

Knowledge, Attitude, and Practice Regarding Diabetes Mellitus among General Public and Diabetic Patients in Riyadh, Saudi Arabia

Alzahrani Salem, Alshammari Majed, Mushabbab Abdulaziaz Mahfooz Mustafa, Alsebyani Abdulsalam, Syed Mohammed Basheeruddin Asdaq, Al-Yamani Mohammed

Department of Pharmacology and Therapeutics, College of Pharmacy, Al Maarefa Colleges for Science and Technology, Riyadh, Saudi Arabia

Abstract

Background: Awareness among patients and general population is a major determinant for prevention of diabetes and its complications. The elucidation of status of knowledge and attitude as well as prevalent practices are the principle indicators of awareness in various populations. **Aim:** The aim of this study was to explore knowledge, attitude and practice (KAP) regarding diabetes mellitus (DM) among nondiabetic (nonDM) population and diabetes mellitus (DM) patients in Riyadh, Saudi Arabia. **Methods:** A cross-sectional study was conducted among adults (784, aged 18 years and above, 47% male and 53% female) participants selected purposively from the outpatient department of two hospitals of Riyadh. After obtaining consent from participants, KAP were assessed by a validated, pre-structured, interviewer-administered questionnaire (Arabic translated). The results were evaluated as average scores as well as levels in KAP. Univariate and bivariate statistical analysis were done as appropriate. Multivariate linear regression was done to examine the association between diabetes related KAP and other covariates. **Results:** Overall, high percentage of participants exhibited good knowledge, attitude and practice score, 75%, 46% and 43%, respectively. Among DM participants, knowledge level was good in 32%, while 56% and 55% of them showed positive attitude and practice, whereas, in the nonDM group, only 25% demonstrated good knowledge and 48% & 52% respectively, showed positive attitude and practice. The KAP towards diabetes was found to be better among people who were living with diabetes compared to people without diabetes. DM males scored better both in knowledge and attitude, compared to their female counterparts ($p < 0.001$). However, females showed better practice compared to males. The level of education positively correlated with KAP scores ($p < 0.001$). On linear regression analysis, knowledge scores correlated strongly with marital status, location, diabetic state, and attitude. On the other hand, the attitude score was found to be associated with sex, DM status and knowledge. Finally, practice score was found to be associated with educational level, location, DM status, knowledge and attitude. **Conclusions:** Even though the majority (75%) of the participants have knowledge on diabetes, but their level of knowledge is not high (overall only 29% have good knowledge), also attitude and practice is not very encouraging. It appears that the current status of knowledge on diabetes did not translate into positive attitude and practices. Therefore, more emphasis should be given to address the issue of negative attitude and practices towards diabetes mellitus among general public as well as DM patients in Riyadh through community educational programs

Key words: Riyadh, Diabetes mellitus, Knowledge, Attitude, Practice

INTRODUCTION

Diabetes mellitus (DM) is one of most commonly fast growing noncommunicable disease threats to global public health. The alarming situation of consistent rise is no different in Saudi Arabia.^[1] In the past few decades, several major socioeconomic changes have taken place in Saudi Arabia. The growth and prosperity have brought significant changes in the lifestyle of the people. Most notably, eating

Address for correspondence:

Dr. Syed Mohammed Basheeruddin Asdaq,
Department of Pharmacology and Therapeutics,
College of Pharmacy, Al-Maarefa Colleges of
Science and Technology, PO Box: 71666, Dariyah,
Riyadh - 11597, KSA. Fax: 00966-4903501.
E-mail: sasdaq@gmail.com

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habits are less healthful, and the level of physical activity has declined. There is increased consumption of fast foods and sugar-dense beverages (e.g., sodas). Simultaneously, technological advances - cars, elevators, escalators, remotes, and smartphones - have led to a decrease in the level of activity. Furthermore, traditional dependence on locally grown natural produce such as fruits, vegetables, and wheat has also changed. This has resulted in the dramatic increase in the diabetes prevalence.^[2]

A report published recently from Riyadh has predicted the high prevalence of DM in Saudi Arabia with a projection of 35.37% in 2020; 40.8% in 2025; and 45.8% by the end of 2030.^[3] This figures are alarming to indicate a rapidly increasing prevalence in the Kingdom of Saudi Arabia. Therefore, it is imperative to include the diabetic preventive measures on a war footing basis in national health policy to curtail the burden of the disease.

