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Nutritional Behaviour of Adolescents and the Impact of Covid-19 on A Diet in Saudi Arabia

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Abstract

In recent decades, changes in food consumption among adolescents in Arabic speaking countries, including The Kingdom of Saudi Arabia (KSA), has resulted in increased burden of overweight and obesity. COVID-19 related restrictions have further impacted lifestyle and diet among adolescents in KSA. The present study aimed to assess the knowledge, attitude, behaviour and dietary patterns of adolescents and the impact of the COVID-19 pandemic related restrictions on these behaviours. A cross-sectional study was conducted in six intermediate schools among 1500 adolescents (11-15 years) via an anonymous online survey. The Chi Square test was used to compare gender stratified nutritional knowledge, attitude and behaviour of adolescents and the impact of COVID-19 related restrictions. To determine the factors associated with nutritional change during COVID-19 lockdown, logistic regression was employed using the categorisation of nutritional change during COVID-19 restrictions versus no change in univariate and multivariate analyses. A good level of nutrition-related knowledge and attitude was demonstrated both by female and male students, with 66% and 57% of participants scoring above the median of the total possible knowledge and attitude score, respectively.After adjusting for all variables, higher nutrition knowledge score predicted students to be less likely to report increased food consumption during COVID-19 restrictions, whereas students with higher nutrition attitude scores and with a higher risk of increased food consumption were more likely to increase food consumption during COVID-19 restrictions. Unhealthy dietary

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habits among Saudi adolescents are of paramount public health concern and the COVID-19 restriction period exacerbated the pre-pandemic nutrition-related unhealthy behaviours. Therefore, school-based interventions aiming to promote healthy lifestyles and the wellbeing of Saudi adolescents anduse of qualitative recall dietary diary is also crucial to develop programs that prevent unhealthy lifestyles in adolescents in Saudi Arabia.

Introduction

Over the past five decades, a dramatic transition has occurred in global diet and activity levels. During the 1970s, the consumption of processed foods, the emergence of fast-food restaurants, and the global availability and use of cheap edible oils and sweetened drinks began to change the dietary habits of many population groups.[1] Increased consumption of energy-rich, nutrient-poor foods, reduction in physical activity, and increase in sedentary lifestyles has been associated with increased health problems related to obesity.[2] This has resulted in a significant global overweight and obesity burden, initially evident in high-income countries but more recentlyin low- and middle-income countries.[3] Global overweight and obesity levels have accelerated further due to economic and income growth, urbanisation, and globalisation.[4-6]

Eating a balanced and varied diet during adolescence is crucial for growth, developmental health, wellbeing and the prevention of obesity, with poor nutrition and lack of physical activity among adolescents contributing to the burden of preventable diseases and premature deathsin adulthood.[7,8] Further, the Commission on Ending Childhood Obesity stated that a healthy adolescent diet comprises limited or restricted high-calorie foods, fats, free sugars or salt, and plentiful fruit, vegetables, and dietary fibre (e.g., whole grains).[9] One study has shown that 'junk food' accounts for 20% of variance in weight gain among youth.[10] Globally (i.e.,more than 80 countries were sampled proportionallyfor each region except for Africa), school-going adolescents, on average, consume low number of servings per day offruit (1.43 serves; 95% confidence interval 1.26–1.60) and vegetables (1.75 serves; confidence interval 1.58–1.92). In contrast,on average adolescents consumed sugary carbonated soft drinks about once a day.[11] However, this varied significantly between countries.Fruit consumption was particularly low in South and East Asia, and consumption of carbonated soft drinks was higher in Latin America.

Studies have indicated that children and adolescents in Arabic speaking countries, including the Kingdom of Saudi Arabia(KSA), experience in consistent nutritional problems, with malnutrition and overnutrition simultaneously common.[12] One study in KSA reported that more than 50% of 14 to 18 year-old adolescents weigh above the 85th percentile.[13] This has been attributed to unhealthy dietary and lifestyle habits such as insufficient intake of vegetables and fruit as well ashigh consumption of sugary food (e.g. sweets, cakes, biscuits, chocolate, and some fizzy drinks and juice drinks) and 'fast food (mass produced high energy foodwhich tends to lack nutrients and is low in fibre and micronutrients and highly processed grains, high sodium, and sugar which is prepared with the sole purpose of serving quickly)'.[14,15]

