



Knowledge of Type II Diabetic Patients About Their Diabetes: A Systematic Review and Meta-Analysis

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Abstract

Introduction: Knowledge is the critical component to counter the harmful side-effects of chronic diseases. Diabetic patients can manage their disease based on their diabetes knowledge and following good self-care behavior. Various studies about patients' knowledge of diabetes show different results. The purpose of this study is to estimate the overall knowledge score of Iranian patients about diabetes.

Methods: In the current study, ten papers published by September 2018 were identified without time limitation. A literature search for the papers was conducted using the keywords: Iran, diabetes, knowledge, and their combinations. The necessary data were extracted and analyzed through meta-analysis using the random-effects model. The I² statistic was used to measure the heterogeneity among the studies. The data were analyzed using Stata software (Version 11).

Results: The pooled estimate of the knowledge score of type II diabetes patients about their diabetes was 64% (95% CI: 52%-76%). According to the meta-regression results, there was no relationship between the knowledge score with age ($P = 0.487$), duration of disease ($P = 0.406$), and the sample size ($P = 0.146$). The patients' knowledge score had experienced an uptrend between 2004 and 2017, the years at which the oldest and the most recent articles were published ($P = 0.06$).

Conclusions: Iranian patients' knowledge about their diabetes was at an average level. Education, along with medication, can significantly reduce short and long-term complications of diabetes.

INTRODUCTION

Diabetes is a chronic metabolic disease that afflicted 383 million people worldwide (8/3%). It has been predicted that 592 million people will have diabetes by 2035, reaching a prevalence of 10% [1]. The current prevalence of diabetes in Iran is 7.7%, and 16.8% of the population with Impaired Fasting Glucose [2]. Uncontrolled diabetes can lead to severe consequences such as heart diseases, strokes, blindness, renal failure, lower-extremity amputation, and even death. Many of these adverse consequences are potentially preventable by adequate metabolic control [3]. Many patients do not have adequate knowledge about the nature of diabetes, risk factors, and its adverse effects [4, 5]. A

crucial part of evaluating diabetes patients is to evaluate their knowledge about diabetes [6]. These patients can decide on and manage their diet, activities, weight control, medication, eyes, and feet care and control some risk factors based on their knowledge about diabetes [7, 8].

The knowledge alone does not guarantee a change in behavior or effective diabetes self-management. The study of diabetes-related knowledge, however, is the first step in the education of patients with diabetes and the evaluation of its effectiveness [7]. Moodley believes that knowledge is the greatest weapon in fighting diabetes [9]. Patients with sufficient knowledge about diabetes

feel more competent and experience a better life [10]. The patients' knowledge is influenced by cultural factors, attitude, their preparation to learn, cognitive function, family support, and their care obstacles [8]. Approximately half of the diabetes patients in Iran have poor health literacy that can lead to adverse consequences [11]. A literature review showed that no systematic study has yet examined the knowledge of diabetic patients about their disease, although the knowledge of diabetes has been studied in nurses [12]. The results of various studies on patients with type II diabetes in Iran show that the patients' knowledge about this disease is variable. Because recognizing the problem is the first step to solving it, investigating knowledge about diabetes for patients can help with health-care planning and interventions aimed at improving patients' knowledge.

In this research, the findings of previous studies were reviewed systematically, and their data were combined using meta-analysis in order to produce a pooled estimate of the knowledge of patients with type II diabetes.

METHODS

Table 1. The search strategies in the Scopus, Pubmed, and web of science

PubMed	("Knowledge"[Mesh] OR Knowledge*[tiab]) AND ("Awareness"[Mesh] OR Awareness*[tiab]) AND ("Diabetes Mellitus" [Mesh] OR diabet*[tiab]) AND ("Iran"[Mesh] OR iran[all])	19
Scopus	TITLE-ABS-KEY (Knowledge*) AND TITLE-ABS-KEY (awareness*) AND TITLE-ABS-KEY ("Diabetes Mellitus" OR diabetes*) AND ALL ("Iran")	89
Web of science	TS=(Knowledge*) AND TS=(awareness*) AND TS=("Diabetes Mellitus" OR diabet*) AND ALL=("Iran") Indexes=SCI-EXPANDED, SSCI, A&HCI, ESCI Timespan=All years	29
Information database and magIran	Diabetes; Knowledge; Awareness	430

Studies Selection and Data Extraction

As a first step, all the papers on knowledge of patients with type II diabetes were collected independently by two researchers. The papers selected were those representing observational studies, written in Persian or English, and with full-text availability. Gray literature was not included.

