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Original Research

Adolescents with Diabetes, exploring Knowledge, Attitude, and Practice: A Cross-Sectional Analytical Study

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Abstract

Background: Diabetes mellitus (DM) constitutes an escalating global health concern, with a discernible impact on new generations, specifically adolescents. This research is uniquely positioned to address a substantial research gap by systematically evaluating the knowledge, attitudes, and practices (KAP) pertinent to DM in adolescent patients. **Methods:** An analytical cross-sectional study was executed. Two well-trained research assistants gathered corresponding data from a cohort of 417 diabetic adolescents (aged 12–19 years; 303 males and 114 females) at the National Centre for Diabetes Endocrinology and Genetics in Amman, Jordan. The assessment of KAP was conducted through face-to-face interviews utilizing a validated questionnaire. Multinomial logistic regression and logistic regression models were used to explore the associations between patients' variables, KAP and other covariates. **Results:** The participants had a mean age of 15.84 ± 1.84. The majority exhibited moderate to high levels of knowledge but poor attitudes and practices. Notably, males showed significantly lower levels of knowledge compared to females (Adjusted Odds Ratio [OR] = 0.501, 95% Confidence Interval [CI]: 0.260 - 0.968). Non-smokers adolescents! demonstrated higher knowledge levels than smokers (Adjusted OR = 1.986, 95% CI: 1.030 - 3.831). Supplement users showed superior knowledge only in unadjusted models. Positive attitudes were observed in only 24% of participants. Obtaining DM information from physicians was significantly associated with more positive attitudes (Adjusted OR = 2.162, 95% CI: 1.216 - 3.844). The majority (71%) displayed poor practices, and this was significantly associated with higher family income (Adjusted OR = 0.392, 95% CI: 0.186 - 0.824). **Conclusion:** Despite knowledge levels, there's a concerning trend of poor attitudes and practices. Addressing gender disparities, smoking, physical activity, and socioeconomic factors remains crucial for effective overall DM management. The findings emphasize the urgent need for targeted educational programs to further enhance knowledge and cultivate more positive attitudes. Collaborating with physicians and diabetic associations is vital for accurate information and improving attitudes and practices in diabetes.

Keywords: knowledge; attitudes and practices (KAP); diabetes mellitus (DM); adolescents

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INTRODUCTION

Diabetes mellitus (DM) is a prevalent non-communicable disease worldwide, characterized by consistently high blood sugar levels over a long period.[1] The global prevalence of (DM) in adults has been increasing and is projected to reach 7.7% by 2030.[2] The burden of DM, along with other non-communicable diseases, has been growing in developing countries. It was reported that the majority of (DM) patients (70%) lived in lower-middle-income countries.[3] Around the globe, the Middle East and North Africa (MENA) region was ranked second among the highest (DM) prevalence, with an estimated 54.8 million (12.8% prevalence) adults affected by (DM).[4] In Jordan, a MENA country that is the focus of the current study, national population-based surveys conducted between 1994 and 2017 reported varying but high rates of (DM) prevalence, ranging from 9% to 30%.[4] According to the National Center for Diabetes, Endocrinology, and Genetics in Jordan, the prevalence of (DM) and pre-DM was approximately 45%.[5]

The available evidence indicates that several socio-demographic factors, such as limited health knowledge, might contribute to the increasing prevalence of (DM) in lower-middle-income countries.[6-10] Recent research focusing on knowledge, attitude, and practice (KAP) has highlighted the urgent need to enhance awareness about DM, which includes promoting early diagnosis, controlling the risk factors,

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and managing the disease.[9,11,12] Numerous (KAP) studies have been conducted among the general population [9,12,13]. For instance, a study involving healthy adults aged ≥18 years reported that 39% had moderate knowledge and 38% had above moderate knowledge about (DM).[9] It was proposed that early diagnosis and effective management are crucial factors in minimizing DM's complications.[14] The primary goal of (DM) management is to delay the onset of macro and microvascular complications by achieving optimal glycemic control,[14] which could be achieved by adopting lifestyle changes such as regular exercise, a healthy diet, maintaining a healthy weight, and utilizing appropriate drug therapy. Therefore, having good health literacy is essential for successfully managing diabetes. It was shown that subjects with (DM) who possess sufficient knowledge about the disease and its complications were more likely to seek proper treatment, engage in self-care, and take responsibility for their health.[15] Solid evidence supports the idea that well-informed and diligent individuals in their (DM) self-care would achieve better and long-lasting control of the condition.[8,16] Furthermore, previous studies on (KAP) related to (DM) have emphasized the importance of increasing awareness about prevention, early diagnosis, and control of risk factors associated with (DM).[17]

