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By Solikhah Solikhah

WORD COUNT 1103
TIME SUBMITTED 09-JUN-2021 11:07AM
PAPER ID 73189723

Journal of Kerman University of Medical Sciences

JKMU

Journal of Kerman University of Medical Sciences, 2020; 27 (5): 380-388

Smoking Habits, Stress, and Physical Activity in relation to Diabetes Mellitus: a nationwide study in Indonesia

Nur Aini Purwaningsih [1], Solikhah Solikhah, Ph.D. [2]

1- Undergraduate Student, Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

2- Assistant Professor, Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta, Indonesia (Corresponding author: Email: solikhah@ikm.uad.ac.id)

Received: 21 May, 2020 Accepted: 10 August, 2020

ARTICLE INFO

Article type:
Original Article

Keywords:
Diabetes mellitus
Smoking
Stress
Physical activity
Indonesia

Abstract

Background: Diabetes mellitus remains a primary chronic disease all around the world, including Indonesia. A poor lifestyle that includes smoking habits, stress, and lack of physical activities will increase the incidence of diabetes mellitus. This study aimed to explore the relationship of smoking habits, stress, and physical activity with diabetes mellitus incidence in Indonesia.

Methods: A total of 12,110 respondents from 13 provinces in Indonesia were interviewed and evaluated in a cross-sectional national-based population study in Indonesia. Multivariate binary logistic regression analysis was used to calculate the adjusted odds ratio value with a 95% confidence interval.

Results: Of the 12,110 respondents, 9,154 (75.59%) were ≥ 45 years old and 6,704 (55.36%) had low physical activity. Exposure to cigarette smoke (AOR = 0.73, 95% CI = 0.57-0.94, p < 0.05) and high or vigorous physical activity (AOR = 0.81, 95% CI = 0.67-0.9, p <0.05) were significantly related to diabetes mellitus.

Conclusion: Smoking habits and physical activity were highly associated with diabetes mellitus but stress was not. Therefore, health promotion measures for improvement of life style and prevention of diabetes mellitus are needed and should be organized by primary health care system.

Introduction

Diabetes Mellitus (DM) is a chronic disease that still creates a significant problem in the world, and a rapid increase in the prevalence of DM has been observed, especially in low and middle-income countries, including Indonesia. Globally, the number of adults with diabetes has increased more than three times, from 108 million in 1980 to 415 million in 2015 (1, 2). Data from the International Diabetes Federation (IDF) in 2017 indicates that the global prevalence of type 2 DM has reached 8.8%. World Health Organization (WHO) has estimated that around 171 million people are living with diabetes (3), and Type 2 DM is ranked the 7th leading cause of death in the world (4). The majority of deaths in type 2 DM patients occur in low and middle-income countries, including Indonesia (4). Based on the data from the *International Diabetes Federation* (IDF) in 2015, Indonesia was ranked the 7th, after China, India, the United States, Brazil, Russia, and Mexico, among countries with the highest DM prevalence with a prevalence of 10 million people. Data from the Indonesian Basic Health Research (2018) shows an increase in the prevalence of diabetes in Indonesia; i.e.,

from 6.9% (2013) to 8.5% (2018) with 1.9% living in the cities where Jakarta was the first with a prevalence of 3.4%. The increasing incidence of diabetes in developing countries is most likely caused by population aging (5) and changes in the lifestyle, including inadequate physical activities, higher obesity rate, unhealthy diet, smoking habit, and alcohol consumption (2, 6-8).

Type 2 Diabetes Mellitus (DM) is a metabolic disease that occurs when insulin produced by the pancreas is ineffective (insulin resistance), which consequently causes an increase in blood glucose levels (9, 10). This condition will be exacerbated by poor lifestyle such as smoking habit (11-13), stress (14, 15) and lack of physical activities (16-18). Smoking habits led to insulin resistance as well as reduced glucose metabolism (19, 20). Stress triggers the production of cortisol and adrenaline hormones in the body, which increase the blood glucose level (14). Meanwhile, regular physical activities are likely to improve insulin sensitivity (21). Some physical activities, such as jogging for 30-40 minutes, increased glucose distribution into the cells by 7-20 times (22). Few studies have investigated the relationship of smoking, stress and physical activity with DM and most of these studies have been conducted in Western populations. In Indonesia, in spite of being a lower middle-income country with a not well-established healthcare infrastructure and limited health care teams and caregivers, most diabetic patients do not undergo routine self-control of blood glucose due to the lack of their knowledge. The present study aimed to investigate the relationship of smoking, stress, and physical activity with DM incidence using a nationwide survey in Indonesia.