Nutrition promotors have recognised that a wide variety of factors influence adolescents' dietary behaviour such asadequate knowledge, recognition of healthy foods, their peers and environmental influences.[16] Nutrition knowledge and understanding the consequences of unhealthy eating play a vital role in predicting an individual's dietary decisions.[17] Nutrition knowledge is essential for any individual to attain a healthy lifestyle and for the prevention of diet-related morbidities.[18,19] Studies have also demonstrated the significance of nutritional attitude in determining diet quality and promoting good nutritional practices, confirming the importance of accurate assessment of attitudes towards nutrition.[20,21] Adequate knowledge and understanding also lead to self-efficacy and self-control. Adolescents with self-control are more likely to develop a positive healthier attitude and make conscious health-related behavioural decisions such as healthy eating and drinking and

avoiding poor eating habits.[22] The higher self-efficacy an individual develops as a result of adequate knowledge, the higher their intake of healthy food, resulting in the ability to manage their healthy diet even when under pressure or facing obstacles.[23] Knowledge and attitudes that predict adolescents daily practices are also influenced by their family members (such as parents), the options available in their neighbourhood, peer status and value and concern for their future health.[24] Thus, studying the correlation between knowledge, attitude and nutrition-related behaviour is important in this period of adolescent nutritional socialisation as they learn to make more individual decisions.[8]

The Impact of COVID-19 on a Diet in Saudi Arabia

As SARS-CoV-2 (COVID-19) cases were first reported in KSA, the government, with the Ministry of Health and public health officials' advice, man dated a population-wide lockdown to control the spread of the virus.[25] During the lockdown, people were forced to change some of their lifestyle behaviours.[26] Physical activity plummeted as gyms, and other recreational facilities were closed.[27] while food consumption increased as a result of boredom and stress, and people started hoarding food as a result of uncertainty about food security.[28] The negative impact of the pandemic on poor dietary habits was also evident among children and adolescents in Saudi Arabia, where more than 39% reported difficulty maintaining a healthy lifestyle and balanced diet during the pandemic.[29]

This paper describes findings from a larger school-based study focusing on obesity prevention. Nutrition knowledge, attitude and behaviour,[30] among intermediate school adolescents in Saudi Arabia will be described. The association between knowledge, attitudes, behaviours and the COVID related nutritional changes among these adolescents and comparison by gender was also explored.

Methods

Study Design, Population and Sampling Method

This cross-sectional study collected data from six intermediate schools. The six schools were randomly selected from the 262 intermediate government schools in Jeddah, KSA, and included three girls' and three boys' schools. All grade 7 to 9 students (11-15 years-of-age from these schools were invited. A random sample of six intermediate schools was generated from the six districts in Jeddah to enhance representativeness.[30]

Data Collection

Consent for school participation was granted by the principal and individual online consent was obtained from both parents and students. A link to an online information sheet, consent and survey was emailed to potential participants by each school's principal. The schools emailed 3483 students. Of those students, 815 (23.3%) participants (or their parents) did not provide assent or consent to participate resulting in an initial response rateof 76.6%. Of the surveys received, 1500 were complete, while1168 (33.5%) were extensively incomplete (more than 50% incomplete items within the survey form). Incomplete questionnaires were excluded during the data cleaning process. The survey was conducted using the Qualtrics platform. The survey consisted of five sections, demographic characteristics, knowledge, attitudes, nutritional behaviours, and COVID-19 related nutritional changes.

Measures

Socio Demographic variables

Age, gender, grade and maternal and paternal level of education were requested. Parental level of education was categorised as primary, intermediate, high school, undergraduate and postgraduate.

Knowledge, Attitude and Behaviour

Questions to measure nutrition knowledge, attitudes and behaviours were adapted from previously validated items used in selected international studies.[31-33] Nutrition knowledge was assessed using eight questions which were adapted from a validated survey targeting urban South African adolescents.[33] Questions are described in Table 1 (responses: true, false, don't know; score 0-8; correct answer = 1 point). Based on the total score, the range and median were identified.

