Pharmacophore

ISSN-2229-5402

Journal home page: http://www.pharmacophorejournal.com

PRE-DIABETES AMONG PEOPLE OLDER THAN 45 IN SAUDI ARABIA: KAP (KNOWLEDGE, ATTITUDE AND PRACTICE) ASSESSMENT

Khalid Alghamdi[1], Amar Khan[2*], Umar Abdul Hai[2], Saeed Alghamdi[2], Abdulrahman Almalki[2], Ali Alali[2], Nawaf Alshehri[2], Shuruq Alshammari[3], Yunus Alzahrani[4], Khames Alzahrani[5]

1. ***Department of Endocrinology and Diabetes, Comprehensive Specialized Clinics of Security Forces, Jeddah, Saudi Arabia.***
2. ***Department of Internal Medicine, College of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia.***
3. ***Department of Internal Medicine, College of Medicine, Princess Nourah University, Riyadh, Saudi Arabia.***
4. ***Department of Internal Medicine, College of Medicine, University of Jeddah, Jeddah, Saudi Arabia.***
5. ***Saudi Board of Endodontic SR, King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia.***

ARTICLE INFO

Received:
28 Sep 2023
Accepted:
06 Dec 2023

Keywords: Pre-diabetes, Diabetes mellitus, Knowledge, Awareness, Risk factors

ABSTRACT

Pre-diabetes is a state caused by insulin resistance that leads to higher-than-normal blood glucose levels, but not high enough to reach the diabetes stage. Therefore, people with untreated pre-diabetes have a significantly increased chance of developing type 2 diabetes and its related complications. The main aim of this study is to evaluate the knowledge awareness level of pre-diabetes among individuals with a risk factor for developing pre-diabetes in the Saudi population. A cross-sectional study will be conducted among the Saudi Arabian male and female population who is above the age of 45 and non-diabetic. A sample size of 385 will be determined by an Online questionnaire to collect the KAP baseline scores. For data analysis, SPSS version 23 will be used. The study included 272 participants. The majority of the participants fall within the age range of 45-50, with females comprising 57.4% of the sample. Knowledge scores of participants were found to be 23.2% good, 46.3% moderate, and 30.5% poor knowledge of pre-diabetes. As for attitude, 12.50% of respondents expressed a positive sentiment, while a smaller percentage, 3%, conveyed a very positive attitude. In conclusion, poor knowledge, attitude, and practice scores were found in Saudi Arabia. The knowledge score of participants was significantly associated with any of the sociodemographic characteristics, while attitude and practice scores towards pre-diabetes were significantly associated with marital status only.

To Cite This Article: Alghamdi Kh, Khan A, Hai UA, Alghamdi S, Almalki A, Alali A, et al. Pre-diabetes Among People Older Than 45 in Saudi Arabia: KAP (Knowledge, Attitude And Practice) Assessment. Pharmacophore. 2023; 14(S1): e-723-8782

Introduction

Diabetes mellitus (DM) is a chronic disease characterized by hyperglycemia and dysfunction in multiple body metabolisms, including protein, fat, and carbohydrate metabolism. Type 1 diabetes mellitus, also known as insulin-dependent diabetes, and type 2 diabetes mellitus, also known as non-insulin-dependent diabetes, are two different types of diabetes [1]. Test results for hemoglobin A1C (HbA1c) that are higher than 5.7 and lower than 6.4 percent indicate the pre-diabetes stage, which is a state caused by insulin resistance that leads to higher-than-normal blood glucose levels but not high enough to reach the diabetes stage (6.5 percent and above) [2, 3]. As a result, those with pre-diabetes who are mistreated have a much higher risk of developing type 2 diabetes and its associated consequences [4]. Age, obesity, genetic factors, unhealthy lifestyle, junk food

Corresponding Author: Amar Khan; Department of Internal Medicine, College of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia. E-mail: amar1420khan@gmail.com.

consumption, lack of physical activity, hypertension, and smoking have all been proven to have a strong correlation with type 2 diabetes mellitus (DM) [5]. It is possible to prevent the disease by avoiding the preceding risk factors, taking the advised medications, eating a healthy diet, reducing weight, exercising regularly, etc [6]. Approximately 463 million people worldwide and 55 million people in the Middle East and North Africa are now diagnosed with diabetes (MENA) [7]. The prevalence of diabetes is highest in the Middle East and North Africa (MENA), where (12.2%) of the population is believed to be affected by the disease [8]. Saudi Arabia has the second-highest prevalence of type 2 diabetes in the Middle East and ranks seventh worldwide, according to the World Health Organization (WHO) [9].

In 2015, (9%) of the population in Jeddah had pre-diabetes [10]. In 2018, a study was conducted on physicians, medical students, and patients about knowledge and perceptions of pre-diabetes revealed that only (3%) of the patients had been aware of pre-diabetes. Moreover, the research demonstrated the general lack of understanding of pre-diabetes among physicians, medical students, and patients [11].

A mixed-methods primary care study has been published on the perceptions of pre-diabetes and concluded that pre-diabetes care barriers must be removed through increased patient awareness and patient-centered education [12]. A recent study conducted in Reunion Island in 2021 found that managing pre-diabetes in primary care was restricted by the absence of health authorities' awareness-raising activities and the absence of an individual's general understanding [13]. Few data have been published to assess the knowledge and awareness of pre-diabetes in Saudi Arabia, Despite the high prevalence of diabetes in Saudi Arabia and the fact that the burden of diabetes is growing. Therefore, it is crucial to conduct a reliable assessment of community knowledge of pre-diabetes and its predictors in Saudi Arabia. The main aim of this study is to evaluate the knowledge and awareness level of pre-diabetes among individuals with a risk factor for developing pre-diabetes in the Saudi population.