Unrelated studies, interventional studies, review articles, and duplicate studies were excluded from the research. To reduce bias, two individuals independently searched for papers, selection of the studies, evaluation of the quality of methodologies in the papers, and extraction of data. In case of disagreement, the corresponding author's viewpoints, who has sufficient experience in the field, were used. The information of interest from the selected papers, including the first author's name, publication year, the location of the study, overall sample size, the patients' mean age, duration of disease, and the methodological quality score of the papers, was recorded in a data extraction sheet. The methodological quality of the papers was investigated based on ten items of the STROBE checklist (title and abstract, objectives and hypotheses,

Search Strategy

In this study, a systematic review and meta-analysis of the overall score of knowledge of type II diabetes patients, as published in Iranian articles was conducted. The study was done according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA). The reviewed literature was obtained from the Internet and desk research in the library of Kurdistan University of Medical Sciences. Search for the related articles published by September 2018 was conducted without time limitation using the keywords knowledge, diabetes, Iran, and their combinations. The articles were obtained from Iran's national databases, including Scientific Information Database (SID) and MagIran, and the international databases Web of Science (WoS), Scopus, and PubMed. In order to conduct a thorough search for more articles, the references for each paper found in the search were also checked. Because national databases were not sensitive to Boolean operators, the search was conducted in a single word, so more articles were obtained from these databases. The search strategies at the databases were presents in Table 1.

the research setting, the research inclusion criteria, sample size, statistical methods, descriptive data, analysis of findings, limitations of the study, and funding) [13].

Statistical Analysis

The average score of the patients' knowledge was first converted to a standard score. The knowledge score percentage of the diabetes patients had been calculated based on percentage. Thus, a binomial distribution was used to combine the selected studies. A forest plot was also used to illustrate the pooled estimated score percentage of the patients' knowledge with a 95% confidence interval. The I^2 statistic and the Cochran Q test were also conducted to check for the heterogeneity among the selected studies. Following Higgins and Thompson's advice, the I^2 heterogeneity index was divided into 3 levels: below 25% (low heterogeneity), 25% - 75% (moderate heterogeneity), and above 75% (high heterogeneity) [14]. Due to the heterogeneity in the selected studies ($I^2=97.6\%$), the pooled score was estimated using the random-effects model. The sensitivity analysis was used to verify the consistency of the results. By excluding one study

from the meta-analysis at a time, the role of the excluded study on the overall knowledge score percentage was determined.

Moreover, subgroup analysis and meta-regression were performed to find the source of the variables affecting the knowledge score percentage. In particular, subgroup analysis was used for the five geographic regions 1 to 5. Also, a univariate meta-regression analysis was applied to check the relation between knowledge score percentage and average age, the average duration of disease, the publication year of the paper, and the sample size of the selected studies. A Funnel plot based on Begg's test was also

utilized to check for publication bias. The data were analyzed using Stata software (Version 11).

RESULTS

Five hundred sixty-seven papers were found in the initial search of the national and international databases. During the identification and screening step, 546 papers were considered unrelated, and thus, were excluded from the study. The remaining 21 papers were thoroughly read, from which 11 papers were excluded from further analysis due to other reasons such as lack of adequate information (10 papers) and studying type I diabetes patients (1 paper). Finally, ten papers were analyzed based on the PRISMA statement. (Figure 1).