Problems associated with DM can be reduced by early diagnosis and proper management.^[4] The desired goal in the management of DM is to avoid development of macro- and micro-vascular complications by achieving optimal glycemic control.^[4] This involves lifestyle modification, including regular exercise, healthy diet, and weight loss in addition to compliance with effective drug therapy. Therefore, apart from good health-care professional involvement and governmental support, patients' self-knowledge and their attitude play a crucial role in obtaining a good healthy life.^[5] Patients with good knowledge on diabetes and its complications seek proper treatment and care and take charge of their health.^[6] There is strong evidence that individuals who are educated and diligent with their diabetes self-care achieve better and durable diabetic control.^[7,8] Furthermore, previous studies on knowledge, attitude, and practice (KAP) on diabetes have supported the needs of greater awareness of prevention, diagnosis, and risk factor control in diabetes.^[9]

As evidenced above, good KAPs of diabetes in diabetic patients as well as in general population, is helpful in effective prevention and management of diabetes among population; however, there is dearth of such study done in Saudi Arabia except a few that mainly focused on small cities such as Jizan and Najran, respectively.^[10,11] Therefore, this study was designed to evaluate KAP toward diabetes in diabetic patients as well as in general population of the capital city of Saudi Arabia, Riyadh.

SUBJECTS AND METHODS

Study setting

In DM cohort, using the purposive sampling method, all subjects attending the health-care facilities of two hospitals during the study period (September 2017 to December 2017) were included in this study. In non-DM cohort, samples were

selected based on inclusion criteria among those visiting shopping malls and general public places.

Study population

It was a cross-sectional study conducted among 784 adult subjects (aged 18 years and above; 367 males and 417 females, 418 non-diabetic [non-DM] and 365 DM). The study population was adults aged 18 years and above from both genders. People who were <18 years old, severe physical illness, mentally handicapped, had attended a diabetes education program in the past 1 year, or declined to participate in this study were excluded.

Development of KAP questionnaire and data collection

Opinion and advice were obtained from teachers, experts from relevant fields, and advisors throughout the initial period of constructing the questionnaire. Important domains relevant to KAP were recognized after an extensive review of similar and validated questionnaires used in other settings.^[12-15] The necessary modifications were done considering lifestyle, social, cultural, regional, and economic factors related to Saudi Arabian population. Face validity of the content of the questionnaire was ensured with the help of experts working with diabetic patients. Subsequently, content validity was done in consultation after meeting several experts in diabetes such as dietician, nursing staff, diabetic educator, psychologist, and diabetic patients.

Initial questionnaire draft was prepared in English, after its validation and approval from subject experts; questionnaire was translated in the native language of Saudi Arabia residents, Arabic. Arabic translated questionnaire was re-checked for content validation. Pretesting of the questionnaire was performed to gather information on its understandability, time consumed by each question, consistency among related variables and acceptability.

Data were collected individually by a personal visit of five data collectors. For standardized data collection, all the collectors were given extensive training over 1 week on relevant issues such as patient counseling and crosschecking of answers.

The questionnaire was divided into two sections. Section 1 consisted of sociodemographic information, age, gender, educational level, occupation, nationality, location, marital status, DM status, and family history of the disease. Section 2 consisted of issues related to knowledge, attitude, and self-care practice. Knowledge was measured using 12 main questions related to diagnosis, risk factors, prevention, and complications of DM. Examples of questions covering knowledge were "What happens to blood sugar in diabetes?" "Dysfunction of which of the following organs leads to DM?"

“What is the best way to diagnose DM?” “Do you think diabetes can affect other organs?” Answers were provided with two categorical responses “yes,” “No,” and “Don’t know.” One point was offered for each correct response, and the total score was calculated. Score range from 0 to 6, 7–9, and 10–12 were considered as poor, moderate, and good knowledge, respectively.

An attitude was assessed using eight questions related to adherence to treatment of DM. The questions were “When you or your family member or friend has diabetes, should they seek treatment?”, “Do you think that controlling glucose with diet alone is better than that of controlling glucose with diet and medications?” “Can long-term use of metformin/Glucofage cause kidney damage?” “Does long-term drug use cause organ failure?” “Does insulin cause harmful effects to the body?” “Do you think that the use of herbal therapy and alternative treatment such as acupuncture, yoga, hypnosis as well as relaxation exercises are better than modern medicine for treatment of diabetes?” “Do you believe that there is not much use in trying to have good blood sugar control, because complications of diabetes will happen anyway?” “Do you think that attending educational awareness lectures or patient counseling help in Diabetic self-care?” Responses to above questions were assessed with categorical responses “Yes,” “No,” and “Don’t know.” Participants who got four or more marks out of eight were categorized as having positive attitudes.

