Post-test	-3.64*	0.52	<0.001	-5.01	-2.27	1.04
		Pre-test	Follow-up	-5.49*	0.52	<0.001	-7.01	-3.98	
		Post-test	Follow up	-1.85*	0.29	<0.001	-2.59	-1.12	
Practice[a]	IG (n=68)	Pre-test	Post-test	-36.42*	0.81	<0.001	-38.68	-34.17	7.60
		Pre-test	Follow-up	-35.20*	0.82	<0.001	-37.43	-32.97	
		Post-test	Follow up	1.22*	0.20	<0.001	0.69	1.76	
	CG (n=70)	Pre-test	Post-test	-0.66*	0.24	0.02	-1.25	-0.08	0.52
		Pre-test	Follow-up	-1.47*	0.28	<0.001	-2.22	-0.72	
		Post-test	Follow up	-0.81*	0.16	<0.001	-1.21	-0.40	

Standard error (SE); (*) significant at p<0.05; confidence interval (CI); lower bound (LB); upper bound (UB); Cohen effect size (d); adjusted mean difference (a)

Table 5. Pairwise comparison between both groups at 3 times for KAP

Variables	Test	IG	CG	Mean difference (IG-CG)	SE	*P*-value	95% CI for difference LB	UB	*d*
Knowledge	Pre-test	IG	CG	0.12	0.38	0.76	-0.64	0.87	0.05
	Post-test	IG	CG	-14.38*	0.31	<0.001	-15.25	-13.51	7.61
	Follow-up	IG	CG	-11.66*	0.34	<0.001	-12.56	-10.77	5.78
Attitude	Pre-test	IG	CG	-0.71	0.97	0.46	-2.61	1.19	0.12
	Post-test	IG	CG	-49.51*	1.07	<0.001	-52.57	-46.45	7.66
	Follow-up	IG	CG	-46.54*	1.09	<0.001	-49.57	-43.52	7.25
Practice[a]	Pre-test	IG	CG	-1.26*	0.46	0.02	-2.37	-0.15	0.61
	Post-test [a]	IG	CG	-37.02*	0.64	<0.001	-38.88	-35.16	10.14
	Follow-up [a]	IG	CG	-34.99*	0.67	<0.001	-36.86	-33.12	9.44

Standard error (SE); (*) significant at p<0.05; confidence interval (CI); lower bound (LB); upper bound (UB); Cohen effect size (d); IG: (n=68); CG: (n=70).

However, the differences for knowledge and attitudes at post-test and follow-up were statistically significant (p<0.001 for both). Furthermore, at pre-test, a significant difference was reported between the groups for practices (p=0.02). In contrast, considering the pre-test scores as covariates, the adjusted differences between the groups at post-test and follow-up were significant (p<0.001 for both). The effect size, based on Cohen's (2013) work, for knowledge between the groups was large at post-test (*d*=7.61), medium at

follow-up (*d*=5.78) and small at pre-test (*d*=0.05). For attitudes, there was a large effect size at post-test (*d*=7.6) and at follow-up (*d*=7.78) and a small effect size at pre-test (*d*=0.12). For practices, the effect size was medium at pre-test (*d*=0.61) and large at post-test (*d*=10.14) and follow-up (*d*=9.44).

4. DISCUSSION

Inadequate nutritional knowledge, negative attitudes, and unhealthy lifestyle behaviours cause health problems, obesity, and overweight [20]. Throughout a three-month intervention, six educational sessions on nutrition, PA, and BI were delivered to Saudi adolescent girls. The intervention components that addressed the benefits, drawbacks, and recommendations regarding nutrition, PA, and BI were developed based on the needs of the population. The KAP of the individuals in the IG were significantly higher than those of the individuals in the CG at post-test and follow-up.