Several previous studies conducted in the Middle East have primarily focused on the adult populations.[18,19] However, there is a notable research gap when it comes to investigating the (KAP) specifically related to (DM) and its complications among vulnerable populations, such as adolescents, diagnosed with (DM). Consequently, limited research evidence is available that assesses the (KAP) related to (DM) among the younger generation who have grown up with the internet and social media. Limited research exists in the examination of (KAP) regarding (DM) and its associated complications within vulnerable populations, particularly adolescents diagnosed with (DM). Consequently, there is a dearth of research evidence assessing the (KAP) on (DM) among the younger generation, who have been raised in the digital age of the internet and social media. The younger generation may differ from their parents in terms of health awareness, dietary habits, and other risk factors.[20] In this context, understanding the (KAP) related to (DM) among adolescents would provide valuable insights for developing targeted preventive strategies tailored to this specific population. Therefore, the current cross-sectional study aimed to assess the (KAP) regarding (DM) among adolescents. In addition, examine the factors that could be associated with the (KAP).

METHODS

Study setting and population

This analytical cross-sectional was study conducted between March and July 2023 among 417 adult adolescents with (DM) aged between 12 and 19, attending The National Center for Diabetes Endocrinology and Genetics in Amman, Jordan. Using the purposive sampling method, all subjects attending the healthcare facilities under the study who fulfilled the inclusion criteria were included in this study. Using the provided formulas, the minimum sample size calculated was 284 participants. The study used an alpha value of 5% for the study's error, a precision value (d) of 0.01, a probability (P) of 7.7% for (DM) occurrence, and a complementary probability (1-P) of 94.3%. However, a larger sample size was collected in this study to increase the statistical power of the sample.

The study details were explained by announcement statements for all the center patients. The inclusion criteria for respondents were individuals aged 12-19 years, without mental illness, and willing to participate in this study. Patients who had severe physical and mental illness were excluded. The questionnaire was made accessible through Google Forms, and portable devices such as PCs, iPads, and tablets were used to gather the data. Participant recruitment took place at The National Center for Diabetes Endocrinology and Genetics in Amman, Jordan, where face-to-face interviews were conducted with eligible adolescents.

Training of Data Collectors

Two research assistants and three dietitians received comprehensive training from the principal investigator (PI). This training covered various aspects, such as introducing the study's purpose and objectives to the participants, conducting effective face-to-face interviews, addressing challenges during data collection, and implementing scientific methods to protect participant privacy. The training lasted for 7 days and included a demonstration by the principal investigator. After completing the training, trainees conducted virtual interviews under the observation and guidance of the principal investigator. Each person was then assigned specific data collection schedules. To ensure data quality and validity, the PI conducted immediate inspections, regularly reviewed the process, and verified the completion of questionnaires. Concurrently, the PI oversaw the coordination of the overall study.

The study questionnaire

The questionnaire used in this study was custom-designed to collect data on participants' (KAP) related to (DM). Permission was obtained from the authors to use a previously published and validated questionnaire in the Arabic language.[21] The internal consistency of the questionnaire was assessed by evaluating the Cronbach alpha coefficient for each scale and the test results indicated that participants' knowledge of (DM) scored 0.743, their attitude toward (DM) scored 0.746, and their behavior related to (DM) scored 0.617.[21]

The first section of the questionnaire focused on collecting sociodemographic information, including age, gender, parents' level of education, and average monthly income (Jordanian Dinar). The second section addressed (KAP) related to (DM). To assess knowledge, the questionnaire included eight key questions about risk factors, diagnosis, prevention, and complications of (DM). Respondents were given three response options: "Yes," "No," and "Don't know." Each correct response received one point, and the total score was calculated out of 26. Based on the score ranges, participants were classified into three groups: poor knowledge (0-13), moderate knowledge (14-18), and good knowledge (19-26).

To evaluate the participants' attitudes, seven questions about adherence to (DM) treatment were included. Participants provided categorical responses of "Yes," "No," or "Don't know" for each question. Those who scored ≥ 4 out of 7 were considered to have a positive attitude.

Lastly, four questions were used to assess practices related to (DM). Positive and negative practices were distinguished based on the responses to the various questions. Participants provided answers in the form of categorical statements: "Yes," "No," and "Don't know." A positive practice was assigned to those who responded "Yes," while a negative practice was assigned to those who responded "No." Those who scored 4 out of 4 were categorized as having good practices.

The data was collected separately by three dietitians who underwent intensive training for one week on relevant topics such as patient counseling and disease information to ensure consistent data collection. The training included explaining the research objective to the participants, conducting face-to-face interviews, and addressing any challenges encountered during the data collection process.

Ethical approval

The study obtained ethical approval from the Ethical Committee Board of the Faculty of Pharmacy and Applied Science at the University of Petra in Amman, Jordan (Grand number: Q2/2023). Prior to data collection, informed written consent was obtained from all individuals participating in the study. Participants were informed of their right to withdraw from the study at any time, the absence of any financial compensation for their participation, and the utilization of their data solely for academic research purposes.

