A randomised controlled trial on the dietary intake of Saudi female adolescents living in Arar

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Abstract

Background: Lifestyle changes in Saudi Arabia have affected the dietary intake of adolescents, who now consume more unhealthy foods.

Aims: We assessed the dietary intake of female Saudi Arabian adolescents living in Arar.

Method: In this randomised cluster study, female students were selected randomly from assigned schools to form the intervention (n = 68) and control (n = 70) groups. Initially, a 60-minute seminar was held for mothers of students in the intervention group. Subsequently, 6 90-minute sessions were held over 3 months for the intervention group on topics such as food groups, healthy and unhealthy eating, body image and physical activity. The data were analysed using generalized estimating equations.

Results: The interaction effect (group by time) between the groups revealed statistically significant differences for dairy products (P < 0.001), sweetened beverages (P < 0.001), sweetened baked goods (P = 0.022) and fruits and vegetables (P < 0.003). The intervention significantly increased the intake of dairy products (P < 0.001) and fruits and vegetables (P = 0.003). It reduced the intake of sweetened beverages (P < 0.001) and sweetened baked goods (P = 0.010) in the intervention group.

Conclusion: This intervention showed a grater positive effect on the intervention than the control group; it increased dietary intake of dairy products, fruits and vegetables, and reduced intake of sweetened beverages and sweetened baked goods among the intervention group participants. We recommend similar nutrition interventions among other young Saudi Arabian population groups to prevent obesity and other diseases.

Keywords: nutrition, obesity, diet, sweetened food, fruits and vegetables, dairy products, students, Saudi Arabia

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Introduction

A healthy diet, i.e. not consuming large quantities of sugar, salt and fat, can protect the body from obesity, heart disease, diabetes and cancer (*1*,*2*). Adolescents need to consume adequate amounts of nutrients for growth, and the recommended daily intake of essential vitamins and minerals can be met if healthy foods, e.g. fruits and vegetables, are consumed daily (*3*).

WHO recommends a daily diet comprising a variety of food groups (*2*), but adolescents from the Eastern Mediterranean region do not follow these recommendations and consume large amounts of fats (including saturated fats) and sugary drinks, and few vegetables, fruits and other high-fibre foods (*4*). Altogether, 25% of Saudi adolescents and adults eat french fries at least 3 times week, and more than 50% consume chocolates and sweets (*5*). It has been reported that Saudi Arabian adolescents aged 12–16 years consume sugary foods at a rate of 11.7 (standard deviation 2.2) (*6*). The Healthy Food Palm was developed around Saudi culture and eating habits, and emphasizes consumption based on food groups with the aim of enhancing nutrient adequacy and improving health (*7*). However, a 2021 cross-sectional study on students from Al-Ahsa, Saudi Arabia, reported that 49.5% of normal weight and 100% of obese participants drank soft drinks daily (*8*).

Many Saudi Arabians do not follow Ministry of Health guidelines strictly: around 48% of adolescents need nutrition counselling to establish healthy eating behaviours (*9*). Nutrition education at an early age can influence the adoption of healthy eating habits before the development of unhealthy habits, and those with healthy habits are more likely to maintain these over time (*10*). Theory-based nutrition intervention emphasising the provision of information and learning skills to practise new behaviours can be effective for dietary change (*11*). A 2021 randomized cluster trial in India significantly changed dietary practices (P = 0.030) and consumption of junk food (P = 0.003) among adolescents (*12*). Students in Lebanon significantly increased their intake of fruits and vegetables and reduced their consumption of crisps after a 3-month nutritional intervention compared with the control group (P < 0.050) (*13*). In a Saudi Arabian study, adolescents in the intervention group showed greater changes in their consumption of healthy (vegetables and fruits) and unhealthy (desserts and snacks) foods compared with the control group after a 9-week school-based nutrition intervention (*14*).

Our study was conducted to assess dietary intake of Saudi Arabian female adolescents living in Arar.

Methods

Design

This single blinded randomized cluster study was conducted (January–June 2020) among females from 2 government intermediate schools. Healthy Saudi Arabian female adolescents aged 13–14 years agreed to participate in the study with the consent of either parent. Adolescents who had disabilities or noncommunicable diseases were excluded.

Rosner's formula was used to determine the sample size according to the mean difference scores for nutritional knowledge in both groups (*15,16*). A minimum of 68 participants was required for each group, with 15% added to cover dropouts (*17*). Therefore, a total of 160 participants was required, i.e. 80 participants per group. The selection and assignments of the participants were implemented randomly using *Excel* software. We selected 40 participants aged 13 years and 40 aged 14 years for each group. The intervention aims and procedures were explained to the participants and their parents before consent forms were collected.

Ethical approval

Before this intervention study began, we received approval from the ethics committee for research involving human subjects, Selangor, Malaysia JKEUPM (Reference No: UPM/TNCPI/RMC/JKEUPM/1.4.18.2), and the local committee on bioethics (Reference No. 13/40/H; HAP-09-A-043), and the Ministry of Education in Arar City, Saudi Arabia.

