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Original Article

Knowledge among Primary Health-care Doctor of Screening, Diagnosing, and Management of Prediabetes in Al-Hasa, Saudi Arabia

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Abstract

Background: Prediabetes affects around 3 million KSA adults, but primary health-care (PHC) doctors knowledge, practices, attitudes, and beliefs toward prediabetes are unclear.

Objective: The objective of this study was to assess the PHC doctors (1) knowledge of risk factors for prediabetes screening, laboratory criteria for diagnosing prediabetes, and overall management of prediabetes, (2) management practices around prediabetes, and (3) attitudes and beliefs about prediabetes.

Design: This was a self-administered written questionnaire of PHC doctors.

Participants: Of 163 PHC doctors, 140 (85%) were selected from Al-Hasa PHC.

Main Measures: Descriptive and analyses of survey questions on knowledge, management, and attitudes and beliefs related to rediabetes. Multivariate logistic regression was used to determine the association between doctors' characteristics (gender, nationality, and years since training) and knowledge, management, and attitudes and beliefs about prediabetes.

Key results: About 45% of PHC doctors correctly identified all of the risk factors that should prompt prediabetes screening. >70% of PHC doctors correctly identified the laboratory parameters for diagnosing prediabetes based on both fasting glucose and hemoglobin A1c. All PHC doctors reported close follow-up (within 6 months) of patients with prediabetes. The most doctor does not prescribe metformin for prediabetes management. Doctor's characteristics were generally not associated with knowledge, management, and attitudes and beliefs about prediabetes in multivariate analyses.

Conclusions: Addressing gaps in knowledge and construction of behavioral change program such as weight loss program for prediabetes are two essential areas where PHC doctors could take a lead in curbing the diabetes epidemic.

Key words: Prediabetes, Prevention, Primary health care

INTRODUCTION

Diabetes has become one of the largest 21st century global health emergencies. The International Diabetic Federation estimates that 415 million adults worldwide have diabetes and 318 million have prediabetes which is expected to increase to 642 million and 482 million, respectively, by 2040.[1] In Saudi Arabia, >50% of the Saudi population aged ≥30 years is either diabetic or prediabetic 25.4% and 25.5%, respectively, which has turned up to epidemic proportion which would definitely indicate an urgent need for primary prevention through the detection of patient at prediabetes stage which is fundamental for diabetes prevention.[2,3] The WHO has reported that Saudi Arabia has the second highest rank in the Middle East, and the seventh in the world for the rate of diabetes with estimation of 7 million of population are diabetic and almost around 3 million prediabetic.[4] Prediabetes is a state that conveys a high risk for developing diabetes.[5] Strategy to detect patient with prediabetes is essential to prevent diabetes with estimation of 70% of prediabetes individual would ultimately develop diabetes.[6,7,8] Evidence estimates that annual conversion of people with prediabetes to diabetes is around 5–10%.[6] Prediabetes could be considered as the stage of diabetes as some diabetes complication such as

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nephropathy, chronic kidney disease, small fiber neuropathy, and diabetic retinopathy could happen at this stage and increased risk of macrovascular disease as well as premature myocardial infarction.[7] On the other hand, detection of patient at this stage with proper management such as intense lifestyle modification and medication is effective in preventing or slowing progression of diabetes.[5] Evidence shows that prediabetes is underdiagnosed and undertreated in with evidence, suggesting that 90% of prediabetes individual are unaware of their diagnosis.[9] Furthermore, a most prediabetic individual is not gathering evidence-based recommendations from their primary doctor for prevention, especially precise counseling and referral for lifestyle modification.[10] Right now, we did not find prior literature in our area why prediabetes is underdiagnosed by PHC doctor; therefore, it is important to assess primary health-care (PHC) doctor knowledge and practice toward prediabetes.[11]

PHC is redefined as a process to organize the full range of health care, from households to hospitals, with prevention equally important as a cure, and with resources invested rationally in the different levels of care. One of four core PHC principles which have the highest priority is people-centered services by giving respond to people's such as prevention and management of chronic diseases strategy.[11] In Saudi Arabia, The Ministry of Health (MOH) provides health services at three levels: Primary, secondary, and tertiary. PHC centers supply primary care services, both preventive and curative, referring cases that require more advanced care to public hospitals.[6] In Alahsa region, there are 67 PHC divided into three health sectors Hofof, Mubarrazz, and Omran health sector which is run with 86 doctors and 86 doctors in Hofof and Omran sector, respectively, wherein Mubarrazz still no answer from their sector.