Statistical analysis

Before conducting the analysis, the data underwent a process of editing to ensure its accuracy and reliability. This involved carefully reviewing and confirming the completed questionnaires at the end of each interview and at the conclusion of the entire survey. For the data analysis, Statistical Analysis Software (SAS) version 9.4 (SAS Institute in Cary, NC) was used. Descriptive statistics, including means and standard deviations for continuous variables, as well as frequencies and proportions for categorical variables, were used to present the sociodemographic characteristics of the participants and their responses to the (KAP) questions. To examine the associations between sociodemographic characteristics and KAP, multinomial logistic regression and logistic regression models were employed. Odds ratios (ORs) along with their corresponding 95% confidence intervals (CIs) were reported for each predictor. A significance level of 0.05 was used to determine statistical significance for all associations.

RESULTS

Sociodemographic characteristics of the study participants

Among the total sample size of 417 participants, a significant proportion (72.7%) consisted of male individuals, and the average age was found to be 15.84 years with a standard deviation of 1.84. Maternal education predominantly comprised individuals with undergraduate degrees (47.2%), while 42.7% of fathers had completed secondary school or possessed lower educational qualifications. Non-smokers constituted the majority of the participants, accounting for 66.45% of the sample. Notably, approximately 52% of the study subjects reported the use of dietary supplements. Social media, friends, and parents served as the primary source of information about (DM) (78.4%), whereas dieticians were the least utilized source of information (5%), as depicted in Figure 1.

Knowledge, Attitude, and Practices regarding (DM) among the adolescents with DM

Table 2 presents the assessment of participants' knowledge regarding (DM). The mean total knowledge score is reported as 16.8 ± 4.3 out of 26, with a range spanning from 0 to 24. A mere 18% of participants exhibited a low level of knowledge, whereas 43% demonstrated a high level of knowledge.

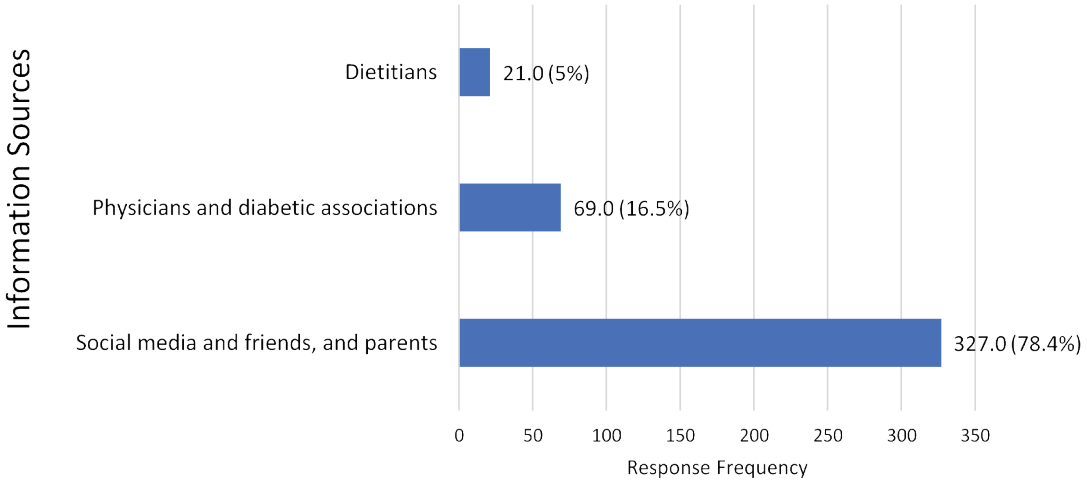

Figure 1. Information sources of the study participants regarding DM (N=417)

Table 1. Sociodemographic characteristics of the study participants (N = 417)	
	N (%)
Age* **(Min.** =12 – **Max.** =19)	15.84 ± 1.84
Sex	
Male	303 (72.7)
Female	114 (27.3)
Smoking	
Yes	116 (27.8)
No	277 (66.4)
Ex-smoker	24 (5.8)
Type of school	
Private	203 (48.7)
Public	214 (51.3)
Mother's education	
Secondary school or less	183 (43.9)
Undergraduate	197 (47.2)
Postgraduate	37 (8.9)
Father's education	
Secondary school or less	178 (42.7)
Undergraduate	217 (52)
Postgraduate	22 (5.3)
Family income (JD/month)	
< 500	116 (27.8)
500 – 1,000	197 (47.2)
> 1,000	104 (24.9)
Vitamins and minerals supplements use	
Yes	201 (48.2)
No	216 (51.8)
Physical activity outside school	
Yes	120 (28.8)
Sometimes	125 (30)
No	172 (41)
Physical activity inside school	
Yes	162 (38.8)
Sometimes	81 (19.4)
No	174 (41.7)
* Values are expressed as mean ± SD. Abbreviation: JD: Jordanian Dinar.	