Practices were assessed using nine questions on preventive strategies; self-care, dietary modifications and monitoring of blood sugar. The questions were, Do you take high calories of snacks between meals? Do you control your weight? Do you take food timely? Do you have practice of eating out at least once a week/month? Do you have habit of regular exercise thrice/twice in a week? Do you smoke or exposed to passive smoking? Do you have practice of checking blood sugar level regularly (weekly/monthly)? Do you control your blood pressure level? Do you control your blood pressure level? The feedback on the above statements was evaluated with categorical responses “Yes,” “No,” and “Don’t know.” Participants who got five or more marks out of nine were categorized as having positive practices.

Operational definitions

Knowledge: “Knowledge in this study was defined as the understanding of information regarding diabetes on 12 items.”

Attitude: “Attitude in this study was defined as the approach of the populations toward the 8 items related to diabetes.”

Practice: “Practice in this study was defined as the pattern and regularity of practices of the 9 items related to diabetes.”

Ethical approval

Ethical approval for this study was obtained from an Ethical Review Committee of College of Pharmacy, Al-Maarefa College of Science and Technology, Riyadh. Informed written consent was obtained from all individuals before data collection. Participants were informed of their rights to withdraw from the study at any stage.

Statistical analysis

Participant’s sociodemographic characteristics including age, gender, educational level, occupation, nationality, location, marital status, DM status, and family history of the disease were reported using descriptive statistics. The KAP on diabetes was compared between gender, age categories, marital status, location, nationality, and level of education using *t*-test and analysis of variance (ANOVA) to test the equality between DM and non-DM groups. All association was considered significant at *P* value of ≤ 0.05 . Multivariable linear regression modeling was applied to determine the variable associated with diabetes-related KAP. The adjusted R^2 was recorded to understand the percentage of variation explained by only the independent variables that actually affect the dependent variable. Statistical software SPSS (IBM-SPSS., version 23) was used in the analysis of data.

RESULTS

Demographic characteristics

As shown in Table 1, a total of 784 study participants, most of them were in a young age group of 18–30 years (39%). Among them, a female ($n = 417$, 53%) preponderance was observed. A higher proportion of the subject (42%) possess a bachelor degree, 30% of them had high school qualification. More than 57% of the respondents were married and 90% of them were residents of urban part of Riyadh. An interesting observation of this study was a denial of smoking by a high percentage of participants (76%), while 58% and 53% of them denied routine use of high intake of lipid and fast food, respectively. However, 37% of them were practitioners of true healthy food. In the disease state, only 47% of the surveyors were diabetic and remaining 53% were non-diabetic. Among DM cohort, around 57% were suffering from DM during past 1–10 years. Slightly more than half of the participants (48%) have someone in the family suffering from DM with 37% of them were parents. Most of the respondents denied DM in spouse, siblings, and children.

KAP score and KAP level

The average KAP score (%) of the respondents was 75, 45.78, and 42.60, respectively [Figure 1]. Among the non-DM, the

Table 1: Demographic characteristics of the study participants

Variables	n (%)
Age (years)	
18–30	310 (38.65)
31–45	272 (33.91)
> 45	220 (27.43)
Gender	
Male	367 (46.8)
Female	417 (53.2)
Educational level	
Ph.D.	20 (2.6)
Master	94 (12.0)
Bachelor	330 (42.1)
High school	241 (30.7)
Intermediate school	51 (6.5)
Primary school	22 (2.8)
Illiterate	26 (3.3)
Marital status	
Married	452 (57.7)
Single	332 (42.3)
Location	
Urban	703 (89.7)
Rural	81 (10.3)
Nationality	
Saudi	630 (80.4)
Non Saudi	147 (18.8)
lifestyle smoking	
Yes	185 (23.6)
No	597 (76.1)
lifestyle lipid intake	
Yes	330 (42.1)
No	454 (57.9)
lifestyle fast food intake	
Yes	370 (47.2)
No	413 (52.7)
lifestyle healthy food	
Yes	296 (37.8)
No	486 (62.0)
Are you suffering from DM?	
Yes	365 (46.6)
No	418 (53.3)
If yes to above question, since how long you suffer from this? (year)	
<1	60 (16.2)
>1<5	107 (28.9)

(Contd...)