One of the tremendous challenges facing MOH is rapid increase in the prevalence of diabetes, financial and medical burden of diabetes which has an annual cost 7 billion Saudi Riyals (SR) (US$ 1.87 billion) for treatment.[6] Therefore, diabetes prevention is the most effective way to reduce the prevalence of diabetes and financial and health burden of diabetes through the detection of prediabetes with proper management.

For this reason, this study has been designed to assess knowledge of PHC doctor for prediabetes screening in an adult with American Diabetic Association (ADA) criteria which include being overweight or obese (body mass index [BMI] ≥25 kg/m2) adults who have one or more of risk factors for diabetes. First-degree relative with diabetes, women who were diagnosed with gestational diabetes mellitus, history of cerebrovascular disease, hypertension (≥140/90 mmHg or on therapy for hypertension), dyslipidemia, women with polycystic ovary syndrome, physical inactivity, other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans).[2] For all patients, testing should begin at the age of 45 years.[12] If results are normal, testing should be repeated at a minimum of 3-year intervals, with consideration of more frequent testing depending on initial results (e.g., those with prediabetes should be tested yearly) and risk status.[5] Moreover, assessing of doctor knowledge of diagnosis of prediabetes which is confirmed with FPG between 100 and 125 mg/dL OR 2-h PG in the 75-g oral glucose tolerance test 140-199 mg/dL OR A1C 5.72-6.4%,[5] as well as modality of management plan with lifestyle modification with >5% weight loss, medication such as metformin and or bariatric surgery. For care improvement of a prediabetic patient, we should understand how PHC doctors are dealing with this patient in terms of management and what barriers are they facing in treating this patient.[10] We should understand how PHC doctors are dealing with this patient in terms of management and what barriers are they facing in treating this patient.

Objectives

General objective

The general objective of this study was to assess the prediabetes practice among PHC doctor in Al-Hasa region which includes:

1. Knowledge of precise risk factors for prediabetes screening.
2. Diagnosing prediabetes through laboratory result interpretation and their management guideline.
3. Management practice and doctor attitude toward prediabetes in Al-Hasa, Saudi Arabia.

Specific Objectives

The specific objectives of this study were as follows:

i. To increase the awareness and assess specific knowledge of prediabetes risk factors.
ii. To assess the correct diagnosis of prediabetes with different laboratory result.
iii. To assess the management plan and attitude of doctor toward prediabetes which is underdiagnosed and undertreated.
iv. To have outcome recommendation for the area of the defect to try to have better prediabetes management for diabetes prevention.

METHODOLOGY

Study Sitting and Time

The study was conducted at PHC center in Al-Hasa, Saudi Arabia, 2017–2018.

Study Design

This was a descriptive cross-sectional study through self-administered pre-prepared questionnaire adapted from Johns Hopkins School of Medicine.

Study Population

Saudi & Non-Saudi doctor work in PHC in Alhasa, Saudi Arabia.

Inclusion criteria

Any PHC doctor who works in a general clinic, chronic disease clinic, and/or family medicine clinic who is willing to participate during the study time will be included in the study.

Exclusion criteria

The doctor who meets the following criteria will be excluded from the study:

1. Working in another clinic such as pediatric, antenatal, ophthalmology, and ENT clinic at PHC.
2. Working in place other than PHC such as hospital or diabetic center even if they work in chronic disease clinic.

Study Variables

Dependent variables

Dependent variables include Pre-prepared questionnaire from the Johns Hopkins School of Medicine for Primary Care Providers' Screening and Treatment Practices for Prediabetes.[9]

Independent variables

Socio demographic data including gender, specialty, experience and nationality.

Sampling

Sample size

Population include in this study has been taken from health resource statistics which includes general physician (GP) and family medicine doctor with total population of 281 doctors; then, the sample size has been calculated online with 95% confidence level and confidence interval 5 through survey system website with sample size result 163 doctors which is calculated through the following formula

$$SS = \frac{Z^{2*}(P)^{*}(1-P)}{C^{2}}$$

Therefore, this number has been divided into three sectors with 54 doctors in each health sectors. These doctors who met the inclusion criteria will be invited to participate in the study. The sampling technique will be random distribution of the questionnaire.