The main aim of this study is to evaluate the knowledge and awareness level of pre-diabetes among individuals with a risk factor for developing pre-diabetes in the Saudi population.

Materials and Methods

Study Design

An observational cross-sectional awareness study was conducted among individuals with a high-risk factor for developing pre-diabetes in the Saudi population, which starts in August.

Study Setting: Participants, Recruitment, and Sampling Procedure

The participant of this study is the entire Saudi population, and they were recruited through a validated online questionnaire. Therefore, the study included Saudi male and female who is above the age of 45 and non-diabetic.

Inclusion and Exclusion Criteria

This study included both male and female Saudi adults, non-diabetic, older than 45 years old, and who agreed to participate in our study. For people who are younger than 45 or diabetic, we will exclude them.

Sample Size

Sample size of 384 was determined. A 95% confidence interval and 5% marginal error were considered in a single-proportion formula to calculate the sample size.

The sample size was estimated using the formula:

n = P(1-P) * Zα 2 / d 2 with a 95% confidence level.
n: Calculated sample size.
Z: The z-value for the selected level of confidence (1- a) = 1.96.
P: An estimated prevalence of knowledge.
Q: (1 – 0.50) = 50%, i.e., 0.50.
D: The maximum acceptable error = 0.05.
Therefore, the calculated minimum sample size was n = (1.96)2 X 0.50 X 0.50/(0.05) 2 = 384.

Method for Data Collection and Instrument (Data Collection Technique and Tools)

The questionnaire was conducted by Dr. Mohsina Hyder [14]. An Online questionnaire was used to collect the KAP baseline scores. The questionnaire consisted of 38 questions classified into main 4 sections. 8 demographics-related questions were included in Section 1. The second section includes 10 questions that assess the knowledge of pre-diabetes. Attitudes toward pre-diabetes were assessed through 10 questions in the third section. Finally, the fourth section includes 10 questions about the practice of pre-diabetes.

The KAP questionnaire used to measure knowledge among participants consists of 10 multiple-choice questions on different aspects of pre-diabetes, like causes, identification, recommendations, and outcomes. Only one right answer out of the available four must be chosen to receive points, while the wrong response receives none. Scoring is out of 17 points for knowledge; points below 10 were assumed to be (poor knowledge), those between 10 and 13 as (average knowledge), and those between

14 and 17 were considered to be (good knowledge). Correct responses to questions 1, 2, 7, 8, and 10 get you one point, while question 3 earns you three points, questions 4 and 5 earn you two points each, and question 6 earns you four points. 10 questions with three-point Likert-type scale options for strongly agree, neither agree nor disagree, and strongly disagree were used to assess attitudes among participants using the KAP. Each negative attitude is worth (-1) points, and neutral attitudes receive (0), while positive attitude is worth (1). Out of 10, 9 and 10 were strongly positive, 7 and 8 were positive, 3 to 6 as neutral attitude, 0 to 2 as negative attitude, and less than 0 were deemed to be a strongly negative attitude. The section on attitudes focused on how people with high risk of pre-diabetes felt about changing their lifestyles and what sentiments and opinions they held about the condition. As a result, KAP's psychological status was assessed using both cognitive and evaluative components. Higher scores in the attitude part reflect a more positive attitude toward diabetes prevention, according to the combined results. 10 multiple-choice questions about daily practices relating to dietary intake, physical activity, sleep pattern, meal frequency, and blood tests were used to measure practice among participants using the KAP questionnaire. The lowest frequencies on the scale received a score of 0, an acceptable practice score of 1, and the maximum frequency on the scale received a score of 2 to 4. A higher score in this part suggests a healthier lifestyle. Points were totaled, the maximum possible score was 26, and the categories were Very Poor (Below 6), Poor (7–13), Good (14–20), and Very Good (Above 20).

Analyzes and Entry Method

For data analysis, SPSS version 23 was used. Descriptive statistics was obtained to summarize data, synthesize, and report the variables. In which numerical data was presented as mean ± SD or as median and range according to the type of distribution of each variable. For categorical variables, percentages and frequencies were used. Comparison between groups was made by Student's t-test or Mann-Whitney test. A chi-squared test was obtained for the association between categorical variables. P-value was considered significant if it was less than 0.05. and Confidence interval (CI) will be set at 95%.

Results and Discussion

The study included 272 participants. The majority of the participants fall within the age range of 45-50, with females comprising 57.4% of the sample. In terms of BMI, the highest percentage falls under the category of obesity. The majority of participants are married and work in the transport and logistics sector. A significant proportion of individuals have a family history of diabetes, with parents, siblings, or children being the most common relatives affected.

Table 1. Sociodemographic characteristics of participants (n=272)

Parameter		No.	%
Age	45 - 50	145	53.3
	51 - 60	98	36.0
	More than 60	29	10.7
Gender	Male	116	42.6
	Female	156	57.4
BMI	underweight	5	1.8
	normal weight	56	20.6
	Overweight	103	37.9
	obesity	108	39.7
Marital status	Single	3	1.1
	Married	235	86.4
	Divorced	11	4.0
	widow	13	4.8
	other	10	3.7
region	South	36	13.2
	Eastern	23	8.5
	North	6	2.2
	Western	148	54.4
	Central	59	21.7
Job	Engineer	2	.7
	The medical section	15	5.5
	Communications and information technology sector	8	2.9
	Tourism and entertainment sector	2	.7

	Industry sector	2	.7
	Chemical industry sector	2	.7
	Energy sector	2	.7
	Transport and logistics sector	3	1.1
	Other	236	86.8
Family history of type 1 or type 2 diabetes	A parent, brother, sister or children	182	66.9
	Grandfather, aunt, uncle, uncle or aunt	53	19.5
	No	37	13.6

Table 2 shows measuring the level of insulin with the level of glucose in the blood during the pre-diabetic stage is important for determining the extent of insulin resistance, according to 53.3% of respondents. Additionally, 21.7% of respondents believe it is important for determining insulin tolerance, while 11.4% believe it is important for determining an insulin overdose. However, 13.6% of respondents believe that none of these reasons are valid.