Nutrition intervention on dietary intake

This school-based nutrition intervention was developed for females aged 13–14 years, focussing on knowledge and skills based on social cognitive theory to improve the dietary intake behaviours of adolescents (*18*). Initially, we conducted a 60-minute seminar for the mothers of the intervention group at the school to encourage their adolescents to eat healthily, be happy with their body image and get 60 minutes of physical activity daily. For the adolescents in the intervention group, 6 interactive 90-minute sessions, 5 of which specifically focussed on nutrition, were delivered fortnightly for 3 months during school hours. Figure 1 shows the methodology flowchart for the nutrition intervention.

The intervention participants were divided into 2 groups based on classroom size. Topics covered the

Figure 1 Methodology flowchart for the nutrition intervention

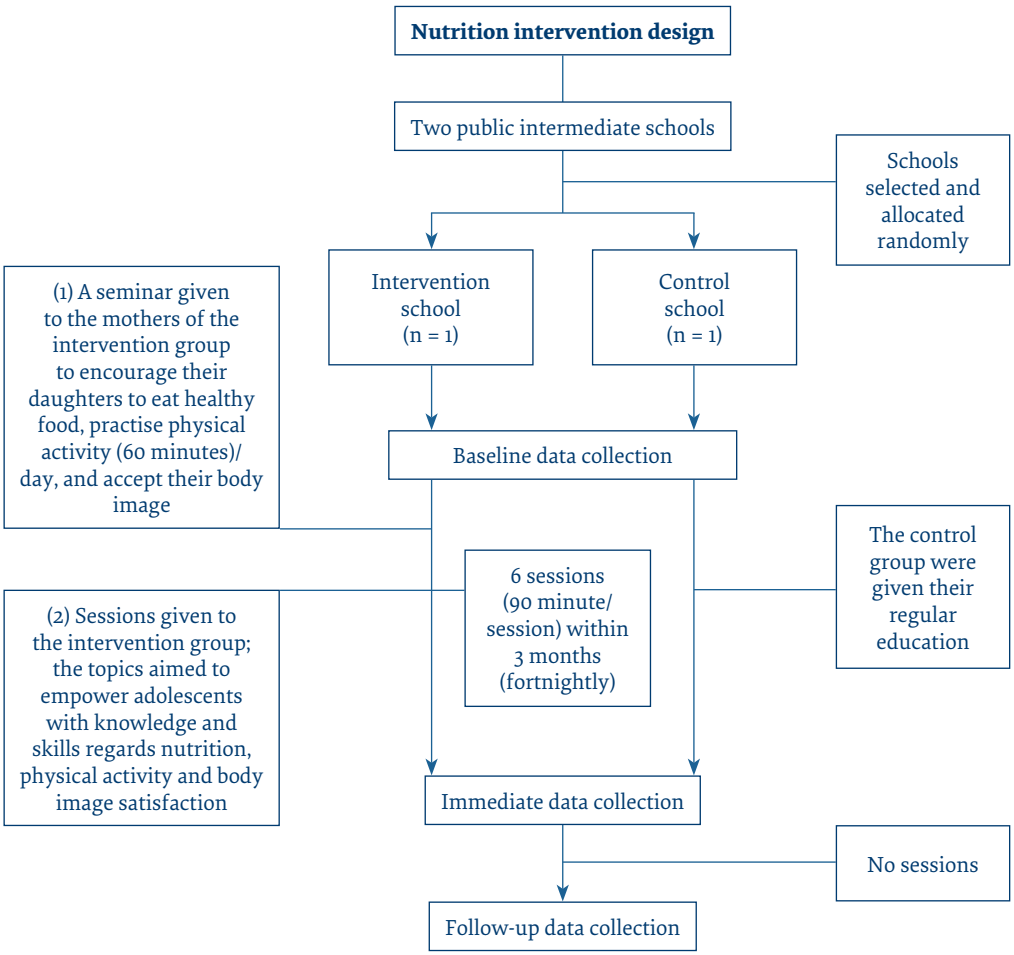

Table 1 Comparison of intake frequencies for food groups, energy and macronutrients for Saudi Arabian female adolescents over the course of the study, 2020