Table 1: (Continued)

Variables	n (%)
>5<10	105 (28.4)
>10	97 (26.2)
Do you have anyone in the family with DM?	
Yes	376 (48.0)
No	396 (50.5)
DM in parents?	
Yes	291 (37.1)
No	493 (62.9)
DM in spouse?	
Yes	72 (9.2)
No	712 (90.8)
DM in sibling?	
Yes	81 (10.3)
No	703 (89.7)
DM in children?	
Yes	38 (4.8)
No	731 (93.2)

DM: Diabetes mellitus

levels of knowledge were poor in 20%, moderate in 54%, and good in 25% of the subjects. The levels of attitude in non-DM participants were described as positive 48% and negative 52%. The levels of practice of the study subjects were found to be positive in 52% and negative in 48% cases. However, for diabetic participants, the levels of knowledge were poor in 23%, moderate in 45%, and good in 32% subjects. Furthermore, the levels of attitude in DM patients were also described as positive in 56% and negative in 44%. The levels of practice of study participants were found to be positive in 55% and negative in 45% of the subjects [Figure 2].

Association of KAP with diabetic status

The KAP toward diabetes was found to be better among people who were living with diabetes compared to people without diabetes. DM males scored both in knowledge and attitude, compared to their counterparts ($P < 0.001$). However, females showed better practice compared to males. Overall KAP was found to be significantly higher ($P < 0.001$) in higher aged (>45 years) participants in each group. In general, participants from urban residence have shown a significantly better attitude ($P < 0.001$) while vice versa in knowledge domain ($P < 0.045$). However, there was no significant difference in practice domain of both these cohorts. There was no significant difference in practice domain in both DM and non-DM participants from Saudi and non-Saudi origin. Among all participants, non-DM has relatively lesser score than the DM in both knowledge and attitude. Furthermore, it is evident from our result that higher educational background

significantly showed a greater scores in terms of KAP both in non-DM and DM groups ($P < 0.001$) [Table 2].

Association of KAP with sociodemographic characteristics

The one-way ANOVA showed significant differences between the mean scores for KAP in the various categories for all the covariates, namely, location, gender, and education. The level of education positively correlated with KAP scores ($P < 0.001$). The pattern was random for other variables.

Multiple linear regressions for the total knowledge scores, total practice scores, and total attitudes scores on covariates identified in the bivariate analysis showed several significant (adjusted) associations. Table 3 shows the results for the KAP score. Regression analysis showed that the knowledge score is associated with marital status, location, DM status, and attitude when knowledge was put as a dependent variable and the covariates of age, sex, location, marital status, DM status, level of education, and attitude score as independent variables. On the other hand, the attitude score was found to be associated

with sex, DM status, and knowledge when attitudes were put as dependent and the covariates of age, sex, location, marital status, DM status, level of education, and knowledge score as independent variables. Finally, the practice score was found to be associated with educational level, location, DM status, knowledge, and attitude when practice was put as dependent and the covariates of age, sex, location, marital status, DM status, level of education, knowledge score, and attitude score as independent variables [Table 3].

DISCUSSION

The state of KAP about diabetes is not a constant subject; it greatly varies from individual to individual based on socioeconomic conditions, cultural beliefs, educational level and their personal likes. In-depth understandings of these variables are imperative to promote and design preventive strategies for averting diabetes and delaying development of its complications. The findings of this research emphasize the presence of gaps in the KAP regarding DM in various sections of the society based on several sociodemographic differences.

There are few studies that explored the relationship between KAP among non-diabetic and DM groups. It has been reported that people living with DM have better KAP scores toward diabetes compared to non-DM subjects.^[16-19] In the present study, the participants' knowledge was assessed based on their understanding of DM, which included the causes, risk factors, symptoms, complications, and treatment options. The diabetes-related knowledge level was found to be almost same in both non-DM and DM respondents with a slight edge toward DM group. However, number of respondents with good knowledge level is higher in DM group compared to non-DM group. This finding is in line with other revelations done elsewhere.^[20]

One of the important revelations of this research was higher knowledge score among both DM and non-DM participants