The best recommendation for pre-diabetic patients, according to 98.2% of respondents, is to adopt a healthy diet and exercise regularly. Only 1.1% of respondents believe that insulin injections are the best recommendation, while 0.7% believe that none of the above options are suitable.

When it comes to dietary choices, 91.9% of respondents believe that pre-diabetic patients should regularly consume high-fiber foods. Additionally, 3.3% of respondents believe that foods high in fat should be consumed, while 2.9% believe that carbohydrate-rich foods are appropriate. Only 1.8% of respondents believe that soft drinks and energy drinks should be consumed regularly.

Exercise is also an important aspect of managing pre-diabetes. According to the data, 88.6% of respondents believe that pre-diabetic patients should exercise most days of the week for at least 30 minutes. Additionally, 9.9% of respondents believe that exercising once a week for at least 30 minutes is sufficient. Only 1.5% of respondents believe that neither of these options is necessary.

Weight loss can be beneficial for obese patients in treating their pre-diabetic stage, according to 92.6% of respondents. Only 1.8% of respondents believe that weight loss provides only a little help, while 4.8% are unsure of the extent to which weight loss can be helpful. Only 0.7% of respondents believe that weight loss won't help at all.

Table 2. Knowledge of participants of pre-diabetes (n=272)

Parameter		**No.**	**%**
Pre-diabetes may lead to	Type 1 diabetes	65	23.9
	Type 2 diabetes	110	40.4
	The two types	51	18.8
	none of the above	46	16.9
Which is not a risk factor for pre-diabetes	Having a family member with type 2 diabetes	61	22.4
	Gestational diabetes	65	23.9
	Asian race	100	36.8
	BMI	46	16.9
The best way to diagnose pre-diabetes	Urine examination	2	.7
	blood test	131	48.2
	both together	136	50.0
	none of the above	3	1.1
Fasting blood glucose level (after a 10-hour fast) in pre-diabetic patients	< 100 mg/dl	98	36.0
	100-125 mg/dl	132	48.5
	140-199 mg/dl	36	13.2
	>200 mg/dl	6	2.2
Average blood sugar for the last three months is measured by analyzing	Sugar tolerance test	4	1.5
	cumulative sugar	240	88.2
	Glycoprotein analysis	4	1.5
	Fasting glucose analysis	24	8.8
The importance of measuring the level of insulin with the level of glucose in the blood in the pre-diabetic stage	To determine an insulin overdose	31	11.4
	To determine insulin tolerance	59	21.7

	To determine the extent of insulin resistance	145	53.3
	none of the above	37	13.6
The best recommendation for pre-diabetic patients	Healthy diet and exercise	267	98.2
	Insulin injection	3	1.1
	none of the above	2	.7
Pre-diabetic patients should take regularly	Foods that are high in fat	9	3.3
	High-fiber foods	250	91.9
	Carbohydrate-rich foods	8	2.9
	Soft drinks and energy drinks	5	1.8
Pre-diabetic patients should exercise	Once a week for at least 30 minutes	27	9.9
	Most days of the week, for at least 30 minutes	241	88.6
	none of the above	4	1.5
To what extent may weight loss help obese patients in treating their pre-diabetic stage	A little help	5	1.8
	Great help	252	92.6
	won't help	2	.7
	Not sure	13	4.8

Table 3 shows the responses of individuals regarding various statements related to pre-diabetes. "There are many things I can do to get over pre-diabetes.": The majority of respondents (89.0%) agreed with this statement, indicating that there are several actions they can take to manage pre-diabetes effectively. "Pre-diabetic patients should keep their blood sugar close to normal": A significant percentage (90.8%) agreed with this statement, emphasizing the importance of maintaining blood sugar levels within a normal range for pre-diabetic individuals. "I think there is not much benefit in controlling blood sugar for pre-diabetics because they are going to get type 2 diabetes anyway.": The majority of respondents (73.5%) disagreed with this statement, indicating that they believe controlling blood sugar levels has significant benefits in preventing the progression of type 2 diabetes. "Patients with pre-diabetes have a higher and faster chance of developing diabetes than people with normal blood sugar.": The responses were varied, with 51.1% agreeing, 18.8% disagreeing, and 0.7% strongly disagreeing. "It is important to educate people with pre-diabetes about diabetes": The majority of respondents (91.5%) agreed with this statement, highlighting the importance of providing education about diabetes to individuals with pre-diabetes. "It is common to ignore pre-diabetes in our society.": The majority of respondents (62.5%) agreed with this statement. "Family support is one of the most important things that help in dealing with pre-diabetes.": The majority of respondents (90.4%) agreed with this statement. "Pre-diabetic patients should be taught about modifying their lifestyle.": The majority of respondents (92.6%) agreed with this statement. "I can live a normal life even though I have pre-diabetes.": The majority of respondents (79.0%) agreed with this statement.