Table 2. Participants' knowledge responses frequency distribution (N = 417)				
DM definition				
	Low (%)	**Increase (%)**	**No change (%)**	**I don't know (%)**
Blood sugar level changes in DM	47 (11.27)	328 (78.66)	5 (1.20)	3 (37)
Organ damage that leads to DM				
	Yes (%)	**No (%)**	**I don't know (%)**	
Pancreas	358 (85.85)	20 (4.80)	39 (9.35)	
3) DM treatment				

The existence of a cure for DM	87 (20.86)	245 (58.75)	85 (20.38)
The efficacy of the following management in controlling blood sugar			
Insulin injection	379 (90.89)	12 (2.88)	26 (6.24)
Oral hypoglycemic medications	250 (59.95)	76 (18.23)	91 (21.82)
Regular physical activity	340 (81.53)	35 (8.39)	42 (10.07)
Avoiding sugary foods and drinks	356 (85.37)	32 (7.67)	29 (6.95)
Regular herbal consumption (cinnamon and ginger)	298 (71.46)	35 (8.39)	84 (20.14)
DM risk factors			
Positive family history for DM	375 (89.93)	18 (4.32)	24 (5.76)
Overweight and obesity	375 (89.93)	24 (5.76)	18 (4.32)
High sugar consumption	349 (83.69)	36 (8.63)	32 (7.67)
Sedentary lifestyle	240 (57.55)	95 (22.78)	82 (19.66)
Stress	294 (70.50)	56 (13.43)	67 (16.07)
DM symptoms			
Excessive thirst	345 (82.73)	26 (6.24)	46 (11.03)
Loss of appetite	149 (35.73)	156 (37.41)	112 (26.86)
Polyuria	376 (90.17)	14 (3.36)	27 (6.47)
Abdominal pain	118 (28.30)	168 (40.29)	131 (31.41)
Palpitations caused by high blood sugar	266 (63.79)	64 (15.35)	87 (20.86)
Slow wound healing	342 (82.01)	31 (7.43)	44 (10.55)
DM complications			
Stroke	219 (52.52)	82 (19.66)	116 (27.82)
Heart attack	226 (54.20)	79 (18.94)	112 (26.86)
Hepatitis	198 (47.48)	94 (22.54)	125 (29.98)
Kidney failure	279 (66.91)	61 (14.63)	77 (18.47)
Arthritis	216 (51.80)	77 (18.47)	124 (29.74)
Total knowledge scores* (Min. =0 – **Max.** =24).	16.8 ± 4.3		
Poor (0 – 13)	76 (18.23)		
Moderate (14 – 18)	161 (38.61)		
High (19 – 26)	180 (43.17)		
* Values are expressed as mean ± SD. Abbreviation: DM: Diabetes mellitus.			

Table 3 presents the analysis of the association between participants' sociodemographic and lifestyle characteristics, and their respective categories of total knowledge scores regarding (DM). The crude model revealed a statistically significant lower level of moderate knowledge among male participants compared to females, with an odds ratio (OR) of 0.484 (95% confidence interval [CI]: 0.268, 0.873). This association remained significant even after adjusting for confounding factors in the fully adjusted model, with an OR of 0.501 (95% CI: 0.260, 0.968). Furthermore, non-smokers exhibited a higher level of knowledge in comparison to smokers, as indicated by an OR of 1.943 (95% CI: 1.096, 3.445) in the crude model and an OR of 1.986 (95% CI: 1.030, 3.831) in the fully adjusted model. Notably, in the crude model only, individuals who did not use vitamins and minerals supplements demonstrated a lower level of knowledge compared to supplement users, with an OR of 0.565 (95% CI: 0.327, 0.976).

Table 4 presents the assessment of participants' attitudes towards (DM). The mean total attitudes score is reported as 2.3 ± 1.6 out of a possible score of 6, ranging from 0 to 6. Only 24% of the participants demonstrated good attitudes, while the majority (76%) displayed poor attitudes.

The relationship between participants' sociodemographic and lifestyle characteristics, and their respective categories of total attitudes scores towards DM, is depicted in Table 5. The crude model revealed that obtaining information about (DM) from physicians and diabetic associations was associated with good attitudes, with an odds ratio (OR) of 2.180 (95% confidence interval [CI]: 1.254, 3.791). This association remained significant even after adjusting for potential confounding factors in the fully adjusted model, with an OR of 2.162 (95% CI: 1.216, 3.844).