Material and Method

Design and Sample

This analysis is based on interviews with 12,110 respondents in the national population-based cross-sectional studies in 2014-2015, which is referred to as the Indonesian Family Life Survey (IFLS-5). IFLS-5 is the fifth wave survey of a series of continuous surveys that have been conducted since 1993. Participants in this study were selected using stratified random sampling and strata were based on the province - locality (rural/urban) combination. These combinations sufficiently described the spectrum of culture and socioeconomic diversity among Indonesian. For cost-efficiency, 13 of 27 provinces were selected containing 83% of the population, namely: North Sumatera, West Sumatera, South Sumatera, Lampung, DKI Jakarta, West Java, DI Yogyakarta, East Java, Bali, West Nusa Tenggara, South Kalimantan, and South Sulawesi. Then, the household was randomly collected until the data collection was completed by chosen enumeration areas (EAs) per each province. Four family members of participants from each selected household were selected until the data collection was completed, as interviewing all members of the household would be a high cost. Inclusion criteria were: participants aged ≥ 18 years old and completion of the questionnaire regarding the studied variables. Participants who relocated in another province and their tracking were difficult and those who passed away or had incomplete data regarding the study variables were excluded. The study protocol was approved by the Universitas Ahmad Dahlan's Ethics Committee for Human Research (011907070).

Measurement instruments

Glycated hemoglobin (HbA1c) level is an indicator of glycemic control in the 2-3 months prior to the test was represented diabetes mellitus as our outcome variable and it was assessed in the fifth wave of the Indonesian Family Life Survey (IFLS-5) collaborated with the laboratory at the Clinical Pathology and Laboratory Medicine Department at the University of Gadjah Mada (UGM), Yogyakarta, Indonesia. Based on the HbA1c level, subjects were classified into the two groups, namely: HbA1c≥ 6.5% (diabetes mellitus) and HbA1c <6.5% (non-diabetes mellitus). Smoking habit was classified into two categories of Yes and No based on chewing tobacco or smoking tobacco or smoking cigarette during the interview or in the past.

The Psychosocial Stress variable was measured using the criteria of Center for Epidemiologic Studies Depression Scale (CES-D) and classified into 5 categories, namely: 0 = no stress at all, 1 = slightly stressed, 2 = mild stressed, 3 = moderately stressed and 4 = severely stressed.

Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ) and was classified into the three following categories:

1) High, daily vigorous 60-minute exercise throughout the past week (e.g., aerobic) recommended by the World Health Organization (2018).

2) Moderate, at least 150 minutes per week

3) Light, at least two hours a week, doing daily intense exercise (23). Lastly, sociodemographic factors were assessed by asking questions about age, sex, education, and occupation.

Statistical Analysis

Continuous data were presented as means and standard deviation and categorical data were expressed as number and percentage. The selection of other risk factors and/or confounders to be included in multivariable models was based on a $p<0.25$ in the bivariate models. Multivariate logistic regression analysis was used to evaluate the independent factors associated with DM. All analyses were conducted using STATA version 15.0. Statistical significance was defined as a p-value of less than or equal to 0.05.

Results

Of the 12,110 respondents, 9,154 (75.59%) were ≥ 45 years old, and 6,704 (55.36%) had low physical activity. The prevalence of diabetes mellitus was 4.67% in all participants, 9.19% among those <45 years and 90.81% among those ≥ 45 years. Detailed characteristics of the respondents are listed in Table 1.