Table 3. Attitude of participants of pre-diabetes (n=272)

	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
There are many things I can do to get over pre-diabetes	12 4.4%	242 89.0%	17 6.3%	0 0%	1 .4%
Pre-diabetic patients should keep their blood sugar close to normal	13 4.8%	247 90.8%	11 4.0%	1 .4%	0 0%
It is difficult to control blood sugar in the pre-diabetic stage	1 .4%	32 11.8%	73 26.8%	159 58.5%	7 2.6%
I think there is not much benefit in controlling blood sugar for pre-diabetics because they are going to get type 2 diabetes anyway.	0 0%	18 6.6%	44 16.2%	200 73.5%	10 3.7%
Patients with pre-diabetes have a higher and faster chance of developing diabetes than people with normal blood sugar	8 2.9%	139 51.1%	72 26.5%	51 18.8%	2 .7%
It is important to educate people with pre-diabetes about diabetes	13 4.8%	249 91.5%	9 3.3%	1 .4%	0
It is common to ignore pre-diabetes in our society	12 4.4%	170 62.5%	26 %9.6	64 23.5%	0%
Family support is one of the most important things that help in dealing with pre-diabetes	13 4.8%	246 90.4%	10 3.7%	3 1.1%	0
Pre-diabetic patients should be taught about modifying their lifestyle	13 4.8%	252 92.6%	5 1.8%	2 .7%	0%
I can live a normal life even though I have pre-diabetes	10 3.7%	215 79.0%	28 10.3%	18 6.6%	1 .4%

In **Table 4**, 35.3% consume sugar-sweetened beverages such as soda, soft drinks, and non-carbonated fruit drinks once or twice a week. 46.7% replace regular food ingredients for high-fiber foods such as oatmeal, whole grains, fruit, or vegetable salads once or twice a week. 52.6% consume foods high in fat, such as snacks, fried meat, fast food, and chocolate, once or twice a week.

Table 4. Practice of participants toward pre-diabetes (n=272)

	One or two times a week	3-4 times a week	5 times or more a week	Mostly no
How many times a week do you consume sugar-sweetened beverages such as soda, soft drinks, and non-carbonated fruit drinks?	96 35.3%	33 12.1%	22 8.1%	121 44.5%
How many times a week do you replace your regular food ingredients with high-fiber foods such as oatmeal, whole grains, fruit, or vegetable salads?	127 46.7%	70 25.7%	35 12.9%	40 14.7%
How many days a week do you sleep less than 6 hours?	101 37.1%	66 24.3%	37 13.6%	68 25.0%
How many times a week do you skip your main meals?	110 40.4%	73 26.8%	24 8.8%	65 23.9%
How many days a week do you consume foods high in fat, such as snacks, fried meat, fast food, and chocolate?	143 52.6%	64 23.5%	19 7.0%	46 16.9%

Table 5 shows that 23.2% of participants do distracted eating once a day. 22.1% of participants check their blood sugar at home once every 6 months or annually. 58.5% have a cholesterol test done in the lab once or more in two years.

Table 5. Practice of participants toward pre-diabetes (n=272)

Parameter		No.	%
How often do you do distracted eating	once a day	63	23.2
	Twice a day	31	11.4
	every-time	43	15.8
	Most likely not	135	49.6
How long per day do you spend in front of the computer/TV?	1-3 hours a day	124	45.6
	4-6 hours a day	63	23.2
	more than 6 hours a day	50	18.4
	Most likely not	35	12.9
How often do you check your blood sugar at home/lab?	once a week or once a month	51	18.8
	Once in two or three months	42	15.4
	Once every 6 months or annually	60	22.1
	never	119	43.8
How often do you have a cholesterol test done in the lab?	Once or more in two years	159	58.5
	Once every 5 years	27	9.9
	Once every 10 years	16	5.9
	never	70	25.7

the knowledge scores of participants were found to be 23.2% good, 46.3% moderate, and 30.5% poor knowledge of pre-diabetes. The attitude scores of study participants. On the positive side, 12.50% of respondents expressed a positive sentiment, while a smaller percentage, 3%, conveyed a very positive attitude. There is a notable presence of optimism and satisfaction among the participants. Conversely, 9.20% of the responses were categorized as negative, with only 0.70% being classified as very negative.

Practice score distribution shows that a significant portion of individuals, approximately 51.50%, have achieved a good score. This indicates a satisfactory level of performance in the given practice. Furthermore, 27.20% of individuals have attained a very good score, reflecting a commendable level of proficiency. On the other hand, 20.60% of individuals have obtained a bad score, suggesting room for improvement in their practice. It is worth noting that only a marginal percentage, 0.70%, have received a very bad score.

In **Table 6**, individuals aged 45-50 had the highest proportion of good knowledge scores (14.0%), followed by those aged 51-60 (5.9%) and those over 60 (3.3%). However, the difference in knowledge scores between age groups was not statistically significant (p=0.141). When examining BMI categories, the data reveals that individuals who were overweight had the highest proportion of good knowledge scores (10.3%), followed by those with obesity (8.5%), normal weight (3.7%), and underweight (0.7%). The difference in knowledge scores between BMI categories was not statistically significant (p=0.100). Marital status did not appear to have a significant impact on knowledge scores, as there were no statistically significant differences between

the proportions of poor, moderate, and good knowledge scores across single, married, divorced, widowed, and other categories (p=0.971). Gender also did not show a significant difference in knowledge scores, as the proportions of poor, moderate, and good knowledge scores were similar between males and females (p=0.229). The region did not appear to have a significant impact on knowledge scores either, as there were no statistically significant differences between the proportions of poor, moderate, and good knowledge scores across the South, Eastern, North, Western, and Central regions (p=0.973). Finally, the data shows that individuals working in the other job sector had the highest proportion of good knowledge scores (19.5%), followed by those in the medical section (0.7%), communications and information technology sector (0.7%), and tourism, culture, and entertainment sector (0.7%). The difference in knowledge scores between job sectors was not statistically significant (p=0.205).