These findings are consistent with those of previous studies showing that nutrition education increases nutrition knowledge and healthy eating, PA, and BI habits [21]–[24]. The KAP of the individuals in the IG were significantly higher than those of the individuals in the CG at post-test and follow-up [25]. Furthermore, Annesi *et al.* [21] reported that knowledge about BI satisfaction and dissatisfaction over 15 weeks effectively produced positive results, and Florence *et al*. [26] found that nutrition education influenced adolescents' knowledge levels more in the IG than in the CG. Previous studies have focused on adolescents; individuals among this age group may change their knowledge levels as they are more interested in their health than children are [23].

Conversely, the adolescents who participated in a nutritional intervention did not report improvements in knowledge [27]. However, the intervention duration in that study was one week, which may have been insufficient to change understanding among Saudi girls between the ages of 11 and 18. Improved attitudes and practices result from specific knowledge of healthy behaviors [28]. Therefore, enhancing adolescents' knowledge is crucial for improving their attitudes. In the present study, scores reflected attitudes toward nutrition, PA, and BI were significantly higher in the IG than among the CG, indicated that the intervention succeeded in improving adolescents' attitudes toward health.

Although scores in the CG showed significant changes in the present study, the change in the IG was greater than that in the CG. The respondents gained knowledge, which led to more positive attitudes. The results of this study indicate that following the implementation of an intervention program, attitude results align with those of previous studies [26], [29]. The IG's educational sessions explained the importance of adopting a healthy lifestyle, such as reducing unhealthy food consumption and reintroducing PA into the daily routine. The findings of this paper are compatible with previous interventions due to the content and the program duration [10]. The intervention discussed healthy food topics and the need to increase PA and BI acceptance. In Saudi Arabia, girls do not receive sufficient education on nutrition, PA, or BI, which may increase their desire to understand more about these terms (Ministry of Education KSA, 2021)

The present results do not support those of Harake *et al*. [12] and Siew *et al*. [23]; in those studies, students' attitudes did not significantly change after educational sessions. However, these studies were conducted in Lebanon and Malaysia, respectively, and the lack of improvements in attitudes may be attributable to differences in societies and cultures. Unsafe areas and a lack of facilities designated for PA may contribute as well [8].

In this study, nutrition, PA, and BI acceptance practices were significantly improved in the IG after six 90-minute sessions over three months. In both groups, practices improved, but improvement was more prominent in the IG than in the CG. Optimistic respondents' attitudes may positively influence their practices, and there is a possibility that in this study, similar teaching hours led to such positive results. Likewise, in another study in Iran, there were significant differences in practices in the IG compared to in the CG following the intervention [25], [29], [30]. Furthermore, adolescents in the IG who completed follow-up had significantly higher nutritional practice scores than adolescents in the CG [25]. The length of the intervention and the content of the sessions may have given the participants the necessary skills to adopt and practice new behaviors. This may account for the agreement between the current study and previous studies. Thus, positive changes in nutrition, PA, and BI KAP among the IG confirm the effectiveness of the current KAP intervention.

This study has several limitations that should be considered. This study was conducted in Arar; its results can be generalized only to adolescents in Arar, not to all adolescents in other cities in Saudi Arabia. The KAP data were collected through self-reports and may, therefore, have been subjected to self-reporting bias. Furthermore, although the first researcher conducted the study, the teachers may have contributed to more positive results.

This study also has several strengths. It was the first intervention including nutrition, PA, and BI acceptance conducted among adolescent girls in Arar after identifying the sample population's needs. Activities after the knowledge portion helped participants develop their practices over time. Additionally, it is

possible that the current program activities and content attracted respondents to attend the entire program. To our knowledge, among Saudi adolescents aged 13–14 years living in Arar, this is the first nutrition, PA, and BI intervention conducted to improve KAP levels in nutrition, PA, and BI.

5. CONCLUSION

This KAP intervention increased scores for nutrition, PA, and satisfaction with BI, benefiting Saudi girls aged 13–14 and indicating the positive effect of the intervention. According to our knowledge, this is the first such intervention performed among this population. We recommend that researchers apply this intervention to Saudi children, adults, males, and females, depending on their needs, to protect them from unhealthy lifestyle behaviors. Trained teachers and peers can participate in the intervention to obtain better results and encourage the continuation of healthy lifestyles.

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