Table 1. Characteristics of respondents with diabetes mellitus in Indonesia (n = 12,110)

Characteristics	Diabetics	Non-diabetics	Total participants	Prevalence 95% CI
Overall	566 (4.67)	11,544 (95.33)	12,110 (100)	0.04 – 0.05
Sex				
Male	259 (45.76)	5,554 (48.11)	5,813 (48.00)	0.47 – 0.49
Female	307 (54.24)	5,990 (51.89)	6,297 (52.00)	0.51 – 0.53
Age				
<45	52 (9.19)	2,904 (25.16)	2,956 (24.41)	0.24 – 0.25
≥45	514(90.81)	8,640 (74.84)	9,154 (75.59)	0.75 – 0.76
Education				
Elementary School	97 (17.14)	6,492 (56.24)	6,760 (55.82)	0.55 – 0.57
Junior high school	127 (22.44)	1,631(14.13)	1,705 (14.08)	0.13 – 0.15
Senior High School	74 (13.07)	2,329 (20.17)	2,456 (20.28)	0.20 – 0.21
University	268 (47.35)	1,092(9.46)	1,189 (9.82)	0.09 – 0.10
Occupation				
Housewife	3 (0.53)	166 (1.44)	169 (1.40)	0.01 – 0.02
Farmer	28 (4.95)	185 (1.60)	213 (1.76)	0.02 – 0.02
Labourer	246 (43.46)	3,481(30.15)	3,727 (30.78)	0.30 – 0.32
Government/business	289 (51.06)	7,712 (66.81)	8,001 (66.07)	0.65 – 0.67
Smoking Habit				
Yes	196 (34.63)	4,740 (41.06)	4,936 (40.76)	0.40 – 0.42
No	370 (65.37)	6,804 (58.94)	7,174 (59.24)	0.58 – 0.60
Stress level				
High	9 (1.59)	227 (1.97)	236 (1.95)	0.02 – 0.02
Moderate	13 (2.30)	264 (2.29)	277 (2.29)	0.02 – 0.03
Mild	11(1.94)	357 (3.09)	368 (3.04)	0.03 – 0.04
Slight	51(9.01)	866 (7.50)	917 (7.57)	0.07 – 0.08
Not at all	482 (85.16)	9,830 (85.15)	10,312 (85.15)	0.85 – 0.86
Physical Activity				
Light	356 (62.90)	6,348 (54.99)	6,704 (55.36)	0.54 – 0.56
Moderate	12 (2.12)	458 (3.97)	470 (3.88)	0.04 – 0.04
High	198 (34.98)	4,738 (41.04)	4,936 (40.76)	0.40 – 0.42

Data have been presented as n (%)

The results of the bivariate and multivariate binary logistic regression models have been presented in Table 2. Based on the results of the study, respondents with smoking habit had lower odds of DM (AOR = 0.73, 95% CI = 0.57-0.94, p<0.05).High physical activity showed significant relationship with the incidence of DM (AOR = 0.81, 95% CI = 0.67-0.9, p<0.05), while in contrast, psychological stress showed no significant relationship with DM incidence. With the same smoking pattern, females were significantly at lower risk of DM (AOR = 0.73, 95% CI = 0.57-0.94, p<0.05). Subjects with the age of ≥ 45 years had 3.53 times higher risk for DM when compared to those who were younger than 45 years old (AOR = 3.53, 95% CI = 2.63-4.74, p<0.001). Those who worked as farmers had 4.11 times higher risk to develop DM when compared to housewives, government/private employees, and those who were self-employed (AOR = 4.11, 95% CI = 2.70-6.29, p<0.001). In addition, respondents who worked as laborers had 1.94 times higher risk for DM compared to housewives, government/private employees, and those who were self-employed (AOR = 1.94, 95% CI = 1.60-2.36, p<0.001). As it is seen in Table 2, educational level had significant relationship with the incidence of DM ($AOR_{elementary\ school}$ = 0.39, 95% CI = 0.30-0.50, p<0.001; $AOR_{junior\ high\ school}$ = 0.50, 95% CI = 0.36-0.69, p p<0.001; $AOR_{senior\ high\ school}$ = 0.65, 95% CI = 0.49-0.86, p<0.01).