Attitudes towards nutrition were measured using eight items (Likert scale withfive responses:"strongly agree" to "strongly disagree"; score range 5-40 with higher scores representing more positive attitudes). Additionally, some items were negatively worded, strongly agreeing with the sentence opposing a healthy diet, and reverse coding was applied.[31] In order to simplify the analysis of the attitude

questions, the responses were dichotomised into "agree" and "disagree" and cross-tabulated by gender (see Table 2).[34,35] In this five-level Likert scale, neutral response were dichotomised with the least healthy answer to the question. The median cut-off point was used to categorise into higher vs lower scores.[24,36]

Nutrition-related behaviours were measured using nine questions adapted from an Australian school student survey.[32] The types and approximate quantities of food consumed regularly were self-reported. The items investigated the reported daily intake of fruit, vegetables, bread and cereal, fast food, energy-dense snacks, sugary drinks, milk and water consumption.[32] Nutritional behaviour categorisations were made on the basis of Australian and KSA dietary guidelines which recommend that the minimum servings of vegetables, fruit and cereal/ breadare five, two and six per day, respectively.[37,38] The guidelines also recommend that fast food and sugary intake be limited, thus, "none" or "less than one intake per week"was considered 'limited'. Two or more servings were regarded as a high weekly intake of unhealthy foods and drinks.

Nutritional Change During COVID-19

Nutritional behaviour changes during COVID-19 lockdowns were measured by asking participants about the changes in their food consumption habits. Response options included a five-level Likert scale ranging from "a lot less" to "a lot more". The items related to nutritional "changes during COVID-19" were adapted from other surveys, including the Australian New South Wales[32] pre-COVID survey questions.[32,39] The NSW survey was initially used as a cross-sectional population survey of school children age 5 to 16 years which assessed children's dietary patterns and eating behaviours, physical activity and measures of fitness to identify factors related to overweight and obesity.

Ethics

Approval was granted from the Curtin University of Human Research Ethics Committee (HR2020-0337). Additionally, permission to collect data from intermediate schools in Jeddah KSA was granted by the KSA Ministry of Education (Ref. No.4181827686).

Statistical Analysis

All measures were characterised using descriptive analysis – frequency and percentage. Nutritional outcomes were grouped by gender, and the association was verified using Pearson's chi-square "χ^2". Fisher's exact test was used when the cell count was less than 5%. Correlation between continuous variables such as total scores of nutritional attitudes was identified using Pearson's correlation coefficient. In order to determine the factors associated with nutritional change during COVID-19 lockdown, logistic regression was employed using the categorisation of nutritional change during COVID-19 restrictions versus no change in univariate and multivariate analyses.

The final model was fitted with all significant variables during univariate analysis: Odds Ratios (OR) and 95%Confidence Intervals(CI) were obtained. The significance level was set at $p<0.05$. The analysis was conducted on IBM SPSS Statistics 27 statistical software.

Results

A total of 1500 adolescent students from six intermediate schools (three boys' andthree girls' schools) participated in this survey. The initial response rate was 76.6%, with more than 55% completed surveys. Participants ranged from 11 to 15 years and were in grades seven to nine. Just over half of participants, (54%; n=822/1500), were females, and 30%of participants fathers and 34% of their mothers were university educated.

Nutritional Knowledge by Gender

Approximately 66% (n=939/1389) of participants scored abovethe median of the total knowledge score (≥5 out of 8). Significantly more girls (69%; n=533/772) scored higher than the median compared to males (32%) ($p =0.011$). Significantly more females (86%; n= 667/772) than males (78%; n=507/648) were aware that drinking a lot of soft drink can cause weight gain ($p<0.001$). More female students (95%; n=736/772) correctly identified fruit and vegetables as part of a healthy dietcompared to 89% (n=575/648) of male students ($p<0.001$). Only 42%, n=327/772 of female and 34%;n=222/648 of male students correctly answered that a small amount of dietary fibre was

insufficient (p=0.002). Knowledge of healthy fibre and salt consumption was poor for both genders, with less than half (48%;n=290/772 female and 45%;n=370/648 male) of all participants correctly answering these questions but not statistically significant (see Table 1).