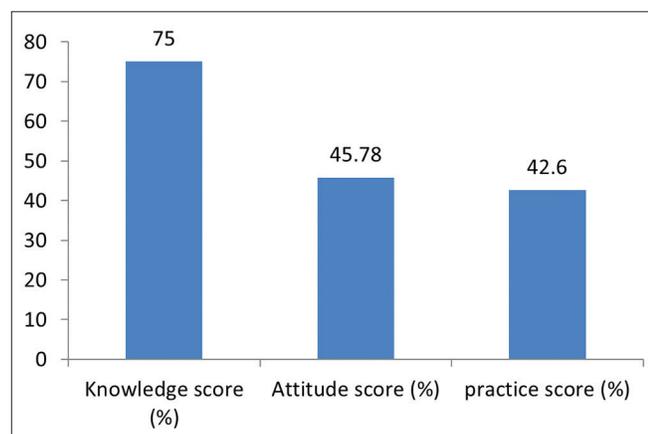


Figure 1: Average knowledge, attitude, and practice score of participants

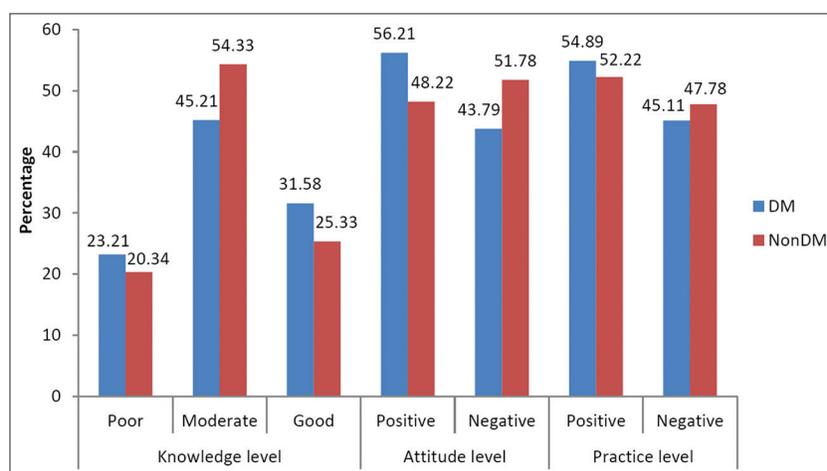


Figure 2: Knowledge, attitude, and practice level among diabetes mellitus and Non-diabetes participants

Table 2: KAP score of the study subjects according to different variables

Variables	Knowledge		Attitude		Practice	
	DM group	NDM group	DM group	NDM group	DM group	NDM group
Age (years)						
18–30	73.64±7.2	73.04±2.1	46.43±0.6	45.60±0.9	43.05±2.3	41.24±2.4
31–45	73.86±2.2	71.01±8.5	46.05±0.8	45.35±0.9	42.95±2.6	41.42±1.8
>45	75.45±3.1	72.38±6.4	46.09±0.9	45.45±0.9	42.80±2.3	42.73±2.1
F/P value*	10.90/0.001		25.35/0.001		2.52/0.014	
Gender						
Male	75.33±6.5	73.39±5.2	47.82±0.8	45.10±1.4	42.41±1.9	42.09±1.4
Female	73.88±6.4	71.25±4.1	46.95±0.9	45.95±1.2	43.30±2.6	41.45±3.3
F/P value	14.95/0.001		50.01/0.001		51.64/0.001	
Education						
Ph.D.	87.25±6.1	83.67±7.2	51.35±1.0	49.61±0.6	49.87±1.7	48.99±0.8
Master	79.79±7.6	77.25±4.6	48.71±1.1	46.43±0.6	46.21±1.2	46.11±0.7
Bachelor	75.35±6.4	73.44±5.9	47.47±0.5	45.39±0.7	44.21±1.3	43.21±0.5
High school	73.58±4.2	70.53±6.8	45.75±0.8	44.43±1.2	41.21±1.4	40.21±0.9
Intermediate school	74.91±6.6	65.21±8.8	42.22±0.9	41.23±1.1	39.21±1.7	37.33±1.2
Primary school	66.25±5.7	58.21±8.7	39.21±1.2	36.21±1.4	35.55±1.4	33.55±1.2
Illiterate	56.81±7.7	52.33±6.2	34.22±1.1	31.22±0.9	32.32±0.9	29.21±1.5
F/P value	7.740/0.001		14.79/0.001		4.50/0.001	
Marital status						
Married	74.39±6.1	70.09±6.8	45.72±0.7	44.94±0.6	42.85±2.4	41.43±1.3
Single	74.82±7.4	74.26±5.2	45.37±0.8	44.75±0.7	43.04±1.4	41.47±1.9
F/P value	26.72/0.001		26.34/0.00		2.45/0.04	
Location						
Urban	74.34±6.2	72.04±6.5	44.89±0.8	40.21±0.8	43.33±1.4	41.29±2.3
Rural	75.67±6.9	75.67±5.9	41.23±0.6	37.32±0.8	42.80±1.8	40.23±1.9
F/P value	2.51/0.045		20.50/0.001		1.263/0.283	
Nationality						
Saudi	74.43±6.2	71.23±6.3	45.61±0.9	42.2±0.8	43.06±2.3	42.31±1.9
Non Saudi	76.00±6.7	75.05±6.5	45.36±1.2	41.2±1.1	42.56±2.1	41.22±2.1
F/P	4.00/0.00		13.26/0.001		1.21/0.278	