Table 2. Multivariate binary logistic regression analysis for diabetes mellitus in Indonesia

Variables	Crude OR	95%CI	Adjusted OR	95%CI
Sex (ref: male)				
Female	1.09	0.93 – 1.28	0.73	0.57 – 0.94*
Age (ref: <45)				
≥45	3.32	2.49 – 4.43***	3.53	2.63 – 4.74***
Education (ref: University)				
Elementary School	0.46	0.37 – 0.65***	0.39	0.30 – 0.50***
Junior high school	0.51	0.37 – 0.70***	0.50	0.36 – 0.69***
Senior High School	0.61	0.47 – 0.81***	0.65	0.49 – 0.86**
Occupation (ref: Government/business)				
Housewife	0.48	0.15 – 1.52	0.45	0.14 – 1.43
Farmer	4.04	2.67 – 6.11***	4.11	2.70 – 6.29***
Laborer	1.89	1.58 – 2.25***	1.94	1.60 – 2.36***
Smoking Habit (ref: No smoking)				
Yes	0.76	0.64 – 0.91**	0.73	0.57 – 0.93*
Stress (ref: not at all)				
Severely stressed	0.81	0.41 – 1.58	0.84	0.42 – 1.66
Moderately stressed	1.00	0.57 – 1.77	1.09	0.62 – 1.93
Mildly stressed	0.63	0.34 – 1.15	0.66	0.36 – 1.23
Slightly stressed	1.20	0.89 – 1.62	1.23	0.91 – 1.67
Physical Activity (ref: light physical activity)				
Moderate	0.47	0.26 – 0.84	0.60	0.33 – 1.09
High	0.75	0.62 – 0.89	0.81	0.67 – 0.97*

***: p<0.001; **: p<0.01; *: p<0.05; ref: reference

Discussion

Diabetes mellitus causes damages to various body systems, especially to the nerves and blood vessels (23), and may trigger renal failure (24), neuropathy (21, 25), retinopathy (26, 27), heart diseases, and stroke (4). The mortality rate of DM patients is doubled when compared to those without DM; thus, good management of DM patients is essential. There are four pillars in DM management, namely education, nutritional therapy, physical activities, and pharmacological intervention to control blood sugar levels and complications (21).

The results of this study indicated a significant relationship between smoking habits and DM incidence. Smoking is one of the primary triggers of morbidity and mortality and should be avoided. This is due to the high level of nicotine in the blood that may affect the release of cortisol hormone and will eventually interfere with the function of insulin (28). Indonesia is the country with high rate of cigarette consumption and about 66% of men adopt smoking habits (29). Therefore, the awareness of the relationship between smoking and diabetes is essential for preventing this habit among the people of Indonesia.

In addition, we found that lack of physical activity was associated with DM. This finding is in line with the previous studies claiming that lack of physical activity can cause insulin resistance in DM patients (30-31). This is due to food that enters the body and is not burned but will be stored in the form of fat instead. It has been agreed that routine physical activities will increase the insulin level in the body and decrease the glucose level (18, 32). Meanwhile, this study fails to show a significant relationship between stress and DM. It is likely because most of the respondents were not experiencing stress when they were interviewed, or there may be bias in the response. Stress increases the activity of sympathetic nerves, triggering the hypothalamus to secrete excessive catecholamine that will lead to glycogenesis and increase of blood glucose level (15).

Moreover, stress can also stimulate the endocrine organs to secrete epinephrine that can, in turn, increase the glucose level in the blood. Effective management is essential to increase the community's awareness about DM pathology, risk factors, management, and complications for reducing morbidity and mortality related to diabetes. Self-control of blood glucose level by the patient and educating both patients and health care teams and caregivers by the authorities is very important to improve the quality of life of diabetic patients. As a low middle-income country with the fourth largest population in the world, Indonesia has limited health care infrastructure, including those for diabetes treatment. Increased education is necessary to encourage the community to live a healthy lifestyle (33, 34). Regular exercise, balanced diet, no-smoking, controlling fat level, blood pressure and blood sugar are the keys in early detection of pre-diabetic patients and successful control of HBA1c.

The present study had several limitations. First, data were collected through interviewing respondents in a serial of continuous national huge-population surveys that had been started since 1994 and spontaneous responses given as the result of emotional factors were considerably existed. Second, this study was cross-sectional, so it could only conclude concurrent associations of DM with a smoking habit, stress, and physical activity. Despite these limitations, the present study had some advantages. First, data were obtained from a large and nationally representative sample of DM patients spreading through 13 provinces in Indonesia; hence, the results of this study can adequately represent the population of Indonesia, both demographically and geographically. Second, to the best of our knowledge, this was the first large-nationwide conducted research and covered 80% of provinces to evaluate lifestyle associated with DM among Indonesian. Finally, the present study covers modifiable risk factors associated with DM reported in the literature.