Table 3. Multinomial logistic regression of the predictor variables of the knowledge regarding DM among DM adolescent's group (N = 417)

	Univariate model				Multivariate model			
Variable	Moderate knowledge (14 – 18)		High knowledge (19 –26)		Moderate knowledge (14 – 18)		High knowledge (19 –26)	
	OR	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Age	1.017	(0.876, 1.180)	0.957	(0.827, 1.108)	1.067	(0.906, 1.256)	1.006	(0.857, 1.181)
Sex								
Female	Ref.							
Male	0.484	(0.268, 0.873) *	0.589	(0.334, 1.041)	0.501	(0.260, 0.968) *	0.561	(0.295, 1.067)
Smoking								
Yes	Ref.							
No	2.033	(1.129, 3.664)	1.943	(1.096, 3.445) *	1.986	(1.030, 3.831) *	1.873	(0.983, 3.567)
Former smoker	4.769	(0.993, 22.907)	3.369	(0.691, 16.438)	4.212	(0.826, 21.489)	2.913	(0.563, 15.070)
Type of school								
Public	Ref.							
Private	0.958	(0.555, 1.654)	0.720	(0.421, 1.233)	0.815	(0.431, 1.539)	0.570	(0.304, 1.068)
Mother's education								
Secondary school or less	Ref.							
Undergraduate	1.583	(0.896, 2.798)	1.514	(0.866, 2.647)	1.510	(0.806, 2.827)	1.441	(0.776, 2.675)
Postgraduate	2.485	(0.777, 7.949)	2.293	(0.723, 7.266)	2.157	(0.577, 8.065)	2.361	(0.642, 8.684)
Father's education								
Secondary school or less	Ref.							
Undergraduate	0.997	(0.568, 1.752)	1.015	(0.586, 1.759)	0.820	(0.419, 1.604)	0.898	(0.465, 1.734)
Postgraduate	2.134	(0.569, 8.012)	0.846	(0.200, 3.587)	1.136	(0.255, 5.061)	0.472	(0.095, 2.356)
Family income (JD/month)								
< 500	Ref.							
500 – 1,000	1.316	(0.700, 2.474)	1.019	(0.551, 1.886)	1.186	(0.568, 2.478)	1.022	(0.497, 2.100)
> 1,000	1.971	(0.886, 4.384)	1.885	(0.868, 4.094)	2.066	(0.802, 5.323)	2.207	(0.876, 5.561)
Vitamins and minerals supplements use								
Yes	Ref.							
No	0.657	(0.376, 1.146)	0.565	(0.327, 0.976) *	0.800	(0.440, 1.454)	0.647	(0.359, 1.164)
Physical activity outside school								
Yes	Ref.							
No	1.054	(0.544, 2.042)	0.861	(0.452, 1.639)	1.124	(0.536, 2.358)	1.046	(0.506, 2.165)
Sometimes	1.218	(0.591, 2.512)	1.029	(0.508, 2.084)	1.043	(0.470, 2.316)	0.991	(0.452, 2.174)
Physical activity inside school								
Yes	Ref.							
No	0.796	(0.431, 1.473)	0.551	(0.302, 1.004)	0.861	(0.437, 1.696)	0.625	(0.322, 1.213)
Sometimes	1.181	(0.535, 2.605)	0.793	(0.362, 1.736)	1.122	(0.474, 2.660)	0.754	(0.321, 1.769)
Information source for DM								
Social media, family and friends	Ref.							
Physicians and DM associations	1.252	(0.585, 2.682)	1.172	(0.552, 2.488)	1.376	(0.620, 3.056)	1.229	(0.558, 2.705)
Dietitians	1.107	(0.328, 3.738)	0.859	(0.249, 2.960)	0.893	(0.249, 3.195)	0.690	(0.188, 2.528)

Notes: The poor knowledge category is reference category (0 – 13), and it was removed from the table
*p-value ≤ 0.05. Univariate model= unadjusted model. Multivariate model 1 included all sociodemographic variables listed in the table. Abbreviations: OR = Odds ratio; CI = Confidence interval; JD = Jordanian Dinar; DM = Diabetes mellitus

Table 4. Participants' attitudes responses frequency distribution (N = 417)			
	Yes (%)	**No (%)**	**I don't know (%)**
Diet alone is better than diet and medications in controlling DM	268 (64.27)	109 (26.14)	40 (9.59)
Metformin may lead to kidney damage	132 (31.65)	28 (6.71)	257 (61.63)
Long term medications use may lead to organ failure	168 (40.29)	72 (17.27)	177 (42.45)
Using insulin injection is harmful	163 (39.09)	105 (25.18)	149 (35.73)
Ginger, cinnamon, and fenugreek are good as medications	107 (25.66)	200 (47.96)	110 (26.38)
Alternative medicines are better than usually prescribed methods (diet and medications)	100 (23.98)	153 (36.69)	164 (39.33)
Inevitable complications for DM	100 (23.98)	217 (52.04)	100 (23.98)
Total attitudes scores* (Min. =0 – **Max.** =6)	2.3 ± 1.6		
Poor (0 – 3)	317 (76.02)		
Good (4 – 7)	100 (23.98)		
* Values are expressed as mean ± SD. Abbreviation: DM = Diabetes mellitus			