Variable	Baseline Mean (SD)	Immediately after 3-month intervention Mean (SD)	3-month follow-up Mean (SD)
		Intervention group (*n* = 68)	
Cereal & grains[a]	0.68 (0.29)	0.74 (0.43)	0.69 (0.33)
Fish, poultry & meat products[a]	0.45 (0.12)	0.43 (0.19)	0.43 (0.16)
Dairy products[a]	0.1 (0.07)	0.16 (0.05)	0.17 (0.05)
Mixed dishes[a]	0.22 (0.05)	0.19 (0.03)	0.29 (0.35)
Sweetened beverages[a]	0.38 (0.14)	0.27 (0.10)	0.27 (0.07)
Sweet baked goods[a]	0.16 (0.03)	0.13 (0.03)	0.14 (0.05)
Fruit & vegetables[a]	0.12 (0.03)	0.13 (0.04)	0.16 (0.09)
Dietary energy (kcal)	4847.88 (1321.82)	4620.28 (1231.93)	4571.96 (1458.58)
Carbohydrates (g)	730.73 (184.54)	870.93 (814.41)	752.62 (335.18)
Protein (g)	196.32 (58.97)	197.73 (88.52)	199.63 (91.31)
Fat (g)	158.44 (49.32)	194.18 (234.04)	156.3 (72.69)
		Control group (*n* = 70)	
Cereal & grains	1.18 (0.79)	0.72 (0.41)	0.72 (0.40)
Fish, poultry & meat products	0.63 (0.48)	0.54 (0.07)	0.56 (0.10)
Dairy products	0.1 (0.14)	0.08 (0.02)	0.08 (0.02)
Mixed dishes	0.27 (0.24)	0.39 (0.67)	0.34 (0.53)
Sweetened beverages	0.44 (0.19)	0.45 (0.17)	0.46 (0.18)
Sweet baked goods	0.16 (0.04)	0.15 (0.04)	0.15 (0.02)
Fruit & vegetables	0.12 (0.02)	0.12 (0.02)	0.12 (0.02)
Dietary energy (kcal)	4580.38 (1545.01)	3973.27 (905.68)	4226.12 (999.97)
Carbohydrates (g)	777.48 (404.04)	747.36 (567.75)	782.13 (580.79)
Protein (g)	274.34 (270.13)	222.92 (231.67)	218.48 (233.41)
Fat (g)	185.05 (127.82)	174.5 (163.96)	172.11 (175.83)

[a]*Frequency (weekly).*
SD = standard deviation.

importance of eating healthily and following the Saudi food guide pyramid regarding weight status, food groups, serving size and variety, macronutrients, consuming main meals on time daily, reading food labels, the drawbacks of consuming unhealthy foods (i.e. those high in sugar, fat and salt, such as fast food, soft drinks and other sweetened beverages), type 2 diabetes and obesity, the importance of positive body image and physical activity.

The sessions comprised 2 parts, one on knowledge and the other on activities that apply the knowledge. Booklets, PowerPoint presentations, whiteboards, group discussions, flashcards and games were used, with awards given out to both groups during data collection. The control group received the traditional education, but was provided with the intervention materials upon the completion of the study. All educational sessions were developed based on the preliminary study; guidance from nutrition experts at the Nutrition and Food Sciences, Medicine and Applied Medical Sciences Departments in Arar; and previous studies (*14*,*16*,*19*–*21*). The intervention was pilot-tested before implementation of the actual intervention to ensure accuracy and appropriateness.

A total of 3 face-to-face survey questionnaires were completed to collect data at baseline, immediately after the 3-month intervention ended, and at the 3-month post-intervention follow-up.

Participants and their parents signed consent forms before data collection. The questionnaire covered sociodemographic characteristics (participants' age, parents' education level, number in household, number of siblings, monthly income, etc.) and dietary intake.

Food intake

The average scores for consumption of food groups, macronutrients and dietary energy were obtained through a semi-quantitative food frequency questionnaire and 24-hour recall for 3 days using the *ProDiet Analysis*, version 6 (Axxya Systems; Redmond, Washington (https://nexgen1.nutritionistpro.com/shop/product-detail/nutritionist-pro-diet-analysis-software-13. New Saudi Arabian food recipes were added to the US Department of Agriculture's database, which was used in the study (*22*). Estimated food intake was derived from frequency of consumption for the food groups, nutrients and energy intake using a conversion factor (*23*):

amount of food consumed (g/day) = frequency of intake × serving size × total number of servings × weight of food in one serving (*24*).

High-frequency consumption would be once or more a week, and low frequency would be less than once (*25*). If consumption frequency was high, the score should be ≥ 0.5 (*26*).

Food habits

Almajwal et al. developed a semi-quantitative food frequency questionnaire covering 74 food items for the Saudi Arabian adolescent population (*27*). The average agreement for food groups was 70.9%, with 70.1% for nutrients. It was categorized as times/day (1, 2–3, 4–5 and 6–7), times/week (1–2, 3–4 and 5–6), times/month (1 and 2–3) and never. The food group components comprised cereals and grains (7 items, e.g. popcorn and bread); meat products (11 items, e.g. eggs, fish and chicken); mixed dishes (12 items, e.g. chicken burger and pizza); dairy products (6 items, e.g. full fat yoghurt and cream cheese); sweetened beverages (9 items, e.g. concentrated orange juice and grape juice); sweet and baked goods (13 items, e.g. honey and cake); and fruits and vegetables (16 items, e.g. dates and tomato) (*27*). Each participant was asked to report on their food consumption in terms of amount and serving size.

24-hour diet recall

To gather more information, 24-hour diet recalls were performed 3 times during the previous week: 2 on weekdays and one during the weekend. Each participant's food and drink activity was collected to assess energy and macronutrient intake, taking into account time of intake and how food was prepared.

Statistical analysis

We analysed the data using *SPSS*; *P*-value was < 0.05. The Mann–Whitney U-test and the chi-squared test were used to ensure the demographic homogeneity of the variables within and between groups at baseline. The data were not normally distributed and we used a randomized cluster design, so the generalized estimating equations test was used to compare mean scores for the food group, energy and macronutrient intakes within and between groups using an autoregressive correlation structure. The group by time effect interaction was applied to determine the effectiveness of the nutrition intervention on dietary intake at 3 different times.