KAP: Knowledge, attitude, and practice, DM: Diabetes mellitus, non-DM: Non-diabetes

(75%). This might be due to a higher number of participation of a qualified individual with urban residency. Even though we did not assess how individuals acquired the knowledge on diabetes, it is possible that higher literacy, as well as well-developed social networks in Riyadh, may have a positive effect on their knowledge toward diabetes. Our findings are corroborating with another study done in Malaysia where they identified a good knowledge among its participants.^[21] It is, therefore, evident that the difference in the knowledge levels among all participants is directly related to the level of literacy, level of training received and availability of information on diabetes.^[22]

It should be noted that we observed a gender gap in KAP regarding diabetes. Male respondents have a higher score in

knowledge as well attitude while the practice scores were higher for female. This indicates a disciplined and coordinated effort from the female cohort in preventing menace of DM despite possessing a low knowledge. The findings show similarities with those from other countries.^[23]

The present study showed a significant positive correlation between KAP. Better knowledge is associated with a better attitude (adjusted $r^2=0.563$, $P=0.000$). Further, good attitude is associated with good knowledge (adjusted $r^2=0.585$, $P=0.000$). Furthermore, positive practice is associated with positive attitude (adjusted $r^2=0.585$, $P=0.000$). This means that “the higher their knowledge, the better their attitude and the positive their practice” toward diabetes. These findings agree with the findings of other studies.^[20,24]

Table 3: Association of socio-demographic characteristics with KAP

Variables	B*	Standard error	Beta**	P values
Dependent variable: Knowledge (Adjusted R square 0.563%)				
Constant	105.76	1.100		0.000
Age	0.039	0.040	0.028	0.330
Gender	-0.002	0.054	-0.01	0.969
Educational level	-0.043	0.024	-0.046	0.069
Marital status	0.173	0.060	0.079	0.004
Location	0.188	0.088	0.053	0.033
Nationality	0.010	0.050	0.050	0.844
DM state	0.018	0.060	0.09	0.034
Attitude score	-0.700	0.024	-0.739	0.000
Dependent variable: Attitude (Adjusted R square 0.585%)				
Constant	99.39	1.93		0.000
Age	0.016	0.041	0.011	0.695
Gender	0.263	0.054	0.115	0.001
Educational level	-0.020	0.024	-0.020	0.424
Marital status	-0.013	0.062	-0.06	0.835
Location	0.017	0.091	0.05	0.85
Nationality	-0.062	0.051	-0.029	0.225
DM state	0.363	0.060	0.160	0.001
Knowledge score	-0.738	0.026	-0.700	0.000
Dependent variable: Practice (Adjusted R square 0.105%)				
Constant	80.933	13.84		0.000
Age	0.258	0.139	0.78	0.063
Gender	-0.192	0.188	-0.036	0.308
Educational level	-0.184	0.083	-0.080	0.027
Marital status	0.236	0.210	0.04	0.261
Location	0.269	0.309	0.145	0.001
Nationality	-0.172	0.175	-0.34	0.325
DM state	-0.124	0.210	-0.214	0.001
Knowledge score	-0.274	0.126	-0.112	0.030
Attitude score	-0.397	0.122	-0.171	0.000

Results are expressed as number (%) and mean \pm SD; NDM: Non-diabetes mellitus; DM: Diabetes mellitus, *For categorical variables P values were obtained by doing independent samples t-test and/or ANOVA where appropriate. F test (Levene's Test of equality of variance) is applied to test the Null hypothesis that the error variance of the dependent variable is equal across groups. *Unstandardized sample regression coefficient; **Standardized sample regression coefficient