Table 5. Logistic regression of the predictor variables of the attitudes regarding DM among DM adolescent's group (N = 417)				
	Univariate model		**Multivariate model**	
Variable	Good attitudes (4 – 7)		Good attitudes (4 – 7)	
	OR	**95% CI**	**OR**	**95% CI**
Age	1.028	(0.909, 1.162)	1.015	(0.890, 1.158)
Sex				
Female	Ref.			
Male	0.854	(0.510, 1.429)	0.917	(0.516, 1.630)
Smoking				
Yes	Ref.			
No	0.710	(0.434, 1.163)	0.791	(0.458, 1.366)
Former smoker	0.838	(0.306, 2.297)	0.945	(0.322, 2.777)
Type of school				
Public	Ref.			
Private	1.191	(0.759, 1.868)	1.206	(0.714, 2.039)
Mother's education				
Secondary school or less	Ref.			
Undergraduate	1.075	(0.674, 1.714)	1.121	(0.665, 1.890)
Postgraduate	0.611	(0.239, 1.562)	0.548	(0.183, 1.639)
Father's education				
Secondary school or less	Ref.			
Undergraduate	0.916	(0.573, 1.462)	0.843	(0.482, 1.474)
Postgraduate	1.794	(0.705, 4.565)	1.901	(0.632, 5.719)
Family income (JD/month)				
< 500	Ref.			
500 – 1,000	1.303	(0.744, 2.281)	1.211	(0.640, 2.290)
> 1,000	1.563	(0.836, 2.924)	1.547	(0.735, 3.255)
Vitamins and minerals supplements use				
Yes	Ref.			
No	0.863	(0.550, 1.353)	0.959	(0.590, 1.558)
Physical activity outside school				
Yes	Ref.			

No	1.096	(0.626, 1.918)	1.027	(0.552, 1.913)
Sometimes	1.351	(0.752, 2.428)	1.257	(0.660, 2.396)
Physical activity inside school				
Yes	Ref.			
No	1.638	(0.986, 2.721)	1.585	(0.910, 2.761)
Sometimes	1.161	(0.605, 2.226)	1.085	(0.540, 2.181)
Information source for DM				
Social media and friends, and parents	Ref.			
Physicians and diabetic associations	2.180	(1.254, 3.791) *	2.162	(1.216, 3.844) *
Dietitians	0.601	(0.172, 2.098)	0.627	(0.174, 2.259)
Notes: The poor attitudes category is a reference category (0 – 3), and it was removed from the table. *p-value≤ 0.05. Univariate model= unadjusted model. The multivariate model included all sociodemographic variables listed in the table. Abbreviations: OR = Odds ratio; CI = Confidence interval; JD = Jordanian Dinar. DM = Diabetes Mellitus				

Table 6 shows the mean total practice score among participants, 2.6 ± 1.2 out of a possible score of 4, ranging from 0 to 4. Only 29% of the participants exhibited good practices, while the majority (71%) displayed poor practices, as outlined in Table 6.

Table 7 provides an analysis of the relationship between participants' sociodemographic and lifestyle characteristics and their respective categories of total practice scores toward (DM). The crude model revealed that individuals who reported a lack of physical activity outside of school exhibited a significantly lower level of good practices compared to those who reported being physically active outside of school, with an odds ratio (OR) of 0.426 (95% confidence interval [CI]: 0.254–0.713). This association remained statistically significant even after adjusting for confounding factors in the fully adjusted model, with an OR of 0.417 (95% CI: 0.232–0.749). Furthermore, frequent engagement in physical activity outside of school was associated with a significantly lower level of good practices in the fully adjusted model, with an OR of 0.512 (95% CI: 0.279, 0.939). Moreover, the fully adjusted model demonstrated that higher family income (> 1,000 JD/month) was associated with a lower level of good practices compared to the reference group with income below 500 JD/month, with an OR of 0.392 (95% CI: 0.186, 0.824).

Table 6. Participants' practices responses frequency distribution (N = 417)			
	Yes (%)	**No (%)**	**I don't know (%)**
Seek treatment if a family member gets DM	380 (91.13)	15 (3.60)	22 (5.28)
Do regular exercise	249 (59.71)	146 (35.01)	22 (5.28)
Check blood sugar annually	183 (43.88)	205 (49.16)	29 (6.95)
Avoiding refined sugar	270 (64.75)	120 (28.78)	27 (6.47)
Total practices scores* (Min. =0 – **Max.** =4)	2.6 ±1.2		
Poor (0 – 3)	298 (71.46)		
Good (4)	119 (28.54)		
* Values are expressed as mean ± SD. Abbreviation: DM = Diabetes mellitus			

Table 7. Logistic regression of the predictor variables of the practices regarding DM among DM adolescent's group (N = 417)				
	Univariate model		**Multivariate model**	
Variable	Good practices (4)		Good practices (4)	
	OR	**95% CI**	**OR**	**95% CI**
Age	0.950	(0.846, 1.066)	0.942	(0.829, 1.071)
Sex				
Female	Ref.			
Male	1.295	(0.812, 2.066)	0.891	(0.521, 1.525)
Smoking				