Results

Sociodemographic characteristics

Dropout rates of 5.3% (n = 4) and 6.5% (n = 5) were registered immediately, and 10.6% (n = 8) and 10.3% (n = 8) at follow-up for the intervention group and control group respectively. Various reasons were cited, e.g. too busy, left the area, or could not complete the 3+ sessions. Ultimately, 89.4% (n = 68) of the intervention group and 89.7% (n = 70) of the control group completed the study.

Comparing sociodemographic variables between the 2 groups, significant differences were found only for monthly income (P = 0.005) and number of siblings (P = 0.045), which were viewed as covariates. No significant differences were found for age, parents' education level and number (of inhabitants) per household, i.e. family size (P > 0.050).

The effectiveness of the nutrition intervention on intake frequency of food groups, energy and macronutrients

A generalized estimating equations test was conducted to gauge intake frequency of the 7 food groups, energy and macronutrients. Significant differences were found in the mean scores at baseline between the groups for cereals and grains; fish, poultry and red meat; and sweetened beverages. Thus, these variables were viewed as covariates during the analysis, which showed the intake frequencies of both groups for the food groups, energy and macronutrients.

When the baseline score for intake of cereals and grains was excluded, the effect on the groups was statistically significant (P < 0.001), whereas no significant effect was reported for intake of cereals and grains (P = 0.370). The interaction time (group by time) effect was statistically significant for intake of dairy products (P < 0.001), sweetened beverages (P < 0.001), sweetened baked goods (P = 0.022) and fruits and vegetables (P = 0.003), indicating that the intervention group and the control group did not experience the same trend over the 3-month study period. We observed no statistically significant improvement in the consumption of fish, poultry and meat (P = 0.625) and mixed dishes (P = 0.174), i.e. both groups shared the same pattern for these over the study period. Intake of cereals and grains, dairy products and fruits and vegetables increased while intake of sweetened beverages and sweetened baked goods decreased. For intake frequencies for energy and macronutrients, the interaction time (group by time) effect on total dietary energy was not statistically significant (P = 0.210) (Table 2). Thus, both groups demonstrated the same pattern. The interaction time (group by time) effect was not significant for carbohydrates (P = 0.382), protein (P = 0.361) and fat (P = 0.452) during the study period.

The Bonferroni post hoc test was conducted on both groups of participants to determine their differences in intake frequencies for food groups, energy and macronutrients over time (Table 3). The results indicated significant differences in intake frequencies for dairy products (P < 0.001), sweetened beverages (P < 0.001), sweetened baked goods (P < 0.01) and fruits and vegetables (P = 0.003) among intervention group participants at baseline and follow-up. The effect (time), based on Cohen (*28*), was classed as medium or large but no significant differences were reported in intake frequencies for cereals and grains; fish, poultry and red meat; and mixed dishes among the intervention group participants at baseline and follow-up (P > 0.050), in which the time effect was classed as small (d < 0.50). Moreover, no significant

differences were found between the intervention and control groups throughout the study period for total intake of energy and macronutrients from the diet (P = 1.000) except for dietary energy at baseline and immediately after the intervention in the control group. The time effect was small for energy and macronutrient intake (d < 0.50) between the groups during the study period.

Statistically significant changes were found between the groups during the follow-up tests in regard to the intake frequencies of dairy products, sweetened beverages and fruits and vegetables (P < 0.05), indicating a large time effect, but no significant changes were found in intake frequencies for fish, poultry and red meat, and mixed dishes (P > 0.050). Intake frequency for cereals and grains for both groups was significant at baseline and immediately after the intervention (P < 0.001 and P = 0.030). No differences were reported between the groups in terms of energy intake at baseline and at the 3-month follow-up (P = 1.000) (Table 3). No significant differences were found for intake of carbohydrates, protein and fat between the groups (P > 0.050) over time. The effect size between the intervention group and control group during the study period was small for intake of dietary energy and macronutrients (d < 0.50) (Table 4).

Table 2 Intake frequencies for food groups, energy, and macronutrients among Saudi Arabian female adolescents, 2020

Variable	Source	Wald chi-square	df	P-value
Cereals and grains[a]	Time	17.247*	2	< 0.001
	Group	0.804	1	0.370
	Group by time	22.993*	2	< 0.001
	Cereal baseline	227.339*	1	< 0.001
Fish, poultry and meat products[a]	Time	3.619	2	0.164
	Group	35.273*	1	< 0.001
	Group by time	0.94	2	0.625
	Fish, poultry, meat baseline	718.234*	1	< 0.001
Dairy products	Time	9.607*	2	0.008
	Group	47.639*	1	< 0.001
	Group by time	28.541*	2	< 0.001
Mixed dishes	Time	3.341	2	0.188
	Group	5.612*	1	0.018
	Group by time	3.503	2	0.174
Sweetened beverages[a]	Time	12.25*	2	0.002
	Group	112.022*	1	< 0.001
	Group by time	20.959*	2	< 0.001
	Sweeten beverages baseline	77.256*	1	< 0.001
Sweet baked goods	Time	20.534*	2	< 0.001
	Group	11.704*	1	0.001
	Group by time	7.633*	2	0.022
Fruits and vegetables	Time	15.333*	2	< 0.001
	Group	14.82*	1	< 0.001
	Group by time	11.691*	2	0.003
Dietary energy	Time	9.256*	1	0.002
	Group	11.031*	2	0.004
	Group by time	3.121	2	0.210
Carbohydrates (g)	Time	0.115	1	0.735
	Group	0.79	2	0.674
	Group by time	1.922	2	0.382
Protein (g)	Time	4.778*	1	0.029
	Group	1.685	2	0.431
	Group by time	2.041	2	0.361
Fat (g)	Time	0.21	1	0.647
	Group	1.125	2	0.570
	Group by time	1.589	2	0.452