The most notable finding in our study is the gap between knowledge on diabetes and attitudes as well as practices toward diabetes and its management. Even though the majority (>75%) had either moderate or good knowledge, it is not reflected on their attitudes (46%) and practices (43%). Most studies show that the attitude goes in hand in hand with the knowledge. Even though it is difficult to find out the reasons for this gap, there may be a number of plausible reasons. One reason may be improper and uncoordinated health education. In Saudi Arabia, most of the diabetes health promotion efforts are conducted in an uncoordinated and ineffective manner through social media. This might lead to spread of

information but in a way that is not convincing to the general population of Riyadh, Saudi Arabia to change their attitude and practices. Therefore, we believe that it is necessary to direct more resources to improve the knowledge and develop an innovative educational model to change the attitude of general public. Knowledge does not always result in positive attitude and practices. A previous study that examined the effect of knowledge on practice showed that the participants continued to take sweetened foods even though they were well aware about the deleterious effects of sugar on oral hygiene.^[25] It is, therefore, important to identify interventions that reinforce peoples' attitudes and change their practices.

Study strengths and limitations

This study included mostly urban areas, young population with high qualification. As Saudi Arabia is undergoing a transitional phase having the predominant young population (>50%) with urbanized residency and desire for education, also, two hospitals selected for collecting the data attracts patients with varying levels of disease control, current study is best representative sample to assess KAP in Riyadh.

However, since the study was conducted in the urban hospitals, where DM related education may be more readily accessible to patients. It raises concerns that DM patients and their relatives attending primary health-care centers with less access to diabetes education may have poor KAP score.

For the non-DM cohort, participants were recruited by an open invitation method and hence can introduce a health-seeking bias with more health conscious people being inadvertently included in the study. However, this raises concerns that people who are less health conscious may have even poorer KAP toward diabetes than what was observed in this study.

Furthermore, we did not ask the sources of health information. Knowledge of the sources of information would have been useful in identifying the most appropriate method for health promotion among the general public in Riyadh, Saudi Arabia.

CONCLUSIONS

The present study demonstrated overall high knowledge score but low attitude and practice scores toward diabetes care. At the same time, most of them possess a low level of good knowledge with almost half of them having positive attitude and practices toward DM. There is a need to carry out large-scale awareness programs, after identifying the appropriate means to spread the message to the general population. There is also a need to develop innovative tools and educational models that could impart DM knowledge in such a way that it changes the attitude and bring about reforms in their practices toward DM. Therefore, this study can be used as a baseline evaluation for the national diabetes awareness campaign and modify the approach toward education on diabetes giving more emphasis on changing the attitude that will change their practice about diabetes.

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REFERENCES

1. Khalid AA, Aljabri KS, Bokhari SA. Prevalence of diabetes mellitus in a Saudi community. *Ann Saudi Med* 2011;31:19-23.
2. Kaveeshwar SA, Cornwall J. The current state of diabetes mellitus in India. *Aust Med J* 2014;7:45-8.
3. Meo SA. Prevalence and future prediction of type 2 diabetes mellitus in the kingdom of Saudi Arabia: A systematic review of published studies. *J Pak Med Assoc* 2016;66:722-5.
4. Nathan DM, Buse JB, Davidson MB, Ferrannini E, Holman RR, Sherwin R, *et al.* Medical management of hyperglycemia in Type 2 diabetes: A consensus algorithm for the initiation and adjustment of therapy: A consensus statement of the American diabetes association and the European association for the study of diabetes. *Diabetes Care* 2009;32:193-203.
5. Khandekar R, Harby SA, Harthy HA, Lawatti JA. Knowledge, attitude and practice regarding eye complications and care among Omani persons with diabetes—a cross sectional study. *Oman J Ophthalmol* 2010;3:60-5.
6. Shrivastava SR, Shrivastava PS, Ramasamy J. Role of self-care in management of diabetes mellitus. *J Diabetes Metab Disord* 2013;12:14.
7. Powers MA, Bardsley J, Cypress M, Duker P, Funnell MM, Fischl AH, *et al.* Diabetes self-management education and support in Type 2 diabetes: A Joint position statement of the American diabetes association, the American association of diabetes educators, and the academy of nutrition and dietetics. *J Acad Nutr Diet* 2015;115:1323-34.
8. Rani PK, Raman R, Subramani S, Perumal G, Kumaramanickavel G, Sharma T, *et al.* Knowledge of diabetes and diabetic retinopathy among rural populations in India, and the influence of knowledge of diabetic retinopathy on attitude and practice. *Rural Remote Health* 2008;8:838.
9. Islam FM, Chakrabarti R, Dirani M, Islam MT, Ormsby G, Wahab M, *et al.* Knowledge, attitudes and practice of diabetes in rural Bangladesh: The Bangladesh population based diabetes and eye study (BPDES). *PLoS One* 2014;9:e110368.
10. Ibrahim AB. Prevalence, knowledge, attitude and practices of diabetes mellitus among Jazan population, Kingdom of Saudi Arabia (KSA). *J Diabetes Mellitus* 2015;5:115-22.
11. Babikr WG, Aedh AI, Ahmed AM, Abdelraheem , Alasmay M, Elhussein AB, *et al.* Assessment of knowledge, attitude and practice of diabetic people in Najran, Kingdom of Saudi Arabia. *Int J Res Med Sci* 2017;5:2150-5.
12. Mohan D, Raj D, Shanthirani CS, Datta M, Unwin NC, Kapur A, *et al.* Awareness and knowledge of diabetes in Chennai—the Chennai urban rural epidemiology study [CURES-9]. *J Assoc Physicians India* 2005;53:283-7.