Yes	Ref.			
No	0.875	(0.543, 1.409)	0.652	(0.380, 1.121)
Former smoker	1.157	(0.454, 2.953)	0.785	(0.285, 2.163)
Type of school				
Public	Ref.			
Private	1.102	(0.721, 1.686)	1.270	(0.765, 2.108)
Mother's education				
Secondary school or less	Ref.			
Undergraduate	0.857	(0.544, 1.349)	0.869	(0.520, 1.452)
Postgraduate	2.142	(1.041, 4.409) *	1.532	(0.642, 3.659)
Father's education				
Secondary school or less	Ref.			
Undergraduate	0.801	(0.514, 1.248)	0.828	(0.486, 1.411)
Postgraduate	2.358	(0.963, 5.772)	2.854	(0.990, 8.222)
Family income (JD/month)				
< 500	Ref.			
500 – 1,000	0.795	(0.484, 1.307)	0.642	(0.356, 1.159)
> 1,000	0.684	(0.380, 1.234)	0.392	(0.186, 0.824) *
Vitamins and minerals supplements use				
Yes	Ref.			
No	0.842	(0.551, 1.289)	0.886	(0.556, 1.414)
Physical activity outside school				
Yes	Ref.			
No	0.426	(0.254, 0.713) *	0.417	(0.232, 0.749) *
Sometimes	0.604	(0.354, 1.032)	0.512	(0.279, 0.939) *
Physical activity inside school				
Yes	Ref.			
No	0.686	(0.420, 1.121)	0.740	(0.428, 1.280)
Sometimes	1.551	(0.887, 2.712)	1.855	(0.997, 3.452)
Information source for DM				
Social media and friends, and parents	Ref.			
Physicians and diabetic associations	1.233	(0.703, 2.161)	1.118	(0.615, 2.031)
Dietitians	1.317	(0.515, 3.368)	1.310	(0.462, 3.718)

Notes: The poor practices category is reference category (0 – 3), and it was removed from the table. *p-value ≤ 0.05. Univariate model= unadjusted model. The multivariate model included all sociodemographic variables listed in the table. Abbreviations: OR = Odds ratio; CI = Confidence interval; JD = Jordanian Dinar; DM = Diabetes mellitus.

DISCUSSION

This study aimed to assess the (KAP) concerning (DM) among a specific cohort of adolescents who have been diagnosed with (DM). Additionally, the study aimed to identify the factors associated with (KAP). The current study revealed significant findings among the adolescents diagnosed with (DM) in Amman, Jordan. The study uncovered a relatively high percentage of smokers (27.8%), this is consistent with previous studies conducted in Jordan, where it was reported the prevalence of smokers was 35.6%.[22] Likely due to the implementation of stricter restrictions on adolescent smoking, the prevalence of smoking among adolescents in studies from the USA was found to be lower at 15.6%.[23] A noteworthy finding was that approximately 51.8% of the study subjects reported using dietary supplements, reflecting a substantial reliance on such supplements among adolescents in our sample. This prevalence is similar to rates indicated in a few studies among Arab adolescents in the Middle East.[24-26]

In the context of analyzing knowledge scores within the study sample, it was observed that merely 18% of the participants displayed a low level of knowledge, whereas 43% showcased a significant level of knowledge. These results are relatively similar to findings reported in studies conducted in Kuwait,[27] but higher than the percentages reported in Saudi Arabia[28]

and Bangladesh.[12] The observed variations in knowledge levels among the studied populations may be attributed to differences in various sociodemographic variables. According to the current results, male adolescents exhibited a notably reduced level of moderate knowledge in comparison to their female counterparts. This finding further reinforces the results from previous studies that have emphasized gender disparities in knowledge related to (DM) among adolescents. For example, a study conducted among Bangladeshi adolescents yielded similar results, with females displaying superior (DM) knowledge when compared to males.[12] Additionally, studies conducted among Kuwaiti and Saudi adolescents found a significant difference in diabetes-related knowledge between males and females, with better knowledge found among female adolescents with (DM) in both studies.[27,28] Nevertheless, other scholars did not report the association between adolescent gender and their knowledge.[29]

While previous research has extensively explored the relationship between smoking habits and its impact on type 1 and type 2 (DM).[30-32] there has been a notable gap in investigating the association between smoking status and adolescent knowledge about (DM). In our study, we sought to address this gap and found that non-smoker adolescents demonstrated a higher level of knowledge about (DM) compared to smokers. Interestingly, our findings align with previous research conducted among adults, where individuals with greater (DM) knowledge were less likely to engage in smoking behaviors.[33] This would suggest a similar pattern of association between knowledge about (DM) and smoking habits across different age groups.