Table 6. Knowledge of pre-diabetes in association with sociodemographic characters of participants (n=323)

		Knowledge score			Total (N=272)	P value
		Poor knowledge	Moderate knowledge	Good knowledge		
Age	45- 50	38	69	38	145	**0.141**
		14.0%	25.4%	14.0%	53.3%	
	51 -60	38	44	16	98	
		14.0%	16.2%	5.9%	36.0%	
	more than 60	7	13	9	29	
		2.6%	4.8%	3.3%	10.7%	
BMI	underweight	3	0	2	5	**0.100**
		1.1%	0.0%	0.7%	1.8%	
	normal weight	20	26	10	56	
		7.4%	9.6%	3.7%	20.6%	
	Overweight	34	41	28	103	
		12.5%	15.1%	10.3%	37.9%	
	obesity	26	59	23	108	
		9.6%	21.7%	8.5%	39.7%	
Marital status	Single	0	2	1	3	**0.971**
		0.0%	0.7%	0.4%	1.1%	
	Married	74	107	54	235	
		27.2%	39.3%	19.9%	86.4%	
	Divorced	2	6	3	11	
		0.7%	2.2%	1.1%	4.0%	
	widow	4	6	3	13	
		1.5%	2.2%	1.1%	4.8%	
	other	3	5	2	10	
		1.1%	1.8%	0.7%	3.7%	
Gender	Male	37	58	21	116	**0.229**
		13.6%	21.3%	7.7%	42.6%	
	Female	46	68	42	156	
		16.9%	25.0%	15.4%	57.4%	
Region	the South	11	17	8	36	**0.973**
		4.0%	6.3%	2.9%	13.2%	
	Eastern	9	9	5	23	
		3.3%	3.3%	1.8%	8.5%	
	North	2	3	1	6	
		0.7%	1.1%	0.4%	2.2%	
	Western	45	66	37	148	
		16.5%	24.3%	13.6%	54.4%	
	Central	16	31	12	59	

		5.9%	11.4%	4.4%	21.7%	
Job	Engineer	0	1	1	2	**0.205**
		0.0%	0.4%	0.4%	0.7%	
	The medical section	5	8	2	15	
		1.8%	2.9%	0.7%	5.5%	
	Communications and information technology sector	3	3	2	8	
		1.1%	1.1%	0.7%	2.9%	
	Tourism, culture, and entertainment sector	0	0	2	2	
		0.0%	0.0%	0.7%	0.7%	
	industry sector	0	0	2	2	
		0.0%	0.0%	0.7%	0.7%	
	Chemical industry sector	1	1	0	2	
		0.4%	0.4%	0.0%	0.7%	
	Energy and water sector	1	0	1	2	
		0.4%	0.0%	0.4%	0.7%	
	Transport and logistics sector	2	1	0	3	
		0.7%	0.4%	0.0%	1.1%	
	other	71	112	53	236	
		26.1%	41.2%	19.5%	86.8%	

Interestingly, there was no significant difference in practice scores based on age or gender, as evidenced by the non-significant P values (0.518 and 0.485, respectively). The study also analyzed the relationship between practice scores and BMI, revealing that individuals with obesity had the highest percentage of very good scores (14.0%). However, the P value of 0.071 suggests that this finding is not statistically significant. Marital status was found to have a significant relationship with practice scores, with married individuals having the highest percentage of good and very good scores (44.9% and 23.5%, respectively). The P value of 0.043 indicates that this finding is statistically significant. Region was also found to have no significant relationship with practice scores, with the highest percentage of very good scores being among individuals in the Western region (13.2%). However, the P value of 0.421 suggests that this finding may not be statistically significant. Finally, the job had no statistical significance on practice scores. **Table 7** shows that, when looking at age, the majority of respondents fell into the neutral category, regardless of their age group. Similarly, for BMI, most respondents had a neutral attitude, followed by overweight and obesity categories. In terms of marital status, married individuals had the highest percentage in all attitude categories. Single individuals had the lowest percentage, while divorced, widowed, and other categories fell in between. There was no significant difference in attitude scores between males and females. Regarding regions, the Western region had the highest percentage in all attitude categories, followed by the South and Eastern regions. The North and Central regions had the lowest percentages. In terms of jobs, the "other" category had the highest percentage in all attitude categories, followed by the medical and communications sectors. The engineer category had the lowest percentage.

Table 7. Participants attitude towards pre-diabetes in association with sociodemographic characters (n=323)

		Attitude score					**Total (N=272)**	**P value**
		Very positive	**Positive**	**Neutral**	**Negative**	**Very negative**		
Age	45-50	4	16	109	16	0	145	0.442
		1.5%	5.9%	40.1%	5.9%	0.0%	53.3%	
	51 -60	3	12	73	8	2	98	
		1.1%	4.4%	26.8%	2.9%	0.7%	36.0%	
	more than 60	0	6	22	1	0	29	
		0.0%	2.2%	8.1%	0.4%	0.0%	10.7%	
BMI	underweight	0	1	4	0	0	5	0.244
		0.0%	0.4%	1.5%	0.0%	0.0%	1.8%	
	normal weight	0	10	42	4	0	56	
		0.0%	3.7%	15.4%	1.5%	0.0%	20.6%	
	overweight	2	17	73	11	0	103	
		0.7%	6.3%	26.8%	4.0%	0.0%	37.9%	