13. Shah VN, Kamdar PK, Shah N. Assessing the knowledge, attitudes and practice of Type 2 diabetes among patients of Saurashtra region, Gujarat. *Int J Diabetes Dev Ctries* 2009;29:118-22.
14. Chen L, Magliano DJ, Balkau B, Colagiuri S, Zimmet PZ, Tonkin AM, *et al.* AUSDRISK: An Australian Type 2 diabetes risk assessment tool based on demographic, lifestyle and simple anthropometric measures. *Med J Aust* 2010;192:197-202.
15. Fatema K, Hossain S, Natasha K, Chowdhury HA, Akter J, Khan T, *et al.* Knowledge attitude and practice regarding diabetes mellitus among nondiabetic and diabetic study participants in Bangladesh. *BMC Public Health* 2017;17:364.
16. Al Shafae MA, Al-Shukaili S, Rizvi SG, Al Farsi Y, Khan MA, Ganguly SS, *et al.* Knowledge and perceptions of diabetes in a semi-urban Omani population. *BMC Public Health* 2008;8:249.
17. Rafique GAI, White F. Knowledge, Attitude and Practice (KAP) Survey of Diabetes and its Complications in People with Diabetes Attending a University Hospital. In: *In: Proceedings of the Second Conference on DIMEMSEA*; 2000. p. 51-2.
18. Tham KY, Ong JJ, Tan DK, How KY. How much do diabetic patients know about diabetes mellitus and its complications? *Ann Acad Med Singapore* 2004;33:503-9.
19. Gul N. Knowledge, attitudes and practices of Type 2 diabetic patients. *J Ayub Med Coll Abbottabad* 2010;22:128-31.
20. Saleh F, Mumu SJ, Ara F, Begum HA, Ali L. Knowledge and self-care practices regarding diabetes among newly diagnosed Type 2 diabetics in Bangladesh: A cross-sectional study. *BMC Public Health* 2012;12:1112.
21. Ambigapathy R, Ambigapathy S, Ling H. A knowledge, attitude and practice (KAP) study of diabetes mellitus among patients attending Klinik Kesihatan Seri Manjung. *NCD Malaysia* 2003;2:6-16.
22. Upadhyay DK, Palaian S, Shankar PR, Mishra P, Pokhara N. Knowledge, attitude and practice about diabetes among diabetes patients in western Nepal. *Rawal Med J* 2008;33:8-11.
23. Brown SA, Harrist RB, Villagomez ET, Segura M, Barton SA, Hanis CL, *et al.* Gender and treatment differences in knowledge, health beliefs, and metabolic control in Mexican Americans with Type 2 diabetes. *Diabetes Educ* 2000;26:425-38.
24. Ng SH, Chan KH, Lian ZY, Chuah YH, Noora A. Reality vs illusion: Knowledge, attitude and practice among diabetic patients. *Int J Collab Res Internal Med* 2012;4:723-6.
25. al-Tamimi S, Petersen PE. Oral health situation of schoolchildren, mothers and schoolteachers in Saudi Arabia. *Int Dent J* 1998;48:180-6.

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