Table 3 Pairwise comparison of mean scores for the intake frequencies for the food groups over time for the intervention (*n* = 68) and control (*n* = 70) groups

Variable/ group	Test (intervention group)	Test (control group)	Mean difference intervention & control groups	SE	*P*-value	95% CI for difference		d
						Lower	Upper	
Cereals & grains[a]								
Intervention group	Baseline	Immediately	−0.06	0.05	1.000	−0.22	0.09	0.03
	Baseline	Follow-up	−0.01	0.04	1.000	−0.13	0.11	
	Immediately	Follow-up	0.05	0.05	1.000	−0.08	0.19	
Control group	Baseline	Immediately	0.46*	0.10	< 0.001	0.17	0.75	0.73
	Baseline	Follow-up	0.45*	0.10	< 0.001	0.16	0.73	
	Immediately	Follow-up	−0.01	0.05	1.000	−0.17	0.15	
Fish, poultry & meat products[a]								
Intervention group	Baseline	Immediately	0.03	0.02	1.000	−0.04	0.09	0.14
	Baseline	Follow-up	0.02	0.02	1.000	−0.04	0.08	
	Immediately	Follow-up	−0.01	0.02	1.000	−0.07	0.06	
Control group	Baseline	Immediately	0.09	0.06	1.000	−0.08	0.25	0.20
	Baseline	Follow-up	0.07	0.06	1.000	−0.10	0.24	
	Immediately	Follow-up	−0.01	0.01	1.000	−0.06	0.03	
Dairy products								
Intervention group	Baseline	Immediately	−0.063*	0.01	< 0.001	−0.09	−0.04	1.15
	Baseline	Follow-up	−0.075*	0.01	< 0.001	−0.10	−0.05	
	Immediately	Follow-up	−0.01	0.01	0.890	−0.03	0.01	
Control group	Baseline	Immediately	0.02	0.02	1.000	−0.03	0.06	0.20
	Baseline	Follow-up	0.02	0.02	1.000	−0.03	0.07	
	Immediately	Follow-up	0.00	0.00	1.000	−0.01	0.01	
Mixed dishes								
Intervention group	Baseline	Immediately	0.030*	0.01	< 0.001	0.01	0.05	0.28
	Baseline	Follow-up	−0.07	0.04	1.000	−0.20	0.05	
	Immediately	Follow-up	−0.10	0.04	0.210	−0.23	0.02	
Control group	Baseline	Immediately	−0.11	0.08	1.000	−0.36	0.13	0.17
	Baseline	Follow-up	−0.07	0.07	1.000	−0.27	0.13	
	Immediately	Follow-up	0.05	0.09	1.000	−0.21	0.30	
Sweetened beverages[a]								
Intervention group	Baseline	Immediately	0.11*	0.02	< 0.001	0.07	0.16	0.99
	Baseline	Follow-up	0.12*	0.02	< 0.001	0.07	0.16	
	Immediately	Follow-up	0.00	0.01	1.000	−0.03	0.04	
Control group	Baseline	Immediately	−0.01	0.03	1.000	−0.09	0.07	0.11
	Baseline	Follow-up	−0.02	0.03	1.000	−0.11	0.06	
	Immediately	Follow-up	−0.02	0.03	1.000	−0.09	0.06	
Sweet baked goods								
Intervention group	Baseline	Immediately	0.03*	0.01	< 0.001	0.02	0.04	0.49
	Baseline	Follow-up	0.02*	0.01	0.010	0.00	0.04	
	Immediately	Follow-up	−0.01	0.01	1.000	−0.03	0.01	
Control group	Baseline	Immediately	0.01	0.01	1.000	−0.01	0.03	0.32
	Baseline	Follow-up	0.01	0.01	0.980	−0.01	0.03	
	Immediately	Follow-up	0.00	0.01	1.000	−0.01	0.02	

Table 3 Pairwise comparison of mean scores for the intake frequencies for the food groups over time for the intervention (*n* = 68) and control (*n* = 70) groups *(concluded)*