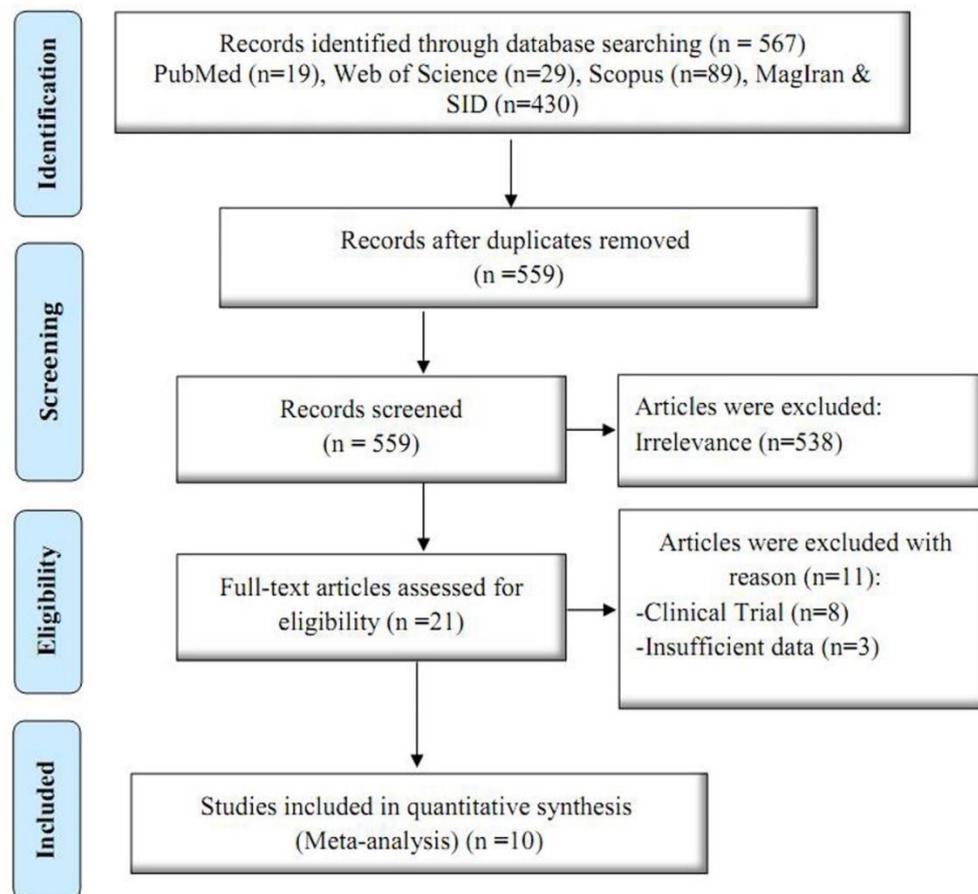


Figure 1. Flow diagram of article screening and selection

The total size of the sample was 1556 people, of which approximately 156 people in each study. The studies of Mohammadi (100 people) [15] and Javadi (212 people) [16] had the smallest and largest sample sizes, respectively. From the studies, seven had been done in Region 1 (Alborz, Tehran, Qazvin, Mazandaran, Semnan, Golestan, and Gom) and 3 (West Azerbaijan, East Azerbaijan, Ardabil, Zanjan, Gilan, and Kurdistan) in other regions of the country (Table 2). Since the questionnaires that examined the knowledge of diabetic patients were not the same, so the raw score of patients'

knowledge in each study became the standard score. For this purpose, the following formula was used:

$$\text{Transformation of Scale Scores} = \frac{\text{Actual raw score} - \text{lowest possible raw score}}{\text{Possible raw score range}} \times 100$$

Where "Actual raw score" is the values achieved through summation, "lowest possible raw score" is the lowest possible value that could occur through summation, and "possible raw score range" is the difference between the maximum possible raw score and the lowest possible raw score [17]. The details of the methodological quality of the articles are presented in Table 3.

The publication bias was plotted to find out whether all the papers on diabetes patients' knowledge have been included in the study. The results showed that the publication bias was not significant ($P = 0.586$). Also, the results of the sensitivity analysis showed that excluding every single study would not affect the percentage of the overall (pooled) standard score (Figure 2).