Table 1: Frequency of Nutrition related knowledge by Gender (N= 1420)

Knowledge items	Total n(%)	Male n(%)	Female n(%)	Chi-square p-value
Scores with median cut-off				
0-4	481(33.9)	242(37.3)	239(31.9)	0.011
5-8	939(66.1)	406(62.7)	533(69.1)	
You should eat a lot of sugar to give you enough energy				
True	370(26.1)	178(27.5)	192 (24.9)	0.266
False (correct response)	1050(73.9)	470(72.5)	580 (75.1)	
If you are eating a healthy diet, there is no need to be physically active				
True	299(21.1)	137(21.1)	162(21.0)	
False (correct response)	1121(78.9)	511(78.9)	610(79.0)	0.942
Eating a lot of different kinds of f oods is healthier than eating only a few types of foods				
False	541(38.1)	247(38.1)	294(38.1)	
True (correct response)	879(61.9)	401(61.9)	478(61.9)	0.989
Your body only needs a little bit of salt to be healthy				
False	760(53.5)	358(55.2)	402(52.1)	0.232
True (correct response)	660(46.5)	290(44.8)	370(47.9)	
Drinking a lot of soft drinks can cause weight gain				
False	246(17.3)	141(21.8)	105(13.6)	<0.001
True (correct response)	1174(82.7	507(78.2)	667(86.4)	
Fruit and vegetables are part of a healthy diet				
False	109(7.7)	73(11.3)	36(4.7)	<0.001
True (correct response)	1311(92.3)	575(88.7)	736(95.3)	
For a healthy diet, you should eat a small amount of dietary fibre				
True	871(61.3)	426(65.7)	445(57.6)	0.002
False (correct response)	549(38.7)	222(34.3)	327(42.4)	
You can eat as much meat as you want every day				
True	608(42.8)	293(45.2)	315(40.8)	0.094
False (correct response)	812(57.2)	355(54.8)	457(59.2)	

Nutrition-Related Attitudes by Gender

Approximately 51%, n=321/648 of males and 43%, n=329/772 of females agreed that they are too young to worry about consuming a healthy diet (p=0.007) (See Table 2). Females (81%, n=614/772) were more likely than males (75%, n=476/648) to agree

that what they eat today may affect their future health (p=0.007). The majority of males (74%;n=469/648) and females (72%, n=541/772) liked the taste of healthy food, but this difference was not statistically significant. Generally, female students showed more positive nutrition-related attitudes when compared to male students, but no differences were statistically significant.

Table 2: Nutrition-related attitude categorised by gender (N=1420)

Attitude items	Total	Male n(%)	Female n(%)	Chi-square p-value
Scores with median cut-off				
8-18	587(43.2)	276(44.8)	311(41.9)	0.284
19-28	771(56.8)	340(55.2)	431(58.1)	
I like the taste of healthy food				
Agree	1010(72.7%)	469(74.1)	541(71.6)	0.292
Disagree	379(27.3%)	164(25.9	215(28.4)	
I am too young to be worried about eating a healthy diet				
Agree	650(46.8)	321(50.7)	329(43.5)	**0.007**
Disagree	739(53.2)	312(49.3)	427(56.5)	
I understand and know what to eat to have a healthy diet				
Agree	1097(79.0%)	488(77.1)	609(80.6)	0.115
Disagree	292(21%)	145(22.9)	147(19.4)	
My health in the future may be affected by what I eat today				
Agree	1090(78.7%)	476(75.2)	614(81.2)	**0.007**
Disagree	299(22.3%)	157(24.8)	142(18.8)	
I know the number of calories or joules of energy in different foods				
Agree	698(50.2%)	331(52.3)	367(48.5)	0.164
Disagree	691 (49.8)	302(47.7)	389(51.5)	
There are no healthy food choices at school				
Agree	1143(82.3)	521(82.3)	622(82.3)	0.988
Disagree	246(17.7)	112(17.7)	134(17.7)	
I believe I eat a balanced healthy diet				
Agree	665(47.9)	310(49.0)	355(47.0)	0.454
Disagree	724(52.1)	323(51.0)	401(53.0)	
I am worried about being too fat				
Agree	875(63.0)	409(64.6)	466(61.6)	0.253
Disagree	514(37.0)	224(35.4)	290(38.4)	