Variable/ group	Test (intervention group)	Test (control group)	Mean difference intervention & control groups	SE	*P*-value	95% CI for difference		d
						Lower	Upper	
Fruits & vegetables								
Intervention group	Baseline	Immediately	−0.010	0.005	0.663	−0.024	0.004	0.60
	Baseline	Follow-up	−0.04*	0.012	0.003	−0.077	−0.009	
	Immediately	Follow-up	−0.03	0.012	0.069	−0.067	0.001	
Control group	Baseline	Immediately	−0.002	0.003	1.000	−0.010	0.005	0.01
	Baseline	Follow-up	−0.002	0.004	1.000	−0.013	0.009	
	Immediately	Follow-up	0.001	0.003	1.000	−0.008	0.009	
Dietary energy								
Intervention group	Baseline	Immediately	227.60	172.66	1.000	−279.19	734.38	0.20
	Baseline	Follow-up	279.57	228.98	1.000	−392.52	951.67	
	Immediately	Follow-up	51.98	201.03	1.000	−538.10	642.05	
Control group	Baseline	Immediately	607.11	182.94*	0.010	70.13	1144.09	0.27
	Baseline	Follow-up	368.21	218.99	1.000	−274.58	1011.00	
	Immediately	Follow-up	−238.90	140.69	1.000	−651.84	174.03	
Carbohydrates								
Intervention group	Baseline	Immediately	−140.20	98.21	1.000	−428.46	148.06	0.08
	Baseline	Follow-up	−27.88	46.70	1.000	−164.96	109.20	
	Immediately	Follow-up	112.32	102.94	1.000	−189.82	414.46	
Control group	Baseline	Immediately	30.12	75.61	1.000	−191.82	252.06	0.01
	Baseline	Follow-up	−2.55	81.22	1.000	−240.96	235.86	
	Immediately	Follow up	−32.67	77.72	1.000	−260.79	195.45	
Protein								
Intervention group	Baseline	Immediately	−1.41	11.58	1.000	−35.40	32.57	0.04
	Baseline	Follow-up	−3.50	13.17	1.000	−42.15	35.15	
	Immediately	Follow up	−2.09	14.33	1.000	−44.16	39.98	
Control group	Baseline	Immediately	51.42	41.24	1.000	−69.62	172.45	0.22
	Baseline	Follow-up	56.80	42.35	1.000	−67.51	181.11	
	Immediately	Follow-up	5.38	32.58	1.000	−90.24	101.01	
Fat								
Intervention group	Baseline	Immediately	−35.74	28.26	1.000	3.57	6.26	0.03
	Baseline	Follow-up	0.95	10.59	1.000	3.56	6.14	
	Immediately	Follow-up	36.69	29.00	1.000	−0.40	0.28	
Control group	Baseline	Immediately	10.55	23.46	1.000	−1.79	−0.11	0.08
	Baseline	Follow-up	13.45	25.56	1.000	−1.90	−0.31	
	Immediately	Follow-up	2.91	23.83	1.000	−0.67	0.36	

SE = standard error of the sample.
CI = confidence interval.
d = Cohen effect size.
**P-value < 0.050; Bonferroni adjustment for multiple comparisons.*
[a]Covariate: adjusted mean difference using baseline score.
Immediately = immediately after the 3-month intervention.
Follow-up = 3-months after the end of the intervention.

Discussion

Dietary patterns are shifting with increasing urbanization, lifestyle changes and increased production of processed foods with people currently consuming greater quantities of sodium, sugar, fat and salt. Consumption of cooking oil and salt is now double the recommended daily intake. Many people consume inadequate amounts of fibre, fruits and vegetables (*1*). This unhealthy eating behaviour can lead to noncommunicable diseases and obesity (*2*). A seminar was held for mothers to encourage their daughters to replace their intake of unhealthy food with healthy food. The sessions on nutrition information and healthy activities, which were held for the intervention group,

Table 4 Pairwise comparison of the intervention (*n* = 68) and control (*n* = 70) groups for intake frequencies for the food groups, energy and macronutrients over time

Variable/test	Mean difference Intervention & control groups	SE	*P*-value	95% CI for difference		d
				Lower	Upper	
Cereals and grains[a]						
Baseline	0.29*	0.06	< 0.001	0.10	0.48	0.84
Immediately[a]	−0.23*	0.07	0.030	−0.45	−0.01	−0.05
Follow-up[a]	−0.17	0.07	0.190	−0.36	0.03	0.08
Fish, poultry & meat products[a]						
Baseline	0.12*	0.04	0.040	0.00	0.23	0.51
Immediately[a]	0.06	0.03	0.690	−0.03	0.14	0.77
Follow-up[a]	0.06	0.03	0.440	−0.02	0.15	0.97
Dairy products						
Baseline	0.01	0.02	1.000	−0.05	0.06	0.58
Immediately	−0.074*	0.01	< 0.001	−0.09	−0.05	2.21
Follow-up	−0.090*	0.01	< 0.001	−0.11	−0.07	3.50
Mixed dishes						
Baseline	0.05	0.03	0.980	−0.03	0.13	0.29
Immediately	0.20	0.08	0.180	−0.03	0.42	0.42
Follow-up	0.04	0.08	1.000	−0.18	0.27	0.11
Sweetened beverages[a]						
Baseline	0.03	0.02	0.560	−0.01	0.08	0.36
Immediately[a]	0.15*	0.02	< 0.001	0.09	0.22	1.29
Follow-up[a]	0.17*	0.02	< 0.001	0.10	0.25	1.39
Sweet baked goods						
Baseline	0.01	0.01	1.000	−0.02	0.02	0.01
Immediately	0.027*	0.01	< 0.001	0.01	0.05	0.57
Follow-up	0.01	0.01	0.730	−0.01	0.03	0.26
Fruits & vegetables						
Baseline	0.00	0.00	1.000	−0.02	0.01	0.01
Immediately	−0.01	0.01	0.700	−0.03	0.01	0.32
Follow-up	−0.044*	0.01	< 0.001	−0.08	−0.01	0.61
Dietary energy						
Baseline	−267.50	235.93	1.000	−960.01	425.01	0.19
Immediately	−647.02*	178.51	< 0.001	−1170.97	−123.06	0.60
Follow-up	−356.13	212.70	1.000	−980.44	268.17	0.28
Carbohydrates						
Baseline	46.75	51.19	1.000	−103.51	197.00	0.15
Immediately	−123.58	115.98	1.000	−463.99	216.84	0.18
Follow-up	21.42	80.14	1.000	−213.80	256.63	0.06
Protein						
Baseline	78.02	31.75	0.210	−15.18	171.22	0.40
Immediately	25.19	28.55	1.000	−58.60	108.98	0.14
Follow-up	17.72	29.77	1.000	−69.68	105.11	0.11
Fat						
Baseline	26.61	15.77	1.000	−19.68	72.90	0.27
Immediately	−19.68	33.38	1.000	−117.66	78.30	0.10
Follow-up	14.10	22.66	1.000	−52.42	80.63	0.12