Data Collection Tool and Technique

Data are collected from the doctor through a self-administered questionnaire. We used printed paper and distributed through as directly to the doctors at PHC.

Data Management

After data collection, any questionnaire, that is, <50% filled will be canceled. Data were entered and analyzed through statistician using SPSS software version 25. All variables would be coded before entry and would be double checked before analysis.

Data Analysis

Descriptive: All continuous data would be presented in mean, median, and standard deviation. Categorical data would be presented in percentage.

Chi-square test will be used to compare two or more qualitative variables Student's *t*-test was used to compare two independent quantitative variables and ANOVA test to compare more than two independent quantitative variables.

Significance will be determined at $P < 0.05$ and confidence interval of 95%CI.

Other appropriate statistical tests will be used as indicated.

This will be done with the assistance of a statistical advisor

Study Strength

To the best of our knowledge, this is the first study in Al-Hasa, Kingdom of Saudi Arabia, emphasizing on the prevention of diabetes through detecting prediabetes by assessing knowledge and practice of PHC doctors and to assess the gap between knowledge and practice.

Study Result

Of 163 doctors, 140 completed questionnaire with 85% response rate [Table 1]. Doctors were mostly male (58.3%), female (41.7%), Saudi (72.53%), and non-Saudi (27.5%) and had been in practice for at least 5 years (53.6%). These doctors were work in PHC (family medicine, resident, GP, and others specialty). All of them see patient in clinic regardless of gender, age, complaint, or nationality.

Risk Factors for Prediabetes Screening

On average, doctors selected seven of the nine correct risk factors for prediabetes screening [Table 4]. 25% of participant identified all of the traditional risk factors (age ≥45, BMI ≥25 kg/m^2, hypertension, dyslipidemia, heart disease, family history of diabetes, sedentary lifestyle, and history of gestational diabetes). 45% of providers correctly identified all nine of the risk factors for prediabetes screening [Figure 1,3]. The most commonly identified risk factors were a family history of diabetes (94%), overweight (82.9%), history of gestational diabetes (99%), dyslipidemia (94%), hypertension (92.9%), and history of heart disease

Table 1: The (count) and percent (%) values for each group

Variables	Categorical	Frequency (%)
1. Which of the following are risk factors that might prompt you to screen for diabetes (TRUE OR FALSE):		
Age≥45	False	3 (2.1)
	True	137 (97.9)
BMI≥25 kg/m^2	False	23 (16.5)
	True	116 (83.5)
Hypertension	False	9 (6.5)
	True	130 (93.5)
Dyslipidemia	False	7 (5)
	True	132 (95)
Heart disease	False	34 (25.2)
	True	101 (74.8)
Sedentary lifestyle	False	11 (8)
	True	126 (92)
History of gestational diabetes	False	1 (0.7)
	True	139 (99.3)
Smoking	False	46 (34.8)
	True	86 (65.2)
Family history of diabetes in a first-degree relative	False	1 (0.8)
	True	132 (99.2)
2. What is the HbA1c range for pre-DM		
	5.5–6.5	9 (6.4)
	5.6–6.5	22 (15.7)
	5.7–6.4	102 (72.9)
	5.8–7.0	5 (3.6)
	I do not know	2 (1.4)
3. What is the FBS range for pre-DM		
	90–100	4 (2.9)
	99–110	5 (3.6)
	100–125	101 (73.2)
	110–125	28 (20.3)
4. True or false: The following is/are part of the overall management of pre-DM		
Weight loss	False	0 (0)
	True	140 (100)
Diet modification	False	0 (0)
	True	140 (100)
Exercising	False	0 (0)
	True	140 (100)
Metformin	False	41 (29.5)
	True	98 (70.5)
It is too early to intervene in pre-DM	False	119 (87.5)
	True	17 (12.5)
5. In your clinical practice: How do you consider pre-DM as a medical condition which needs intervention		
Pre-DM needs aggressive intervention		40 (28.6)
Pre-DM needs moderate intervention		56 (40)
Pre-DM needs mild intervention		36 (25.7)
Pre-DM does not need intervention		6 (4.3)
I do not know		2 (1.4)
6. In your clinical practice, when would you follow-up a pre-DM patient, if at all		
3 months		70 (50)
6 months		48 (34.3)
1 year		18 (12.9)
2 years		1 (0.7)
I do not know		1 (0.7)
No specific recommendation		2 (1.4)
7. Of your patients with prediabetes (without progression to diabetes), for what percentage of them have you prescribed metformin? (Select one)		
0%		33 (24.4)
1–10%		40 (29.6)
11–20%		23 (17)
21–30%		19 (14.1)
31–50%		9 (6.7)
More than 50%		11 (8.1)

(Contd...)