The knowledge score percentage of type II diabetes patients was estimated at 64% (95% CI: 52%-76%). In the studies conducted, the knowledge score percentage

for Region 1 was lower than that for other regions of the country (60%; 95% CI: 44%-75% compared to 75% (95% CI: 61%-88%) (Figure 3).

The results of the meta-regression showed the score percentage of the patients' knowledge about diabetes had been decreasing with an increase in age ($P = 0.487$), duration of disease ($P = 0.406$), and the sample size ($P = 0.146$). However, the change was not meaningful. Also, patients' knowledge score percentage had been increasing during 2004-2017 (Figure 4).

Table 2. The characteristics of the selected papers

First Author	Year	Sample Size	Type of Study	Age	Duration (year)	City	Scale	Standard Score
Fadaiyan Arani [18]	2017	120	analytical descriptive	48.38±9.57	6.8 ± 4.99	Isfahan	Research-made	86.25
Ghannadi [19]	2016	117	cross sectional	68.70 ± 9.26	14.23 ± 7.29	Tehran	Research-made	59.5
Karbalaefar [20]	2016	120	analytical descriptive	55.98 ± 9.50	9.10 ± 6.70	Tehran	KAP	67.99
Maleki [21]	2016	182	cross sectional	53.8	9.1 ± 6.08	Zahedan	Research-made	64.70
Niroomand [22]	2016	200	cross sectional	60.17±13.56	13.06 ± 9.26	Tehran	Research-made	61.41
Haji arabi [23]	2015	145	cross sectional	54.91	11.8 ± 8.6	Semnan	Audit of Diabetes Knowledge	63.04
Mohammadi [15]	2015	100	cross sectional	-	4.05 ± 1.4	Ahvaz	KAP	73.07
Tol [24]	2012	160	cross sectional	52.73±8.56	6.66 ± 4.5	Tehran	Research-made	82.76
Goodarzi [25]	2011	200	analytical descriptive	55.06±10.23	8.74 ± 6.68	Karaj	Research-made	58.92
Javadi [16]	2004	212	analytical descriptive	-	-	Qazvin	Research-made	24.65

Table 3. The methodological quality of selected papers

First Author	Title & abstract	Objectives and hypotheses	Research setting	Inclusion criteria	Sample size	Statistical methods	Descriptive data	Analysis of findings	Limitations	Funding	Quality score
Fadaiyan Arani [18]	+	+	+	+	+	+	+	+	+	-	9
Ghannadi [19]	+	+	+	+	+	+	+	+	+	-	9
Karbalaefar [20]	+	+	+	+	+	+	+	+	+	-	9
Maleki [21]	+	+	+	+	+	+	+	+	-	-	8
Niroomand [22]	+	+	+	+	+	+	+	+	+	+	10
Haji arabi [23]	+	+	+	+	+	+	+	+	+	+	10
Mohammadi [15]	+	+	+	-	+	+	+	+	-	-	8
Tol [24]	+	+	+	+	+	+	+	+	+	+	10
Goodarzi [25]	+	+	+	+	+	+	+	+	-	-	8
Javadi [16]	+	+	+	-	+	+	+	+	-	-	7

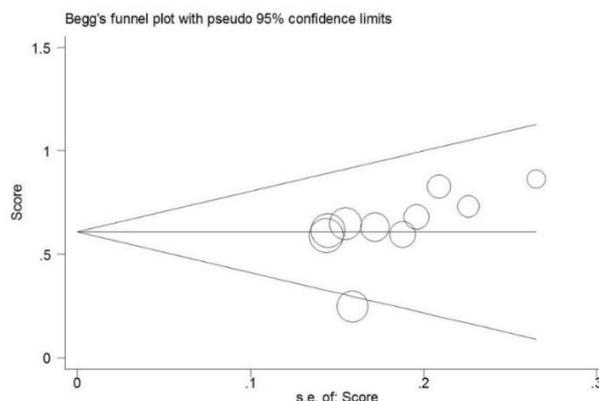


Figure 2. Publication bias. Since all the points lie within the 95% confidence interval with some sort of symmetry, the effect of publication bias is not significant