* Total rows vary as a result of missing values

Nutrition-Related Behaviour

Figure 1 illustrates the proportion of students who reported that they met the recommended number of serves of different foods per day. Notably, 56% ate sufficient fruit per day, and 48% consumed less than one serving per day of fast food and sweetened drinks. However, nearly 10% (n=133) and 6% (n=85) of students reported not consuming vegetables and fruit every day, respectively. The majority of participants (86%, n = 1171) ate at least one fast-food meal during the last week, with 47% consuming two or more fast-food

meals. Approximately three-quarters of participants (n=1027) reported consuming sweetened drinks at least once in the previous week, out of which 35.5% drank sweetened beverages at least twice a week. In addition, more than 37% of students reported consuming more than four servings of unhealthy snacks such as chocolate bars, cake or chips during the last week.

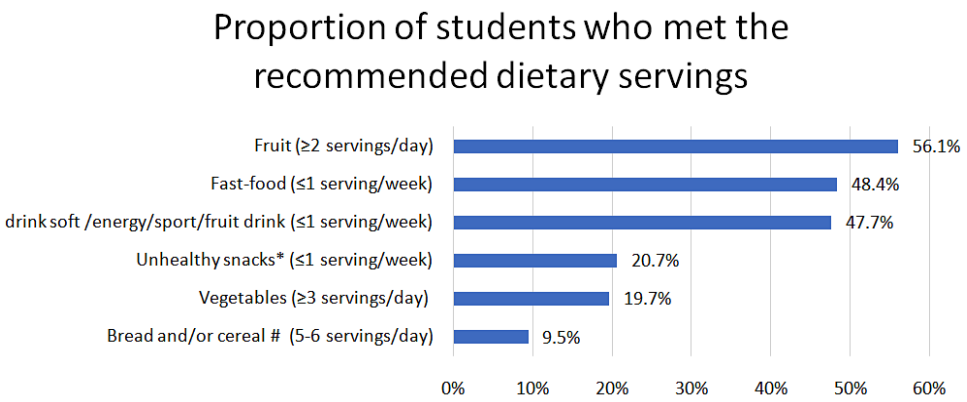

Fig.1: Proportion of students who meet dietary recommendations (N=1356).

Fast-food: McDonald's, ALBAIK, KFC, pizza, hamburgers, etc.
* For example, a chocolate bar, a piece of cake, a packet of chips /corn chips, ice cream, 3-4 sweet biscuits; #1 slice of bread, ½ bread roll, ½ cup breakfast cereal, or ½ cup rice, pasta, or noodles

Nutrition-Related Behaviour During Covid-19 Restrictions by Gender

Overall, approximately one-third of participants (27-38% across the four categories) reported little change in eating behaviours during the pandemic. Generally eating behaviours improved with reported decreased consumption of fast foods (54%), unhealthy snacks (42.4%) and sugary drinks (44.3%) with 35.3% reporting increases in fruit and vegetable consumption. About18.7% of participants reported eating more fast-food meals, whereas more than 50% ate less fast-food meals during the COVID-19 restrictions with this distribution similar between male and female students (See Table 3). Approximately 25% of participants reported consuming more unhealthy snacks while 17.4% of participants reported they drank more sweetened drinks compared to before the pandemic and 44.3% reported they drank less. Additionally, 35% of participants reported eating more healthy foods such as fruits and vegetables, while 38% consumed the same amount, and 27% reported eating"a lot" or "a littleless"healthy foods.

Students were also asked if the overall amount of food they ate had increased during the COVID-19 restrictions (See Table 5). While 42% of participants reported no change in the amount of food consumed, approximately 58% reported increased food consumption during COVID-19 restrictions.

Table 3: Changes in nutritional behaviour during COVID-19 restriction (n=38 (2.5%) missing)

COVID Items	A lot less	A little less	About the same	A little more	A lot more
Eat fast food meals	479(35.6)	247(18.4)	368(27.4)	179(13.3)	72(5.4)
Male	227(37.3)	107(17.6)	163(26.8)	79(13.0)	32(5.3)
Female	252(34.2)	140(19.0)	205(27.8)	100(13.6)	40(5.4)
Eat unhealthy snacks*	267(19.9)	303(22.5)	434(32.3)	229(17.0)	112(8.3)