Table 1: *(Continued)*

Variables	Categorical	Frequency (%)
8. What is your specialty? (select all that apply)		
GP		81 (58.7)
Family medicine resident		34 (24.6)
Family medicine specialist or consultant		13 (9.4)
Other		10 (7.2)
9. How long ago did you graduate from medical college		
0–1 year		10 (7.2)
1.1–2 years		22 (15.9)
2.1–5 years		32 (23.2)
More than 5 years		74 (53.6)
10. On average, how many half-day clinic sessions do you have per week		
1–2		20 (14.9)
3–4		13 (9.7)
5–6		19 (14.2)
7–8		16 (11.9)
9–10		66 (49.3)
11. What is your gender	Female	58 (41.7)
	Male	81 (58.3)
12. What is your nationality	Saudi	100 (72.5)
	Non-Saudi	38 (27.5)

Table 2: The frequency and percentage of risk factors and overall management

Variables: Original	Frequency (%)	Percent of cases
1. Which of the following are risk factors that might prompt you to screen for diabetes (true)		
Age≥45	137 (12.50)	97.90
BMI≥25 kg/m^2	116 (10.60)	82.90
Hypertension	130 (11.80)	92.90
Dyslipidemia	132 (12.00)	94.30
Heart disease	101 (9.20)	72.10
Sedentary lifestyle	126 (11.50)	90.00
History of gestational diabetes	139 (12.60)	99.30
Smoking	86 (7.80)	61.40
Family history of diabetes in a first-degree relative	132 (12.00)	94.30
Total	1099 (100.00)	785.00
2. True: The following is/are part of the overall management of pre-DM		
Weight loss	140 (26.20)	100.00
Diet modification	140 (26.20)	100.00
Exercising	140 (26.20)	100.00
Metformin	98 (18.30)	70.00
It is too early to intervene in pre-DM	17 (3.20)	12.10
Total	535 (100.00)	382.10

Adds up to>100% because more than one answer could be selected

(72.1%). The least commonly identified risk factors were smoking (61.4%) [Figure 1, Table 2,3].

Laboratory Criteria for Diagnosing Prediabetes

Laboratory criteria for diagnosing prediabetes FBS were 73.2% of participants correctly identified and HBA1C was 72% correctly identified. All were statistically significant $P < 0.05$. We found that the result of corrected identified laboratory test increases with the experience years [Tables 1 and 7 and Figure 2].

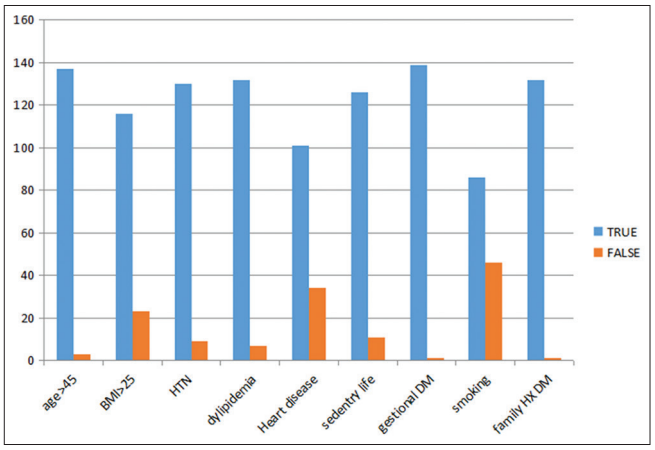

Figure 1: Percentage of each risk factors of prediabetes

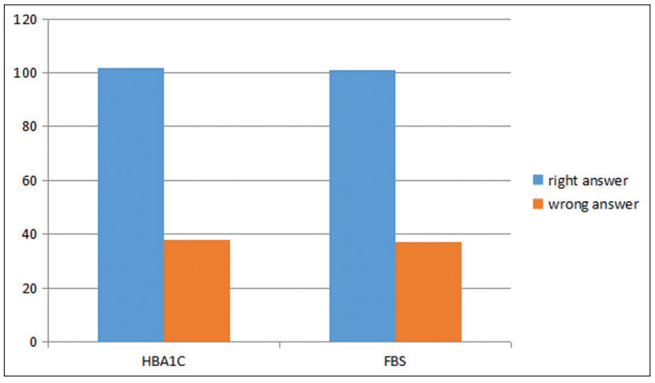

Figure 2: Identify laboratory data

Overall Management of Prediabetes

All doctors were agreed for lifestyle modifications for prediabetes including weight loss, diet modification, and exercise. On another hand, metformin use for prediabetes