Conclusion

Smoking habit and physical activity were risk factors that can increase the risk of DM in Indonesia. However, we could not demonstrate the association of stress with DM. It is expected that the community can apply anticipatory measures in the form of prevention so that the incidence of DM can be minimized. Furthermore, primary health care facilities are also expected to put more emphasis on the promotion and preventive activities against non-communicable diseases, including diabetes mellitus.

Conflict of interest

There is no potential conflict of interest relevant to this article.

Acknowledgment

This study was supported by the fifth wave of the Indonesian Family Life Survey (IFLS-5) conducted by RAND and Survey Meter (https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS/ifls5.html). We thank RAND for providing permission to use the survey data and the study participants who provided the survey data.

References

1. Zhou B, Lu Y, Hajifathalian K, Bentham J, Cesare MD, Danaei G, et al. Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4·4 million participants. *Lancet* 2016; 387(10027):1513-30.
2. International Diabetes Federation. *IDF Diabetes Atlas: Seventh Edition*. Brussels, Belgium: International Diabetes Federation; 2015.
3. Ogurtsova K, da Rocha Fernandes JD, Huang Y, Linnenkamp U, Guariguata L, Cho NH, et al. IDF diabetes atlas: global estimates for the prevalence of diabetes for 2015 and 2040. *Diabetes Res Clin Pract* 2017; 128:40-50.
4. World Health Organization. *Global Report on Diabetes*. France: WHO; 2016.
5. Charvat H, Goto A, Goto M, Inoue M, Heianza Y, Arase Y, et al. Impact of population aging on trends in diabetes prevalence: a meta-regression analysis of 160,000 Japanese adults. *J Diabetes Investig* 2015; 6(5):533-42.
6. Boles A, Kandimalla R, Reddy PH. Dynamics of diabetes and obesity: epidemiological perspective. *Biochim Biophys Acta Mol Basis Dis* 2017; 1863(5):1026-36.
7. Reddy PH. Can diabetes be controlled by lifestyle activities? *Curr Res Diabetes Obes J* 2017; 1(4): 555568
8. Pan A, Wang Y, Talaei M, Hu FB. Relation of smoking with total mortality and cardiovascular events among patients with diabetes: a meta-analysis and systematic review. *Circulation* 2015; 132(19):1795-804.
9. Wang Y, Qu H, Xiong X, Qiu Y, Liao Y, Chen Y, et al. Plasma asprosin concentrations are increased in individuals with glucose dysregulation and correlated with insulin resistance and first-phase insulin secretion. *Mediators Inflamm* 2018; 2018:9471583.
10. Salunkhe VA, Veluthakal R, Kahn SE, Thurmond DC. Novel approaches to restore beta cell function in prediabetes and type 2 diabetes. *Diabetologia* 2018; 61(9):1895-901.
11. Akter S, Goto A, Mizoue T. Smoking and the risk of type 2 diabetes in Japan: a systematic review and meta-analysis. *J Epidemiol* 2017; 27(12):553-61.
12. Cai X, Chen Y, Yang W, Gao X, Han X, Ji L. The association of smoking and risk of diabetic retinopathy in patients with type 1 and type 2 diabetes: a meta-analysis. *Endocrine* 2018; 62(2):299-306.
13. Hilawe EH, Yatsuya H, Li Y, Uemura M, Wang C, Chiang C, et al. Smoking and diabetes: is the association mediated by adiponectin, leptin, or c-reactive protein? *J Epidemiol* 2015; 25(2):99-109.
14. Derek MI, Rottie J, Kallo V. Hubungan tingkat stres dengan kadar gula darah pada pasien diabetes mellitus tipe II di Rumah Sakit Pancaran Kasih GIMM Manado. *J Keperawatan* 2017; 5(1).

15. Hackett RA, Steptoe A. Type 2 diabetes mellitus and psychological stress - a modifiable risk factor. *Nat Rev Endocrinol* 2017; 13(9):547-60.

16. Castaneda C, Layne JE, Munoz-Orians L, Gordon PL, Walsmith J, Foldvari M, et al. A randomized controlled trial of resistance exercise training to improve glycemic control in older adults with type 2 diabetes. *Diabetes Care* 2002; 25(12):2335-41.