Male	148(24.3	140(23.0)	192(31.6)	93(15.3)	35(5.8)
Female	119(16.1)	163(22.1)	242(32.8)	136(18.5)	77(10.4)
Drink soft/energy/sport/ fruit drinks	381(28.3)	215(16.0)	515(38.3)	161(12.0)	73(5.4)
Male	178(29.3)	95(15.6)	235(38.7)	72(11.8)	28(4.6)
Female	203(27.5)	120(16.3)	280(38.0)	89(12.1)	45(6.1)
Eat healthy food like fruit, vegetables, meat and milk	170(12.6)	193(14.3)	507(37.7)	311(23.1)	164(12.2)
Male	103(16.9)	85(14.0)	230(37.8)	136(22.4)	54(8.9)
Female	67(9.1)	108(14.7)	277(37.6)	175(23.7)	110(14.9)

*For example: chocolate bars, cake, a packet of chips /corn chips, ice cream, sweet biscuits

Correlation of Continuous Kap Scores

The total nutrition knowledge score was negatively, weakly (r=-0.219) and significantly (p<0.001) correlated with the total nutrition attitude score (See Table 4). The nutrition knowledge score was also very weakly associated with the nutrition-related behaviour pre-pandemic (r=0.027, p=0.319) and with nutrition-related behaviour during COVID-19 restrictions (r=0.075, p=0.006). However, nutrition attitude scores were negatively and significantly correlated with behaviours pre-pandemic (r=-0.109, p<0.001) and during COVID-19 restrictions (r=-0.209, p<0.001). Those who reported higher scores of healthy nutrition behaviours (i.e. favouring healthy eating and lower consumption of unhealthy meals, snacks and drinks) were positively related to higher scores of nutrition-related behaviours during COVID-19 restrictions (r= 0.158, p<0.001).

Table 4: Bivariate correlations of knowledge, attitude and behaviour scores

	1	**2**	**3**
1. Knowledge nutrition score	1		
2. Attitude nutrition score	-0.219 ***	1	
3. Behaviour nutrition score	0.027	-0.109***	1
4. Behaviour nutrition during COVID-19 score	0.075**	-0.209***	0.158***

Impact of COVID-19 on Nutrition

Univariate analysis of the factors associated with the increase in food consumption during COVID-19 lockdown was conducted using binary logistic regression (see Table 5). About 58% (n=777) of participants reported increased food consumption during the COVID-19 restrictions. Higher proportions of older students (15 years) were more likely to report increased food consumption during COVID-19 restrictions when compared to younger students (11 years). Higher nutrition knowledge score (OR= 0.9, 95%CI 0.8-0.96) predicted students to beless likely to report increased food consumption during COVID-19 restrictions, whereas students with higher nutrition attitude scores were more likely to (OR= 1.05, 95%CI 1.02-1.08) increase food consumption during COVID-19 restrictions. Higher servings of unhealthy snacks (OR= 1.13, 95%CI 1.07-1.2), as well as higher servings of fruit (OR= 1.1, 95%CI 1.0-1.14), were associated with increased food consumption. Other factors such as gender, grade, parents' level of education and servings of vegetables, fast-food and sweetened drinks were not related to the amount of food consumption during COVID-19 restrictions. After adjusting for variables included in Table 5, only higher levels of nutrition knowledge, nutrition attitude and previous high intake of unhealthy snack consumption were associated with a higher risk of increased food consumption during COVID-19 restrictions.

Table 5: Univariate and multivariate analysis of factors associated with nutritional change during COVID-19