Table 3: The frequency ,percentage and direction of risk factors and overall management

Variables: Edited	Frequency (%)	Percent of cases	Direction
1. Which of the following are risk factors that might prompt you to screen for diabetes (true)			
History of gestational diabetes	139 (12.60)	99.30%	Most agreement
Age≥45	137 (12.50)	97.90%	↓
Dyslipidemia	132 (12.00)	94.30%	↓
Family history of diabetes in a first-degree relative	132 (12.00)	94.30%	↓
Hypertension	130 (11.80)	92.90%	↓
Sedentary lifestyle	126 (11.50)	90.00%	↓
BMI≥25 kg/m^2	116 (10.60)	82.90%	↓
Heart disease	101 (9.20)	72.10%	↓
Smoking	86 (7.80)	61.40%	Less agreement
Total	1099 (100.00)	785.00%	
2. True: The following is/are part of the overall management of pre-DM			
Weight loss	140 (26.20)	100.00%	Most agreement
Diet modification	140 (26.20)	100.00%	Most agreement
Exercising	140 (26.20)	100.00%	Most agreement
Metformin	98 (18.30)	70.00%	↓
It is too early to intervene in pre-DM	17 (3.20)	12.10%	Less agreement
Total	535 (100.00)	382.10%	
Adds up to>100% because more than one answer could be selected			

Table 4: The (count) and percent (%) values for each question, (mean values) and the direction

Question. No	Strongly disagree		Disagree		Neutral		Agree		Strongly agree		Mean	Direction
	Count	%	Count	%	Count	%	Count	%	Count	%		
1-More time for doctors to counsel patients	1	0.7	2	1.4	5	3.6	38	27.3	92	66.2	4.58	Strongly agree
2-More educational resources for patients	1	0.7	0	0	4	2.9	28	20.1	105	75.5	4.71	Strongly agree
3-Improved access to Diabetes Prevention Programs (an evidence-based lifestyle change program)	1	0.7	1	0.7	6	4.3	22	15.8	107	77	4.7	Strongly agree
4-Improved nutrition resources for patients	1	0.7	0	0	6	4.3	35	25.2	97	69.8	4.63	Strongly agree
5-Improved access to weight loss programs	1	0.7	0	0	7	5	40	28.8	91	65.5	4.58	Strongly agree
6-Improved access to bariatric surgery	8	5.8	19	13.7	41	29.5	42	30.2	29	20.9	3.47	Agree
Overall	13.00	1.57	22.00	2.65	69.00	8.31	205.00	24.70	521.00	62.77	4.444	Strongly agree

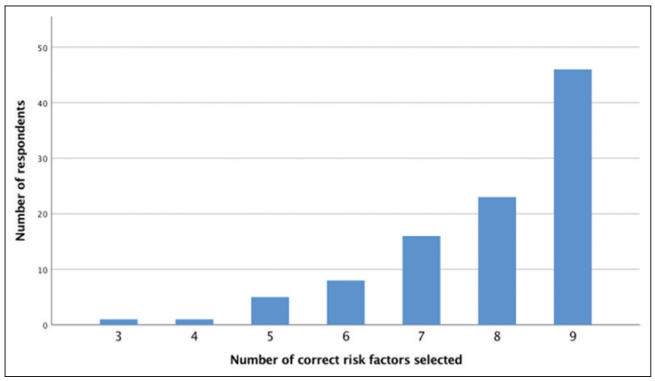

Figure 3: Number of correct risk factors selected

was less common only 70% agree with metformin [Table 2,3]. We did not find a significant association between doctor characteristics and overall management [Table 8].