	obesity	5	6	85	10	2	108	
		1.8%	2.2%	31.3%	3.7%	0.7%	39.7%	
marital status	Single	0	0	3	0	0	3	0.001
		0.0%	0.0%	1.1%	0.0%	0.0%	1.1%	
	Married	3	28	181	21	2	235	
		1.1%	10.3%	66.5%	7.7%	0.7%	86.4%	
	Divorced	1	3	6	1	0	11	
		0.4%	1.1%	2.2%	0.4%	0.0%	4.0%	
	widow	0	1	10	2	0	13	
		0.0%	0.4%	3.7%	0.7%	0.0%	4.8%	
	other	3	2	4	1	0	10	
		1.1%	0.7%	1.5%	0.4%	0.0%	3.7%	
Gender	Male	3	16	88	9	0	116	0.694
		1.1%	5.9%	32.4%	3.3%	0.0%	42.6%	
	Female	4	18	116	16	2	156	
		1.5%	6.6%	42.6%	5.9%	0.7%	57.4%	
Region	the South	1	4	27	3	1	36	0.665
		0.4%	1.5%	9.9%	1.1%	0.4%	13.2%	
	Eastern	1	2	15	5	0	23	
		0.4%	0.7%	5.5%	1.8%	0.0%	8.5%	
	North	0	0	6	0	0	6	
		0.0%	0.0%	2.2%	0.0%	0.0%	2.2%	
	Western	2	20	111	14	1	148	
		0.7%	7.4%	40.8%	5.1%	0.4%	54.4%	
	Central	3	8	45	3	0	59	
		1.1%	2.9%	16.5%	1.1%	0.0%	21.7%	
Job	Engineer	0	0	1	1	0	2	0.778
		0.0%	0.0%	0.4%	0.4%	0.0%	0.7%	
	The medical section	1	4	7	2	1	15	
		0.4%	1.5%	2.6%	0.7%	0.4%	5.5%	
	Communications and information technology sector	0	0	7	1	0	8	
		0.0%	0.0%	2.6%	0.4%	0.0%	2.9%	
	Tourism, culture, and entertainment sector	0	0	2	0	0	2	
		0.0%	0.0%	0.7%	0.0%	0.0%	0.7%	
	industry sector	0	0	2	0	0	2	
		0.0%	0.0%	0.7%	0.0%	0.0%	0.7%	
	chemical industry sector	0	0	1	1	0	2	
		0.0%	0.0%	0.4%	0.4%	0.0%	0.7%	
	Energy and water sector	0	0	2	0	0	2	
		0.0%	0.0%	0.7%	0.0%	0.0%	0.7%	
	Transport and logistics sector	0	0	3	0	0	3	
		0.0%	0.0%	1.1%	0.0%	0.0%	1.1%	
	other	6	30	179	20	1	236	
		2.2%	11.0%	65.8%	7.4%	0.4%	86.8%	

Saudi Arabia, like many other countries, is facing a growing epidemic of diabetes. According to the International Diabetes Federation, Saudi Arabia ranks among the top 10 countries with the highest prevalence of diabetes. This alarming statistic highlights the urgent need to address pre-diabetes, as it serves as a precursor to the development of full-blown diabetes [4]. Understanding the knowledge, attitude, and practice of pre-diabetes among people older than 45 years in Saudi Arabia is crucial for several reasons. Firstly, this age group is particularly vulnerable to developing diabetes due to factors such as

sedentary lifestyles, unhealthy dietary habits, and genetic predisposition. Therefore, assessing their awareness and understanding of pre-diabetes is essential in order to design effective prevention and intervention strategies.

Secondly, the attitude towards pre-diabetes plays a significant role in determining the likelihood of adopting healthy lifestyle changes. Attitudes can be influenced by cultural, social, and personal beliefs, which may either facilitate or hinder the adoption of healthy behaviors. By identifying the prevailing attitudes towards pre-diabetes, healthcare professionals can tailor their educational programs and interventions to address specific barriers and misconceptions.

Lastly, the practice of pre-diabetes management is a crucial aspect that needs to be assessed. It encompasses various lifestyle modifications such as regular physical activity, healthy eating habits, weight management, and regular monitoring of blood sugar levels. Understanding the current practices among this age group will help identify gaps and areas for improvement, thereby enabling the development of targeted interventions.

According to our study results, knowledge scores of participants were found to be 23.2% good, 46.3% moderate, and 30.5% poor knowledge of pre-diabetes. A comprehensive evaluation of six research found that up to 93.7% of people did not know what the terms "pre-diabetes," "impaired fasting glucose," "impaired glucose tolerance," or "borderline diabetes" meant. Patients' knowledge of the causes and effects of pre-diabetes, however, varied widely. Studies from middle-income nations generally found that one in three patients comprehended the causes and effects of pre-diabetes. Contrarily, more than half of patients from high-income countries (range 63%–88%) were aware of the causes and effects of pre-diabetes [15]. According to the findings of a different study, the average pre-diabetes knowledge score was 1.72 ± 1.0 (out of 17), and more than 95% of senior people had limited understanding of nutrition, exercise, controlling their weight, and diagnostic and screening techniques [16]. People with diabetes don't know enough about the disease, according to earlier research in Asia and poor nations [17-23]. According to a study by Nguyen *et al*. (2020), Vietnamese adults over the age of 70 had significantly less understanding of diabetes than Vietnamese adults between the ages of 60 and 69 [24]. Knowledge is a key element in preventing pre-diabetes and diabetes, according to the study's experts. Pre-diabetes and preventative interventions may result in a high prevalence of pre-diabetes and diabetes if there is inadequate understanding, which is a risk factor for pre-diabetes. By learning more about changing one's lifestyle, type 2 diabetes can be prevented from developing in those with pre-diabetes [25].

As for attitude, 12.50% of respondents expressed a positive sentiment, while a smaller percentage, 3%, conveyed a very positive attitude. These figures indicate that there is a notable presence of optimism and satisfaction among the participants. Conversely, 9.20% of the responses were categorized as negative, with only 0.70% being classified as very negative. This implies that a minority of individuals hold a pessimistic or unfavorable opinion. Four papers were included in a systematic review that examined patients' attitudes about pre-diabetes and documented their perspectives and perceptions of the condition [15]. According to a study from India, half of the participants were confident in their ability to manage pre-diabetes but worried that it might eventually cause consequences such as developing diabetes, ischemic heart disease, or stroke [15]. According to a study, 50% of senior individuals showed a negative attitude toward changing their lifestyle during the pre-diabetes period [16]. More than 85% of Brazilian seniors have negative attitudes toward diabetes, according to research by Borba *et al*. (2019) [22]. According to Islam *et al*. (2014), those over the age of 35 had considerably more positive attitudes towards diabetes than those under that age [21]. People with negative views towards pre-diabetes are less likely to think they can successfully adopt the lifestyle adjustments required to prevent diabetes and to support screening, according to Mainous *et al*. [26]. Therefore, mental-emotional variables should be taken into account by interdisciplinary experts when developing health measures for changing lifestyles in the pre-diabetic aged.