Variables	Increase in food consumption		Unadjusted OR	Adjusted OR
	Yes n=777 (57.9%)	No n=564(42.1%)		
Age				
11	6(20.7)	23(79.3)	Ref.	0.90(0.66-1.22)
12	102(46.4)	118(53.6)	0.3(.1-.8)*	
13	190(45.8)	225(54.2)	0.3(.1-.8)*	0.76(0.59-0.98)
14	226(38.1)	367(61.9)	0.4(.2-1.1)	Ref
15	40(47.6)	44(52.4)	0.3(.1-.8)*	
Gender				
Male	248(40.9)	359(59.1)	Ref.	Ref
Female	316(43.1)	418(56.9)	0.9(0.7-1.1)	0.99(0.79-1.24)
Grade				
7	190(44.2)	240(55.8)	Ref.	
8	228(40.1)	340(59.9)	1.2(.9-1.5)	0.200
9	146(42.6)	197(57.4)	1.1(.8-1.4)	0.652
Maternal level of education				
< Primary	102(41.3)	145(58.7)	1.0(.6-1.7)	1.05(.57-1.94)
Intermediate	67(39.4)	103(60.6)	1.1(.6-1.9)	1.15(.62-2.13)
High school	174(43.2)	229(56.8)	0.9(.6-1.6)	1.01(.57-1.77)
Undergrad	192(42.6)	259(57.4)	1.0(.6-1.6)	1.01(.58-1.75)
Post-graduate	29(41.4)	41(58.6)	Ref.	Ref
Paternal level of education				
< Primary	79(40.9)	114(59.1)	0.9(0.6-1.3)	0.77(0.46-1.28)
Intermediate	58(41.1)	83(58.9)	0.9(0.5-1.4)	0.80(0.48-1.34)
High school	175(43.3)	229(56.7)	0.8(0.5-1.1)	0.76(0.50-1.17)
Undergrad	197(43.3)	258(56.7)	0.8(0.5-1.1)	0.80(0.53-1.22)
Post-graduate	55(37.2)	93(62.8)	Ref.	
Knowledge*	4.97(1.57)	5.24(1.59)	0.9(0.8-0.96)**	0.92(0.86-0.99)*
Attitude*	19.7(4.12)	19.0(3.98)	1.05(1.02-1.08)**	1.03(1.01-1.07)*
Nutritional change during COVID				
Bread and/or cereal	2.83(2.08)	2.60(2.11)	1.1 (1-1.1)*	1.03(.97-1.09)
Vegetables	2.45(1.96)	2.36(1.85)	1.0(1.0-1.1)	0.97(.91-1.04)
Unhealthy snacks	3.80(2.06)	3.27(2.11)	1.13(1.07-1.2)***	1.13(1.07-1.20)***
Sweetened drinks	4.06(2.58)	4.22(2.96)	.98(.94-1.02)	0.96(0.92-1.01)
Fast-food	3.11(2.33)	3.15(2.64)	1.0(1.0-1.1)	0.97(0.93-1.02)
Fruit	2.57(1.79)	2.37(1.71)	1.1 (1.0-1.14)*	1.05(.98-1.14)

*Mean(standard deviation)

Discussion

This study aimed to describe the level of nutritional KAB among school-going adolescents and the impact of COVID-19 restrictions on their eating habits in KSA. Intermediate school is potentially the most criticalstage of adolescence to develop nutrition-related health behaviours due to the type and magnitude of age-related transitions (puberty) that affect adolescents' body shape, weight status, and appearance occurring during this time.[40] During the COVID-19 restrictions, adolescents' routine behaviours altered, influencing all aspects of life, including food buying behaviour, dietary habits and activity level.[41] Thus, it is note worthy to identify KAB levels among this age group during the restrictions. A good level of nutrition-related knowledge was demonstrated both by female and male students, with 66% of participants scoring above the median of the total knowledge score. Females were more likely to demonstrate higher nutrition-related scores compared to males. Just over half of participants (57%) also reported positive attitudes toward nutrition. Research has suggested that male and female adolescents rank differently on food literacy assessment tools.[42] International studies reveal that female adolescents are more likely to score higher on food and nutrition assessment tools because they care more about food, nutrition, and health and have more substantial physical appearance concerns than males.[43,44] Although appearance concerns are more frequently identified among girls, males are not immune to body image concerns during adolescent development as height, and muscular mass is perceived as ideal for manly maturity.[45] Nutritional knowledge assists adolescents to select healthy food options, to plan meals and provides awareness as to how food intake impacts wellbeing.[46] However, good nutrition-related knowledge does not always translate to good dietary practice.[47,48]

Nutritional behaviour before COVID-19 restrictions indicated that more than 50% of students were eating more than one serving of fast food and more than 80% of the students ate unhealthy snacks per week, respectively. This could be due to the decreasing quality of diet during adolescence, which may remain suboptimal until adulthood.[49] Adolescents' dietary patterns are often characterised by skipping meals, unhealthy frequent snacking and fast-food consumption without notable concern for their health.[50] This study confirmed that unhealthy food consumption such as fastfood, unhealthy snacks and sweetened drinks was high,and more than 15% of students reported increased consumption during the COVID-19 restrictions. However, 44.3% reported that they drank less sweetened drinks compared tobefore the pandemic. This could be due to access. For example, before the pandemic, they may have spent more time out with friends – shopping, attending movies and at other recreational activities with high availability of soft drinks, and unhealthy snacks. During the COVID-19 restrictions, participants spent most or all of their time at home, where the availability of. For some, unhealthy food may have been limited.