The majority of doctor agrees that prediabetes need intervention varies of aggressive to mild intervention, only 8% disagrees with prediabetes intervention. There was no significant difference in intervention between male and female as well as between Saudi and non-Saudi [Tables 8 and 9]

For follow-up, 84.3% of doctor selected between 3 and 6 months [Table 1].

Attitude and Believe

The majority of participant strongly agreed that prediabetes management includes: intervention in weight loss, exercising, and diet modified (100%). While using metformin in pre-DM only 70.5% agree to it, Only 28.6% agree with aggressive intervention. [Tables2 and 3].

Table 5: The (number of agreement), percent (%), mean, standard deviation and direction values for each question

Question. No	No in agreement (%)	Mean±SD	Direction
More time for doctors to counsel patients	130/138 (94.2)	4.58±0.703	Strongly agree
More educational resources for patients	133/138 (96.4)	4.71±0.594	Strongly agree
Improved access to diabetes prevention programs (an evidence-based lifestyle change program)	129/137 (94.2)	4.7±0.657	Strongly agree
Improved nutrition resources for patients	132/139 (95)	4.63±0.639	Strongly agree
Improved access to weight loss programs	131/139 (94.2)	4.58±0.658	Strongly agree
Improved access to bariatric surgery	71/139 (51.1)	3.47±1.138	Agree
Overall	726/830 (87.47)	4.44±0.494	Strongly agree

Dichotomized the answers by combining (strongly agree and agree) versus (neutral, disagree, and strongly disagree)

Table 6: The percent (%), P value with demographic variety for lab result

Provider characteristic	% of knowledge with correct HbA1c for pre-DM		% of knowledge with correct FBS for pre-DM	
	Percentage	*P* value	Percentage	*P* value
Gender				
Female	39	0.038	38	0.021
Male	61		62	
Nationality				
Saudi	73	0.001	76	0.001
Non-Saudi	27		24	
Specialty				
GP	62.4	0.001	57.6	0.001
Family medicine resident	20.8		24.2	
Family medicine speciallist or consultant	10.9		11.1	
Other	5.9		7.1	
How long you graduate from medical college				
0–1 year	7.9	0.001	7	0.001
1.1–2 years	10.9		9	
2.1–5 years	24.8		28	
More than 5 years	56.4		56	

Table 7: The percent (%), P value with demographic variety for overall pre-DM management

Provider characteristic	% of knowledge with correct weight loss		% of knowledge with correct diet modification		% of Knowledge with correct exercising		% of Knowledge with correct metformin		% of Knowledge with correct its too early to intervence in pre-DM	
	Percentage	*P* value	Percentage	*P* value	Percentage	*P* value	Percentage	*P* value	Percentage	*P* value
Gender										
Female	42	0.062	42	0.062	42	0.062	43	0.223	31	0.210
Male	58		58		58		57		69	
Nationality										
Saudi	72	0.001	72	0.001	72	0.001	75	0.001	75	0.077
Non-Saudi	28		28		28		25		25	
Specialty										
GP	58.7	0.001	58.7	0.001	58.7	0.001	59.4	0.001	56.3	0.099
Family medicine resident	24.6		24.6		24.6		24		31.3	
Family medicine speciallist or consultant	9.4		9.4		9.4		9.4		NULL	
Other	7.2		7.2		7.2		7.3		12.5	
How long you graduate from medical college										
0–1 year	7.2	0.001	7.2	0.001	7.2	0.001	5.2	0.001	12.5	0.037
1.1–2 years	15.9		15.9		15.9		14.6		12.5	
2.1–5 years	23.2		23.2		23.2		28.1		18.8	
More than 5 years	53.6		53.6		53.6		52.1		56.3	

Regarding interventions for improving prediabetes management, PHC doctors reported that more time for counseling (93.5%), more educational resources for patients (95.6%), improved nutrition resources (95%),

Table 8: Comparison between female and male doctor for prediabetes intervention

Q3 - is there difference between (female and male) in their (interventions of the management of the pre-diabetes)?
A3 - We will use statistical test call: (Independent *t*-test) to determine if there are any statistically significant differences between two groups

Group	Female (*n*=58)	Male (*n*=81)	Independent sample *t*-test	
	Mean (SD)	Mean (SD)	*t*	*P* value
Interventions of the management of the pre-diabetes	4.474 (0.378)	4.423 (0.563)	0.607	0.545

P value>0.05 we will assume there is no statistical difference between groups Table 8