Regarding practice towards pre-diabetes, a significant portion of individuals, approximately 51.50%, have achieved a good score. This indicates a satisfactory level of performance in the given practice. Furthermore, 27.20% of individuals have attained a very good score, reflecting a commendable level of proficiency. On the other hand, 20.60% of individuals have obtained a bad score, suggesting room for improvement in their practice. It is worth noting that only a marginal percentage, 0.70%, have received a very bad score, indicating that the majority of individuals have performed relatively well. According to a systematic review, the quality level of all included studies was subpar. The majority of participants reported bad eating habits, including skipping meals, eating while distracted, consuming insufficient fiber, too much fat, and eating foods with added sugar. Less than half of the individuals reported getting enough sleep (6 hours per day), and poor sleep hygiene and quality were detected [15].

The findings of a different study also demonstrated that the pre-diabetic elderly's practices regarding healthy food consumption, exercise, sleep patterns, and diagnostic and screening techniques were not desired. Ng *et al*. came to the conclusion that the right knowledge and attitude elements had produced effective disease control strategies [27]. Knowledge has the power to significantly alter someone's behavior by altering their thought patterns, habits, and attitudes. In general, a person's knowledge serves as the fundamental underpinning of proper and successful practice in a variety of areas [28]. A person's ability in the light of knowledge manifests itself in the shape of acceptable human practices.

Exercise and physical activity to help with weight control and blood glucose reduction, as well as psychological and social support and timely screening, should be taken into consideration to increase the results of changing lifestyle in pre-diabetic people [29]. Providing healthy lifestyle strategies related to correcting the eating pattern with the aim of weight loss (5- 10% of body mass) using real and sustainable dietary approaches with the support of a nutritionist should also be taken into consideration. Therefore, in nations where diabetes is a major public health concern, increasing awareness and health literacy

about pre-diabetes, fostering positive attitudes towards lifestyle modification through counseling programs, and empowering the pre-diabetic elderly may all help prevent and control programs for pre-diabetes and diabetes more effectively [30].
The findings of this study can serve as a foundation for developing targeted interventions and educational programs aimed at raising awareness, promoting positive attitudes, and encouraging healthy practices among people older than 45 years with pre-diabetes in Saudi Arabia. These interventions can be delivered through various channels, such as healthcare facilities, community centers, and digital platforms, to ensure widespread dissemination and accessibility.

Conclusion

In conclusion, poor knowledge, attitude, and practice scores were found in Saudi Arabia. The knowledge score of participants was not significantly associated with any of the sociodemographic characteristics, while attitude and practice scores towards pre-diabetes were significantly associated with marital status only. The knowledge, attitude, and practice of pre-diabetes among people older than 45 years in Saudi Arabia is a critical issue that needs to be addressed urgently. By conducting a comprehensive research study, we can gain valuable insights into the existing knowledge levels, attitudes, and practices related to pre-diabetes in this age group. This knowledge can then be utilized to develop targeted interventions and educational programs that will help prevent or delay the onset of type 2 diabetes, ultimately improving the health outcomes of the population.

Acknowledgments: We thank the participants who all contributed samples to the study.

Conflict of interest: None

Financial support: None

Ethics statement: Ethical approval was obtained from the research ethics committee of the Ministry of Health. Application number: (A01565). An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.
Written informed consent was obtained from all individual participants included in the study.

References

1. Almutiri AH, Alsofyani TA, Algetham BD, Abdulrazaq SS, Sultana S. Assessment of different risk factors contribute to type 2 diabetes and evaluates the effect of natural treatment in pre-diabetic population in Taif city, Saudi Arabia. Int J Pharma Sci Res. 2019;10(10):321-35.
2. Santosa A, Gustiawan A, Putra R, Chasanah N. Body Mass Index to Predict Pre-diabetes. Ethiop J Heal Dev. 2019;33(1).
3. Khan T, Wozniak GD, Kirley K. An assessment of medical students' knowledge of pre-diabetes and diabetes prevention. BMC Med Educ. 2019;19(1):1-7.
4. Rett K, Gottwald-Hostalek U. Understanding pre-diabetes definition, prevalence, burden and treatment options for an emerging disease. Curr Med Res Opin. 2019;35(9):1529-34.
5. Chowdhury S, Chakraborty P pratim. Awareness of diabetes risk factors among Bisha Residents Southwestern Saudi Arabia Muffarah. J Fam Med Prim Care. 2021;6(2):169-70.
6. Brown R. *Assessing for awareness and knowledge regarding diabetes in pre-diabetes obese patients* (Doctoral dissertation, Walden University).
7. Alsaleh E, Alnaser M, Alsalman A, Alramdhan A, Alsalman H, Alhamrani O, et al. A community-based pre-diabetes knowledge assessment among Saudi adults in al-ahsa region, 2018. J Public Health Res. 2021;10(1):1-7.
8. Mohsen F, Safieh H, Shibani M, Ismail H, Alzabibi MA, Armashi H, et al. Assessing diabetes mellitus knowledge among Syrian medical students: A cross-sectional study. Heliyon. 2021;7(9):1-7.
9. Amer OE, Sabico S, Alfawaz HA, Aljohani N, Hussain SD, Alnaami AM, et al. Reversal of Pre-diabetes in Saudi Adults: Results from an 18 Month Lifestyle Intervention. Nutrients. 2020;12(3):1-10.
10. Aldossari KK, Aldiab A, Al-Zahrani JM, Al-Ghamdi SH, Abdelrazik M, Batais MA, et al. Prevalence of Pre-diabetes, Diabetes, and Its Associated Risk Factors among Males in Saudi Arabia: A Population-Based Survey. J Diabetes Res. 2018;2018:2194604.
11. Saeed N, Jaffery T, Ansari FA, Hamid B, Khan BA. Knowledge and perceptions about pre-diabetes amongst doctors, medical students, and patients in a tertiary care hospital of Islamabad. J Pak Med Assoc. 2019;69(4):527-32.
12. Roper KL, Thomas AR, Hieronymus L, Brock A, Keck J. Patient and Clinician Perceptions of Pre-diabetes: A Mixed-Methods Primary Care Study. Diabetes Educ. 2019;45(3):302-14.
13. Montee N, Anthony N, Collet A, Franco JM, Marimoutou C, Leruste S, et al. Knowledge, attitudes, and practices regarding pre-diabetes among general practitioners in Reunion Island. Diabetes Epidemiol Manag. 2022;6:100048.