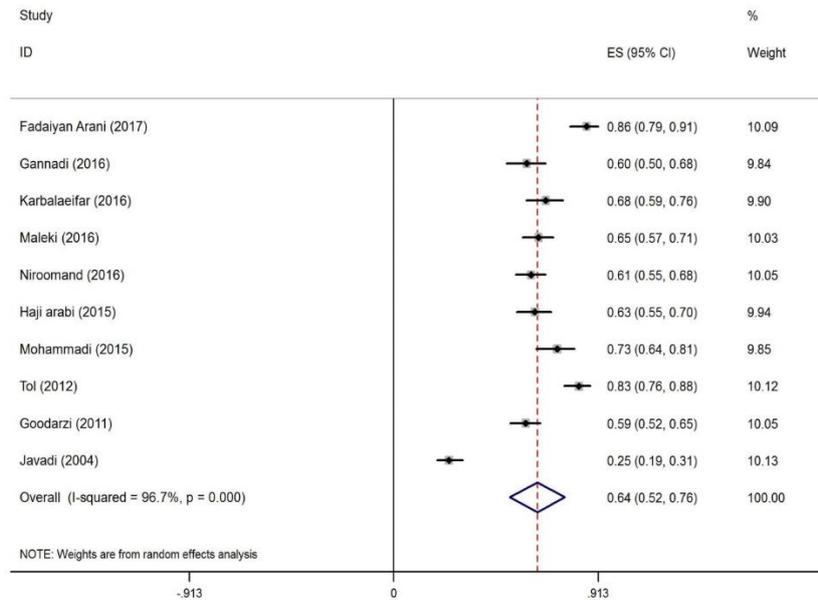


Figure 3. The percentage of knowledge score and 95% confidence interval in patients with type ii diabetes based on the random effects model, shown by the first author's name and year of publication. The point in the middle of each line shows knowledge score percentage in each study as well as the pooled estimate (diamond) of knowledge score percentage for all studies conducted in Iran.