Table 9: Comparison between Saudi and Non-Saudi doctor for prediabetes intervention

Q4 - is there difference between (female and male) in their (interventions of the management of the pre-diabetes)?
A4 - We will use statistical test call: (Independent *t*-test) to determine if there are any statistically significant differences between two groups

Group	Saudi (*n*=100)	Non-Saudi (*n*=38)	Independent sample *t*-test	
	Mean (SD)	Mean (SD)	*t*	*P* value
Interventions of the management of the pre-diabetes	4.454 (0.527)	4.429 (0.398)	0.263	0.793

P value>0.05 we will assume there is no statistical difference between groups Table 9

access to diabetic prevention program (92.8%), and weight loss programs (91%) would be helpful. While participant agrees to follow up patient in 3-6 months (84.3%) [Tables 1,4 and 5].

DISCUSSION

The study shows important gaps in participant knowledge of risk factors (i.e., heart disease and smoking), diagnostic criteria, and evidence-based recommendations for pre-DM. Participants follow prediabetes closely but infrequently recommend metformin. Participants believe that patient-related factors are important barriers to managing prediabetes (sedentary life, exercising, and diet modification). Only 11 participants who are considering to use metformin early.

Before this study, there were no clear data in prediabetes practices in PHC regarding prediabetes screening, diagnosis, or management. We describe PHC knowledge around prediabetes for the 1st time and we choose paper questionnaire to increase response rate which reaches 85%. The data show around 25% of participants did not choose the right answer to laboratory criteria of prediabetes. If the participants have the knowledge of risk factors and lab criteria, it would contribute to decrease incidentally discovering DM type 2 in Saudi Arabia. In our survey, the majority of participants reported following their patients with prediabetes closely with nearly all providing counseling on lifestyle change.

Since 2003, the ADA guidelines for prediabetes have focused on lifestyle modification for prediabetes, and recommendations for metformin use were added in 2007. Notably, there was no specific recommendation of prediabetes that participants will follow for treatment.

Consensus guidelines by administrator or diabetic center may help to improve overall diagnosis, screening risk factors, and treatment of prediabetes as it may help improve the identification and management of prediabetes as the clear recommendation will increase confidence in participants and decrease hesitancy to start metformin. We believe that recommendation will help to prevent further complication of DM2 if pick-up early in prediabetes.

The barriers include time constraints, limited staffing resources were seen in data collection. Other barriers like if there is an existing program to diabetes prevention, weight loss program, nutrient resource, or easy access for bariatric surgery. Even though the participants agree 100% of weight reduction, exercising, and diet modified, there were no terms of accessibility of any of this program.

Notably, the study did not cover patients' attitude or believe regarding prediabetes patients as disease or management need (weight reduction, exercising, diet modified, and start treatment by metformin).

CONCLUSION

PHC doctors had substantial gaps in knowledge about prediabetes screening, diagnosing, and management.

Study Limitations

Several limitations to our study deserve mention. First, this survey was conducted among doctors from PHC only so findings may not be generalizable for other area dealing with this condition.

Second, there may be response bias (unmotivated misreporting) regarding doctor practices.

Third, social desirability bias (motivated misreporting in a socially desirable direction) may be problematic, particularly when reporting attitudes and barriers. This bias could have led to more respondents agreeing that prediabetes is an important condition to identify when they do not feel this way. The strengths of our study include a high response rate (85%), a comprehensive, detailed survey, and, to the best of our knowledge, the first data on PHC doctors knowledge around prediabetes.

RECOMMENDATIONS

One in four Saudi Arabian people are at risk of developing diabetes, and this number continues to rise. In our sample, PHC doctors had substantial gaps in knowledge about prediabetes that need to be addressed for interventions through screening and prevention program to be successful. Educating doctors on screening guidelines, diagnostic criteria, and management options will be the important first step to filling these gaps. The role of professional societies in improving knowledge and addressing attitudes cannot be underestimated. System changes to support provider behavior are also important. Despite substantial evidence for the effectiveness of metformin, they remain underutilized. Reasons for this are likely complex and warrant further investigation.

With these changes, PHC is optimally positioned to take a lead in curbing the diabetes epidemic.