14. Hyder KM, Mohan J, Varma V, Ponnusankar S, Raja D. Impact of a pre-diabetes education program on knowledge, attitude, and practice among the pre-diabetic population of south India. Prev Med Reports. 2021;23:101395. doi:10.1016/j.pmedr.2021.101395
15. Teoh KW, Ng CM, Chong CW, Bell JS, Cheong WL, Lee SWH. Knowledge, attitude, and practice toward pre-diabetes among the public, patients with pre-diabetes and healthcare professionals: a systematic review. BMJ Open Diabetes Res Care. 2023;11(1):e003203. doi:10.1136/bmjdrc-2022-003203
16. Pakpour V, Molayi F, Nemati H. Knowledge, Attitude, and Practice of the Pre-Diabetic Elderly regarding Pre-diabetes.
17. Abbasi YF, See OG, Ping NY, Balasubramanian GP, Hoon YC, Paruchuri S. Diabetes knowledge, attitude, and practice among type 2 diabetes mellitus patients in Kuala Muda District, Malaysia–A cross-sectional study. Diabetes Metab Syndr. 2018;12(6):1057-63. doi:10.1016/j.dsx.2018.06.025
18. Gautam A, Bhatta DN, Aryal UR. Diabetes-related health knowledge, attitude, and practice among diabetic patients in Nepal. BMC Endocr Disord. 2015;15(1):1-8. doi:10.1186/s12902-015-0021-6
19. Hawal NP, Shivaswamy M, Kambar S, Patil S, Hiremath M. Knowledge, attitude and behavior regarding self-care practices among type 2 diabetes mellitus patients residing in an urban area of South India. Int Multidiscip Res J. 2013;2(12).
20. Hussain R, Rajesh B, Giridhar A, Gopalakrishnan M, Sadasivan S, James J, et al. Knowledge and awareness about diabetes mellitus and diabetic retinopathy in suburban population of a South Indian state and its practice among the patients with diabetes mellitus: A population-based study. Indian J Ophthalmol. 2016;64(4):272-6. doi:10.4103/0301-4738.182937
21. 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(10):e110368. doi:10.1371/journal.pone.0110368
22. Borba AKOT, Arruda IKG, Marques APdO, Leal MCC, Diniz AdS. Knowledge and attitude about diabetes self-care of older adults in primary health care. Cien Saude Colet. 2019;24(1):125-36. doi:10.1590/1413-81232018241.35052016
23. 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(1):8-11.
24. Nguyen AT, Pham HQ, Nguyen TX, Nguyen TTH, Nguyen HTT, Nguyen TN, et al. Knowledge, Attitude and Practice of Elderly Outpatients with Type 2 Diabetes Mellitus in National Geriatric Hospital, Vietnam. Diabetes Metab Syndr Obes. 2020;13:3909-17. doi:10.2147/DMSO.S267866
25. AlSaleh E, Alnaser M, Alsalman A, ALRamdhan A, Alsalman H, Alhamrani O, et al. A community-based prediabetes knowledge assessment among Saudi adults in Al-Ahsa region, 2018. J Public Health Res. 2021;10(1):2032. doi:10.4081/jphr.2021.2032
26. Mainous AG, Tanner RJ, Scuderi CB, Porter M, Carek PJ. Pre-diabetes screening and treatment in diabetes prevention: the impact of physician attitudes. J Am Board Fam Med. 2016;29(6):663-71. doi:10.3122/jabfm.2016.06.160138.
27. Ng SH, Chan KH, Lian ZY, Chuah YH, Waseem AN, Kadirvelu A. Reality vs illusion: knowledge, attitude and practice among diabetic patients. Int J Collab Res Internal Med. 2012;4(5):723.
28. Smith KL, Cameron PA, Meyer A, McNeil JJ. Knowledge of heart attack symptoms in a community survey of Victoria. Emerg Med (Fremantle). 2002;14(3):255-60. doi:10.1046/j.1442- 2026.2002.00340.x
29. Hyder KM, Mohan J, Varma V, Ponnusankar S, Raja D. Impact of a pre-diabetes education program on knowledge, attitude, and practice among the pre-diabetic population of south India. Prev Med Rep. 2021;23:101395. doi:10.1016/j.pmedr.2021.101395
30. Bell K, Shaw JE, Maple-Brown L, Ferris W, Gray S, Murfet G, et al. A position statement on screening and management of pre-diabetes in adults in primary care in Australia. Diabetes Res Clin Pract. 2020;164:108188. doi:10.1016/j.diabres.2020.108188