In contrast to the findings of a study conducted in Saudi Arabia,[28] our study revealed no significant relationship between income and knowledge. This disparity in results might be attributed to the utilization of a multivariate regression model in our study, whereas the Saudi authors employed a univariate model to assess the association. An additional study in Bangladesh[12] reported similar initial findings of an association between income and knowledge, as indicated by the unadjusted Odds ratio. Nevertheless, this association was attenuated when adjusting for other relevant variables in their analysis. The use of different statistical approaches across these studies highlights the importance of considering various factors when interpreting the relationship between income and knowledge. It is noteworthy to highlight that in our comprehensive multivariate models, we observed a significant association between the income of adolescents' families and their health-related practices. Surprisingly, higher family income levels (> 1,000 JD/month) were found to be correlated with lower rates of good practices compared to the reference group with lower income levels (< 500 JD/month). In line with our multivariate analysis, both the mother's and father's education demonstrated no significant association with adolescents' knowledge about diabetes. These findings are consistent with the adjusted model conducted by Akter and colleagues,[12] which also reported no significant relationship. However, our results contradict the findings of the univariate association analysis carried out by Algthami and colleagues which suggested a significant univariate association between parental education (mothers in particular) and knowledge about (DM).[28]

Recommendations

Developing and implementing targeted educational programs to improve knowledge about (DM) among adolescents diagnosed with (DM) are recommended. In addition, designing interventions are needed to promote positive attitudes towards (DM) among adolescents with (DM). Collaboration with physicians and diabetic associations is crucial to provide accurate and reliable information about DM, which can help improve attitudes and reduce the stigma associated with the (DM) diagnosis. We encourage adolescents with (DM) to engage in regular physical activity, both within and outside of school, and spread more information on resources and support on (DM) available to enhance their understanding of the benefits of physical activity in managing (DM) and maintaining overall health. Finally, further research is warranted to explore the factors influencing (KAP) regarding (DM) among adolescents with (DM). We recommend future studies to investigate other potential variables, such as the impact of parental education levels and social support, to gain a comprehensive understanding of the topic.

CONCLUSION

In conclusion, this study provides valuable insights into (KAP) regarding (DM) among adolescents diagnosed with (DM) and the associated factors and provides a foundation for informed, data-driven interventions that can enhance the health and well-being of adolescents with DM. Regarding knowledge about DM, the majority of participants demonstrated a moderate to high level of knowledge. Male participants exhibited lower knowledge levels compared to females, while non-smokers had higher knowledge levels than smokers. Supplement users displayed higher knowledge levels compared to non-users. Participants' attitudes towards (DM) were generally poor. Obtaining information about (DM) from physicians and diabetic associations was associated with more positive attitudes. In terms of practices related to (DM) management, the majority of participants had poor practices. Lack of physical activity outside of school was associated with poorer practices, while higher family income was associated with lower levels of good practices. These findings highlight the need for interventions and educational programs to improve (KAP) regarding (DM) among adolescents with (DM). Targeted efforts can focus on addressing specific factors influencing KAP, such as gender differences, smoking status, physical activity levels, and socioeconomic status. By enhancing these aspects, better management of (DM) can be achieved, ultimately leading to improved health outcomes for adolescents with (DM).

Strength and limitations

This study has many strengths and limitations. To the best of the authors' knowledge, this study was the first study conducted in Jordan that focused on this topic among adolescents who were diagnosed with (DM). It provides a comprehensive assessment

of the (KAP) regarding (DM) among a specific cohort of adolescents diagnosed with (DM) with a representative number of participants for analysis. The study successfully identified the associated factors, such as gender, smoking status, and socioeconomic status, that influence the participants (KAP). Furthermore, the study's findings present an opportunity to develop targeted interventions and educational programs aimed at improving knowledge, attitudes, and practices regarding (DM) among adolescents with (DM). On the other hand, participants may provide socially desirable responses or overestimate their positive responses in (KAP) leading to response bias. Finally, the study identifies various factors that influence KAP, but other unmeasured or unknown confounding factors may also impact the outcomes.

AUTHORS' CONTRIBUTIONS

Nour Amin Elsahoryi played the main role in the study's conceptualization and design, provided guidance in data collection and analysis, and took the lead in writing the manuscript and revising it based on feedback from co-authors and reviewers. Took responsibility for the accuracy and integrity of the research presented. Mohand Musa Odeh contributed to the draft-writing process. Mervat Alsous reviewed and validated the study, and approved the final version of the manuscript. Donia Hussain Kastero, Leen Firas Al-Mughrabi, and Samar Ahmad Darras played a significant role in data collection. Abeer Ali Aljahdali conducted data analysis, contributed to the draft-writing process, and provided critically reviewing and editing the manuscript for important intellectual content. All authors have read and approved the final version of the manuscript, taking responsibility for the accuracy and integrity of the research presented. Their individual contributions have significantly contributed to the quality and scientific rigor of this academic research.

DECLARATIONS

Competing interests

The authors declare that they have no competing interests.

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AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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