17. Colberg SR, Sigal RJ, Fernhall B, Regensteiner JG, Blissmer BJ, Rubin RR, et al. Exercise and type 2 diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement. *Diabetes Care* 2010; 33(12): 2692-6.

18. Jadhav RA, Hazari A, Monterio A, Kumar S, Maiya AG. Effect of physical activity intervention in prediabetes: a systematic review with meta-analysis. *J Phys Act Health* 2017; 14(9):745-55.

19. Grøndahl MF, Bagger JI, Lund A, Faurschou A, Rehfeld JF, Holst JJ, et al. Effects of smoking versus nonsmoking on postprandial glucose metabolism in heavy smokers compared with nonsmokers. *Diabetes Care* 2018; 41(6):1260-7.

20. Seifu W, Woldemichael K, Tsehaineh T. Prevalence and risk factors for diabetes mellitus and impaired fasting glucose among adults aged 15-64years in gilgel gibe field research center, southwest Ethiopia, 2013: through a who step wise approach. *MOJ Public Health* 2015; 2(4):136-43.

21. Soelistijo SA, Novida H, Rudijanto A, Soewondo P, Suastika K, Manaf A, et al. *Konsensus: pengelolaan dan pencegahan diabetes melitus tipe 2 di Indonesia 2015*. Indonesia: PB. PERKENI; 2015.

22. Dolongseda FV, Massie G, Bataha Y. Hubungan pola aktivitas fisik dan pola makan dengan kadar gula darah pada pasien diabetes melitus tipe 2 di poli penyakit dalam rumah sakit Pancaran Kasih Gmim Manado. *Jurnal Keperawatan UNSRAT* 2017; 5(1).

23. Jonsdottir IH, Rödjer L, Hadzibajramovic E, Börjesson M, Ahlborg G. A prospective study of leisure-time physical activity and mental health in Swedish health care workers and social insurance officers. *Prev Med* 2010; 51(5):373-7.

24. Zheng Y, Ley SH, Hu FB. Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. *Nat Rev Endocrinol* 2018; 14(2):88-98.

25. Kohnert KD, Heinke P, Vogt L, Salzsieder E. Utility of different glycemic control metrics for optimizing management of diabetes. *World J Diabetes* 2015; 6(1):17-29.

26. White NH, Sun W, Cleary PA, Danis RP, Davis MD, Hainsworth DP, et al. Prolonged effect of intensive therapy on the risk of retinopathy complications in patients with type 1 diabetes mellitus. *Arch Ophthalmol* 2008; 126(12):1707-15.

27. Chew EY, Lovato JF, Davis MD, Gerstein HC, Danis RP, Ismail-Beigi F, et al. Persistent effects of intensive glycemic control on retinopathy in type 2 diabetes in the Action to Control Cardiovascular Risk in Diabetes (ACCORD) Follow-On Study. *Diabetes Care* 2016; 39(7):1089-100.

28. Śliwińska-Mossoń M, Milnerowicz H. The impact of smoking on the development of diabetes and its complications. *Diab Vasc Dis Res* 2017; 14(4):265-76.

29. World Health Organization. WHO Diabetes Country Profile. WHO; 2016.

30. Zanuso S, Jimenez A, Pugliese G, Corigliano G, Balducci S. Exercise for the management of type 2 diabetes: a review of the evidence. *Acta Diabetol* 2010; 47(1):15-22.

31. Mann S, Beedie C, Balducci S, Zanuso S, Allgrove J, Bertiato F, et al. Changes in insulin sensitivity in response to different modalities of exercise: a review of the evidence. *Diabetes Metab Res Rev* 2014; 30(4):257-68.

32. Chudyk A, Petrella RJ. Effects of exercise on cardiovascular risk factors in type 2 diabetes: a meta-analysis. *Diabetes Care* 2011; 34(5):1228-37.

33. Alanazi FK, Alotaibi JS, Paliadelis P, Alqarawi N, Alsharari A, Albagawi B. Knowledge and awareness of diabetes mellitus and its risk factors in Saudi Arabia. *Saudi Med J* 2018; 39(10):981-9.

34. Alsous M, Jalil MA, Odeh M, Kurdi RA, Alnan M. Public knowledge, attitudes and practices toward diabetes mellitus: A cross-sectional study from Jordan. *PLoS One* 2019; 14(3):e0214479.

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