SE = standard error of the sample.
CI = confidence interval.
d = Cohen effect size.
**P-value < 0.050; Bonferroni adjustment for multiple comparisons.*
[a]Covariate: adjusted mean difference considering baseline score.
Immediately = immediately after the 3-month intervention.
Follow-up = 3-months after the end of the intervention.

were effective in eliciting positive improvements regarding intake of the food groups except for intake of cereals and grains; fish, poultry and red meat; and mixed dishes. This may indicate that more information should be provided to adolescents about these food groups.

Saha et al. reported that after 6 nutritional sessions, students increased their intake of fruits and vegetables ($P < 0.001$) (*18*). The outcomes matched those of Salem and Said, who included nutritional sessions (*29*). Girls aged 12–15 increased their consumption of healthy food, particularly fruits and vegetables ($P < 0.001$). The reduced consumption of salt, sugar, unhealthy drinks and foods was maintained ($P < 0.001$). Similarly, in a study on Syrian refugees in Lebanon, an increase in healthy food consumption was found among adolescents in the intervention group (e.g. fruits and vegetables) along with a reduction in intake of unhealthy food (e.g. sweets and fast food) immediately after a 3-month intervention (*16*). Previously, intervention group participants may have increased their dietary intake due to improved knowledge. Thus, the components and instruments were appropriate for the participants to achieve their targeted goals (*30*).

Fetohy et al. (*31*) conducted 3 sessions among Saudi Arabian intermediate and secondary school students, who subsequently increased their daily consumption of fresh food ($P = 0.050$) and whole grains ($P = 0.020$) and avoided fatty meals ($P = 0.030$). However, our participants did not demonstrate any significant changes in their intake of cereals and grains. Previous research conducted among Saudi Arabian adolescents found significant improvement in the consumption of healthy snacks and food groups as well as a reduction in the consumption of unhealthy foods, e.g. soft drinks, fast food, chocolates and other sweets ($P < 0.050$) (*20*). The participants were younger than those involved in this intervention, so their health concerns were less important than the older participants in the study (*32*).

Our findings can be attributed to the nutrition intervention offered to participants as a way to reduce unhealthy eating. Although consumption of cereals and grains; fish, poultry and red meat; and mixed dishes did not improve among intervention group participants, significant differences were found in their intake of dairy products, sweetened beverages, sweetened baked goods and fruits and vegetables based on social cognitive theory.

This school-based intervention provided activities, e.g. planning healthy main meals based on a variety of foods and serving sizes, recognising healthy vs unhealthy foods, reading food labels (calories, carbohydrates, serving size) and discussing with the group how to replace unhealthy eating with healthy eating behaviours. These activities may have helped the participants acquire and maintain new healthy eating behaviours. Recent research suggested that nutrition education sessions be conducted among Saudi Arabian, Lebanese and Egyptian participants, with an emphasis on group discussions about food groups and the importance of eating healthy food (*13*,*14*,*29*). Information can be provided through PowerPoint presentations to encourage participants to eat healthy foods and reduce their consumption of unhealthy foods. The appropriate components, activity tools and duration of an intervention all play a vital role in the success of nutrition education sessions (*30*).

This study had certain limitations. Only females were included because they are taught in schools separate from males in Saudi Arabia. The investigation was conducted in a single intervention school and city, thereby preventing generalization of the results to all 13- and 14-year-old Saudi Arabian females. Parental influence on changing intake frequencies for food groups among participants was not examined. This study was developed after determining the need for a nutrition education intervention among the adolescent female population.

This school-based intervention included sessions and activities that enhanced nutrition intervention and promoted new behaviours among participants. To avoid bias, 24-hour recall was used during the 3 days when the data were being collected.