Similar to a study conducted in the United States of America,[51] this study found no significant correlation between knowledge and healthy practice. Notably, in this study unhealthy nutrition behaviours were consistent before and during the COVID-19 restrictions with 27% of males and 32% of females reporting similar consumption of fast-food meals and unhealthy snacks before and during COVID-19 restrictions respectively. The US study found prolonged time spent at home could contribute to higher COVID-19 specific stress which may have that caused a higher intake of unhealthy food and snacks. This then led to an increase in food consumption irrespective of the nutritional value during the COVID-19 restriction.[51] Interestingly, participants with higher nutritional knowledge and attitude were more likely to increase their food intake during the COVID-19 restrictions. However, the survey question did not ask if this increase was in healthy or unhealthy foods. The students increased their food intake not only for the unhealthy options but also for fruit, vegetables, bread and cereals. The sealtered consumption behaviours could be due to their closer proximity to their kitchen and perhaps an increased interest in food preparation, increased consumption of relatively healthier food provided by their parents; and reduced purchasing of food from shops and the school canteen. Other international studies have found people to find enjoyment in cooking and eating, to have more time available time to prepare food, and to eat more family meals during COVID-19 restrictions.[52,53] While these changes have led to increased consumption of healthy food, there is also evidence of increased consumption of indulgence food during pandemic lockdowns.[54]

There are a number of strengths and limitations that should be considered when interpreting the findings of this study. The study has adequate sample sizes with participants recruited from Jeddah, one of the biggest cities in KSA, however, participants were from only one region in KSA, which may affect the results' generaliz ability. However, the findings of this study adds to existing knowledge about nutritional changes during the unprecedented situation of the COVID-19 restrictions. Theself-reported, online survey requiring adolescent dietary recall may have led to information bias and may have resulted in overor underestimating the nutritional information provided. Participants tend to respond with socially acceptable responses[55] which may have influenced reporting of healthy food consumption. The study's cross-sectional nature cannot establish the temporality between the amount of food consumption during the COVID-19 restrictions and the KAB of the nutrition among the participants prior to COVID-19 lockdowns. The final limitation is the outcome variable identifying an overall increase in food consumption that did not differentiate between healthy and unhealthy food (so students might be eating more, but it may be more healthy foods). For instance, increased fruit consumption was significantly associated with increased food consumption during the COVID-19 restrictions.

Despite these limitations, the strength of this study was the 77% response rate which is considered an excellent rate for an online survey.[56] Moreover, this study provides an overview of nutrition knowledge, attitude and behaviours of intermediate school students in Jeddah, KSA, and provides comparisons between male and female students. As schools in KSA are single-gender, gender-specific findings are imperative to inform school-based interventions.

Conclusion

Findings from the present study confirm that many students demonstrated good nutritional knowledge and attitudes. Female participants tended to have significantly higher nutritional knowledge and attitude levels than their male counterparts, even though no significant difference was shown in the amount of food consumption during the pandemic lockdown between both genders. However, unhealthy dietary habits among Saudi adolescents are a paramount public health concern. Their pre-pandemic nutrition-related unhealthy behaviours continued during the COVID-19 restriction period. The findings of this study provide updated and essential data informing school-based interventions aiming to promote healthy lifestyles and the wellbeing of Saudi adolescents. Future research is recommended using qualitative recall dietary diary and a universal tool that measures nutritional behaviours among adolescents and links this to their Body Mass Index (BMI). It is also crucial to developand tailor interventional programs that prevent unhealthy lifestyles in adolescents in Saudi Arabia.

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Conflict of Interests

No potential conflict of interest was reported by the authors.

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