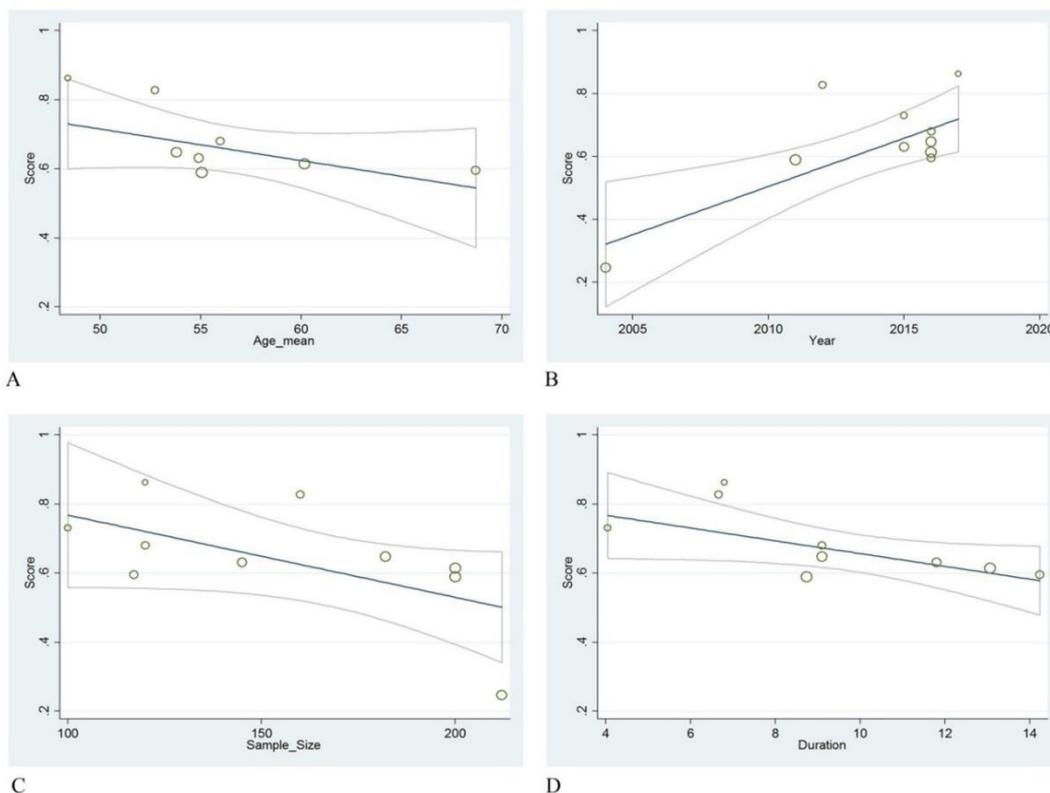


Figure 4. The meta-regression of the relationship between the score percentage of type ii diabetes patients and average age (A), Publication year (B), Sample size (C), Duration of the disease (D).

DISCUSSION

The purpose of the current study was to estimate the knowledge score percentage of type II diabetes patients about their disease. The findings showed that the estimated knowledge score percentage of patients with type II diabetes was 64% (95% CI: 52%-76%). Bruce's

study also showed similar results, in which patients received 60% of the total score [10]. The results of two studies in India and Malaysia showed the score percentages of 50% and 58%, respectively [26, 27]. In the study by Powell et al. (2007), the patients' received approximately 57% of the total knowledge score [28].

The results of studies in Bangladesh, India, and Nepal all indicated low knowledge of diabetes patients about their disease [29-31]. Factors contributing to differences in knowledge score of diabetes patients, as reflected in various studies, can be demographic characteristics of the samples, socio-economic, and cultural factors of various samples. In total, the results of all the aforementioned studies indicate that diabetes patients have medium knowledge about their disease. Low knowledge about the disease leads the patients into lacking a positive attitude toward managing their disease, therefore being unable to show appropriate function. A study conducted in Pakistan showed that diabetes patients exhibit weak knowledge, attitude, and function [3]. Rezaei et al. 's qualitative study (2019) showed that patients disregarded some dietary and medical advice given by clinicians due to insufficient knowledge about diabetes. They even sometimes took their medications according to their physical conditions instead of the doctor's prescription [32].

In the current study, the knowledge score percentage of the patients decreased with an increase in age. In other words, the lowest score percentage belongs to the elderly. West et al. (2002) showed in their research that with every ten years increase in the patient age, the knowledge score decreased 3% [33]. In another study by Al-Qazaz et al. (2012), the diabetes knowledge score of the patients was 53%. Older patients received lower scores than younger ones [34]. With an increase in age, and in turn, more physical and mental complications, patients' ability to keep up with the status of their disease and gaining information about it diminish. Therefore, patients grow dependant on their caregivers gradually.

On the other hand, the risk of long-term complications such as eye and renal failure increases. Thus, such a finding is expected. Also, those with longer disease duration could be older and thus have less knowledge due to being less educated, or those with longer disease duration have many visits to their clinics and talked to their doctors extensively over time.

The patients' diabetes knowledge score percentage was increasing during 2004-2017 (the publication years of the oldest and newest articles selected). Establishing more diabetes centers, filing medical records for patients, following up with their conditions, an increase in the use of mass media and technology to gain information, and performing educational programs have increased patients' knowledge about their disease in Iran in recent years. On the other hand, social and cyberspace developments in recent years have been considered as another factor in increasing patients' knowledge, since they have provided essential information for the patients. Meta-regression findings showed that with

REFERENCES

1. Domingueti CP, Dusse LM, Carvalho M, de Sousa LP, Gomes KB, Fernandes AP. Diabetes mellitus: The linkage between oxidative stress, inflammation, hypercoagulability and vascular

longer disease duration, patients' diabetes knowledge was descending. Abbasi et al. 's study (2018) did not assert any relation between the duration of the disease and diabetes knowledge [25]. In contrary to the aforementioned statements, the studies in India and Malaysia showed a direct link between diabetes' knowledge and the duration of the disease: patients with a longer duration of the disease were more knowledgeable [24, 32].