Conclusion

This intervention was successful at increasing dietary intake of dairy products and fruits and vegetables, and reducing intake of sweetened beverages and sweetened baked goods among the intervention group participants. We recommend further studies among a larger group of Saudi Arabian females, both above and below age 13–14 years, to prevent obesity and other diet-related diseases. The number of schools and cities in the intervention should be expanded to determine the effectiveness of this nutrition intervention among Saudi Arabian female adolescents. We recommend that parents participate in the sessions to accurately determine the effect of the intervention. Future researchers should focus more on energy foods and macronutrients to elicit changes among adolescents.

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Essai contrôlé randomisé sur l'apport alimentaire des adolescentes saoudiennes vivant à Arar

Résumé

Contexte : En Arabie saoudite, les changements de mode de vie ont eu une incidence sur l'apport alimentaire des adolescents, qui consomment désormais davantage d'aliments nocifs pour la santé.

Objectif : Évaluer l'apport alimentaire des adolescentes saoudiennes vivant à Arar.

Méthode : Dans la présente étude en grappes randomisée, les étudiantes ont été sélectionnées aléatoirement dans des écoles désignées pour former les groupes d'intervention (n = 68) et de contrôle (n = 70). Au départ, un séminaire de 60 minutes a été organisé à l'intention des mères d'élèves du groupe d'intervention. Par la suite, six sessions de 90 minutes ont été tenues pendant trois mois pour le groupe d'intervention, portant sur des sujets tels que les groupes alimentaires, l'alimentation saine et malsaine, l'image corporelle et l'activité physique. Les données ont été analysées à l'aide d'équations d'estimation généralisées.

Résultats : L'effet d'interaction (groupe réparti en fonction du temps) entre les groupes a révélé des différences statistiquement significatives pour les produits laitiers (p < 0,001), les boissons sucrées (p < 0,001), les produits de boulangerie sucrés (p = 0,022) et les fruits et légumes (p < 0,003). L'intervention a augmenté de manière significative la consommation de produits laitiers (p < 0,001) et de fruits et légumes (p = 0,003). Elle a permis de réduire la consommation de boissons sucrées (p < 0,001) et de produits de boulangerie sucrés (p = 0,010) dans le groupe d'intervention.

Conclusion : Cette intervention a eu un effet positif plus important sur le groupe d'intervention que sur le groupe témoin. Elle a permis d'augmenter la consommation de produits laitiers, de fruits et de légumes, ainsi que de réduire la consommation de boissons et de produits de boulangerie sucrés chez les participantes du groupe d'intervention. Nous recommandons des interventions nutritionnelles similaires auprès d'autres groupes de jeunes dans la population saoudienne pour prévenir l'obésité et d'autres maladies.

تجربة عشوائية مضبوطة بالشواهد عن المدخول الغذائي للمراهقات السعوديات في مدينة عرر

عبير باحاذق، عزيزي أبو سعد

الخلاصة

الخلفية: أثرت التغيرات التي طرأت على أنماط الحياة في المملكة العربية السعودية على المدخول الغذائي للمراهقين الذين يستهلكون الآن مزيدًا من الأطعمة غير الصحية.

الأهداف: هدفت هذه الدراسة إلى تقييم المدخول الغذائي لمراهقات سعوديات مقيمات في عرعر.

طرق البحث: في هذه الدراسة العنقودية العشوائية، اختيرت الطالبات عشوائيًّا من المدارس المخصصة لتشكيل مجموعة التدخل (العدد = 68) والمجموعة المرجعية (العدد = 70). وفي البداية، عُقدت ندوة مدتها 60 دقيقة لأمهات الطالبات في مجموعة التدخل. وبعد ذلك، عُقدت 6 جلسات مدة كل منها 90 دقيقة على مدى 3 أشهر لمجموعة التدخل بشأن موضوعات مثل المجموعات الغذائية، والأكل الصحي وغير الصحي، ومظهر الجسم والنشاط البدني. وخضعت البيانات للتحليل باستخدام معادلات تقديرية معممة.

النتائج: كشف تأثير التفاعل (المجموعة حسب الوقت) بين المجموعتين عن اختلافات ذات دلالة إحصائية فيما يتعلق بمنتجات الألبان (القيمة الاحتمالية < 0.001)، والمشروبات المحلاة (القيمة الاحتمالية < 0.001)، والمخبوزات المحلاة (القيمة الاحتمالية = 0.022)، والفواكه والخضروات (القيمة الاحتمالية < 0.003). وأدى التدخل إلى زيادة كبيرة في تناول منتجات الألبان (القيمة الاحتمالية < 0.001) والفواكه والخضروات (القيمة الاحتمالية = 0.003). وأدى إلى تقليل تناول المشروبات المحلاة (القيمة الاحتمالية < 0.001) والمخبوزات المحلاة (القيمة الاحتمالية = 0.010) في مجموعة التدخل.

الاستنتاجات: أظهر التدخل تأثيرًا إيجابيًّا أكبر على مجموعة التدخل مقارنة بالمجموعة المرجعية، فيما يتعلق بمنتجات الألبان والمشروبات المحلاة والفواكه والخضروات. ولم يتبين اختلاف كبير في مدخول الأغذية الغنية بالطاقة والمغذيات الكبرى بين المجموعتين

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