Ethical Considerations

Even with the increase of research demand in Saudi Arabia, incorporating research ethics into clinical and academic institutions are still growing. Each recruiting PHC sector administration has its own procedure in obtaining ethical approval. However, they all share the same basic ethical principles and also remarkable similarities in procedures. Participants will be provided with information about the study and what this involves before taking part. If they expressed an interest, verbal and written consent will be obtained from them and the steps will include the following:

- Written permission from the Joint Program of Family and Community Medicine will be obtained before conduction of the research.
- Approval of the study will be requested from the Ministry of Health Research Committee before implementation of the study.
- All the information from the questionnaire will be kept confidential.
- We will explain to the doctors the study purpose and to reassure them that there will be no negative impact on them.
- Informed consent will be taken before the respondents' involvement in the study.
- Doctors would be allowed to refuse to participate in the study.

Work Plan and Duties

Activity	9/2017	2/2018	3/2018	4/2018	5/2018	6/2018	7/2018	8/2018	9/2018	10/2018	11/2018	12/2018
Finalize Research Proposal												
Research Committee Approval												
Pretest &Refining Instruments (Pilot)												
Recruitment of Data Collectors												
Data Collection												
Data Entry &Analysis												
Final report Writing												
Dissemination of Findings												
Publication												

Study Implication

This study will help to assess the knowledge of PHC doctor of prediabetes and their awareness of this underestimated condition and their attitude in practice to see any deficient element need to be improved to improve outcome which is diabetes prevention.[12]

Study Reporting and Implementation

A scientific paper will be written at the end of study for publication in national and international journals.

Study Funding

This study will be self-funded.

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APPENDIX 1: QUESTIONNAIRE

Knowledge among PHC doctor of screening, diagnosing, and management of prediabetes in Al-Ahsa, Saudi Arabia

Questionnaire

I have fully understood the purpose of this study and I agree to participate knowing that all the information from these questionnaires will be kept confidential.

I agree to participate in this study I refuse participation in this study.

☐ Yes ☐ No

Part I. The following questions apply to your knowledge and practices regarding diabetes screening.

1. Which of the following are risk factors that might prompt you to screen for diabetes (TRUE OR FALSE):

	True	False		True	False
Age≥45			Heart disease		
BMI≥25 kg/m^2			Sedentary lifestyle		
Hypertension			History of gestational diabetes		
Dyslipidemia			Smoking		
			Family history of diabetes in a first-degree relative		

2. What is the HbA1c range for pre-DM:

A. 5.5–6.5	B. 5.6–6.5	C. 5.7–6.4	D. 5.8–7.0	E. I do not know

3. What is the FBS range for pre-DM:

F. 90–100	G. 99–110	H. 100–125	I. 110–125	J. I do not know

4. True or false: The following is/are part of the overall management of pre-DM:

	True	False
A. Weight loss		
B. Diet modification		
C. Exercising		
D. Metformin		
E. It is too early to intervene in pre-DM		

Part II. The following questions apply to your knowledge, practices, and beliefs regarding prediabetes management.

5. In your clinical practice: How do you consider pre-DM as a medical condition which needs intervention:
A. Pre-DM needs aggressive intervention.
B. Pre-DM needs moderate intervention.
C. Pre-DM needs mild intervention.
D. Pre-DM does not need intervention.
E. I do not know.

6. In your clinical practice, when would you follow up a pre-DM patient, if at all

a. 3 months	b. 6 months	c. 1 year
d. 2 years	e. I do not know	f. No specific recommendation

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
More time for doctors to counsel patients					
More educational resources for patients					
Improved access to Diabetes Prevention Programs (an evidence-based lifestyle change program)					
Improved nutrition resources for patients					
Improved access to weight loss programs					
Improved access to bariatric surgery					

8. Of your patients with prediabetes (without progression to diabetes), for what percentage of them have you prescribed metformin? (Select ONE)

A. 0%	B. 1–10%	C. 11–20%	D. 21–30%	E. 31–50%	F. More than 50%

Part III: Demographic information

9. What is your specialty? (Select ALL that apply)

a. GP	b. Family medicine resident	c. Family medicine specialist or consultant
D.Other		

10. How long ago did you graduate from medical college

A. 0–1 year	B. 1.1–2 years	C. 2.1–5 years	D. More than 5 years

11. On average, how many half-day clinic sessions do you have per week:

A. 1–2	B. 3–4	C. 5–6	D. 7–8	E. 9–10

12. What is your gender:	A) Female	B) Male
13. What is your nationality:	A) Saudi	B) Non-Saudi