One of the strengths of this study was to estimate the knowledge score percentage of type II diabetes patients. The first step to control and eliminate any problem is its correct identification. Therefore, findings of this study can provide useful information for health-care providers in Iran so they can better evaluate the knowledge of diabetes patients about their disease. Based on such information, interventions aimed at enhancing patients' knowledge will be possible. As a limitation of this study, the scores are not reported based on differences in gender, education, marital status, and similar socio-economic variables.

CONCLUSIONS

The modern management of diabetes requires special attention to educating patients in addition to medication. With proper and constant education, it is possible to change the health beliefs of the patients, thereby leading to proper self-care behavior. Also, it may reduce considerably diabetes' short- and long-term complications, recurrent hospitalizations, and the time and expenses spent by the patients. This will translate into a better quality of life for the patients' caregivers.

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AUTHORS' CONTRIBUTION

All authors read and approved the final manuscript.

ETHICAL CONSIDERATION

None.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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complications. *J Diabetes Complications*. 2016;30(4):738-45. doi: 10.1016/j.jdiacomp.2015.12.018 PMID: 26781070

2. Esteghamati A, Gouya MM, Abbasi M, Delavari A, Alikhani S, Alaedini F, et al. Prevalence of diabetes and impaired fasting glucose in the adult population of Iran: National Survey of Risk Factors for Non-Communicable Diseases of Iran. *Diabetes Care*. 2008;31(1):96-8. doi: 10.2337/dc07-0959 pmid: 17921357
3. Rafique G, Azam S, White F. Diabetes knowledge, beliefs and practices among people with diabetes attending a university hospital in Karachi, Pakistan. *Eastern Mediterranean Health J*. 2006;12(5):590-8.
4. Kassahun T, Gesesew H, Mwanri L, Eshetie T. Diabetes related knowledge, self-care behaviours and adherence to medications among diabetic patients in Southwest Ethiopia: a cross-sectional survey. *BMC Endocr Disord*. 2016;16(1):28. doi: 10.1186/s12902-016-0114-x pmid: 27381349
5. Karaoui LR, Deeb ME, Nasser L, Hallit S. Knowledge and practice of patients with diabetes mellitus in Lebanon: a cross-sectional study. *BMC Public Health*. 2018;18(1):525. doi: 10.1186/s12889-018-5416-7 pmid: 29678148
6. Fitzgerald JT, Funnell MM, Hess GE, Barr PA, Anderson RM, Hiss RG, et al. The reliability and validity of a brief diabetes knowledge test. *Diabetes Care*. 1998;21(5):706-10. doi: 10.2337/diacare.21.5.706 pmid: 9589228
7. Murata GH, Shah JH, Adam KD, Wendel CS, Bokhari SU, Solvas PA, et al. Factors affecting diabetes knowledge in Type 2 diabetic veterans. *Diabetologia*. 2003;46(8):1170-8. doi: 10.1007/s00125-003-1161-1 pmid: 12856126
8. Garcia AA, Villagomez ET, Brown SA, Kouzekanani K, Hanis CL. The Starr County Diabetes Education Study: development of the Spanish-language diabetes knowledge questionnaire. *Diabetes Care*. 2001;24(1):16-21. doi: 10.2337/diacare.24.1.16 pmid: 11194219
9. Moodley L, Rambirith V. An assessment of the level of knowledge about diabetes mellitus among diabetic patients in a primary health-care setting. *South African Fam Pract*. 2007;49(10):16-22. doi: 10.1080/20786204.2007.10873652
10. Bruce DG, Davis WA, Cull CA, Davis TM. Diabetes education and knowledge in patients with type 2 diabetes from the community: The Fremantle Diabetes Study. *J Diabet Complicat*. 2003;17(2):82-9. doi: 10.1016/S1056-8727(02)00191-5
11. Pashaki MS, Eghbali T, Niksima SH, Albatineh AN, Gheshlagh RG. Health literacy among Iranian patients with type 2 Health Literacy, Knowledge and Relevant Factors in Patients with Type 2 Diabetes Presenting to a Diabetes Clinic in Zahedan in 2014. *Health*. 2016;2030:5-10. doi: 10.18869/acadpub.cjhr.2.2.9
22. Niroomand M, Ghasemi SN, Karimi-Sari H, Kazempour-Ardebili S, Amiri P, Khosravi MH. Diabetes knowledge, attitude and practice (KAP) study among Iranian in-patients with type-2 diabetes: A cross-sectional study. *Diabetes Metab Syndr*. 2016;10(1 Suppl 1):S114-9. doi: 10.1016/j.dsx.2015.10.006 pmid: 26610404
23. Haji-Arabi E, Nobahar M, Ghorbani R. Relationship between depression and knowledge about diabetes with the amount of self-care in patients with type 2 diabetes. *Koomesh*. 2018:210-20.
24. Tol A, Pourreza A, Tavasoli E, Rahimi Foroshani A. Determination of knowledge and health literacy among women with type 2 diabetes in teaching hospitals of TUMS. *J Hospital*. 2012;11(3).
25. Goodarzi M, Ebrahimzadeh I, Rabi A, Saedipoor B, Jafarabadi MA. Impact of distance education via mobile phone text messaging on knowledge, attitude, practice and self efficacy of patients with type 2 diabetes mellitus in Iran. *J Diabetes Metab Disord*. 2012;11(1):10. doi: 10.1186/2251-6581-11-10 pmid: 23497632
26. Raj C, Angadi M. Hospital-based KAP study on diabetes in Bijapur, Karnataka. *India J Med Spec*. 2010;1(2):80-3. doi: 10.7713/ijms.2010.0022
- diabetes: A systematic review and meta-analysis. *Diabetes Metab Syndr*. 2019;13(2):1341-5. doi: 10.1016/j.dsx.2019.02.020 pmid: 31336489
12. Alotaibi A, Al-Ganmi A, Gholizadeh L, Perry L. Diabetes knowledge of nurses in different countries: An integrative review. *Nurse Educ Today*. 2016;39:32-49. doi: 10.1016/j.nedt.2016.01.017 pmid: 27006032
13. von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP, et al. The Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Ann Intern Med*. 2007;147(8):573-7. doi: 10.7326/0003-4819-147-8-200710160-00010 pmid: 17938396
14. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. *Stat Med*. 2002;21(11):1539-58. doi: 10.1002/sim.1186 pmid: 12111919
15. Mohammadi S, Karim NA, Talib RA, Amani R. Knowledge, attitude and practices on diabetes among type 2 diabetic patients in Iran: a cross-sectional study. *Sci*. 2015;3(4). doi: 10.11648/j.sjph.20150304.20
16. Javadi A, Javadi M, Sarvghadi F. Knowledge, Attitude and practice in Diabetes. *J Birjand Med Sci*. 2004;11:46-50.
17. Scoring Domains of the WHOQOL-Brief. U.S. Version. University of Washington Seattle. Washington United States of America 1997.
18. Fadayian Arani E, Amin Shokravi F, Tavakoli Ghouchani H. The Relationship between Health Literacy and Knowledge in Rural Patients with Type 2 Diabetes Mellitus in 2016. *Health Educat Health Promotion*. 2017;5(2):19-32.
19. Ghannadi S, Amouzegar A, Amiri P, Karbalaieifar R, Tahmasebinejad Z, Kazempour-Ardebili S. Evaluating the Effect of Knowledge, Attitude, and Practice on Self-Management in Type 2 Diabetic Patients on Dialysis. *J Diabetes Res*. 2016;2016:3730875. doi: 10.1155/2016/3730875 pmid: 27478845
20. Karbalaieifar R, Kazempour-Ardebili S, Amiri P, Ghannadi S, Tahmasebinejad Z, Amouzegar A. Evaluating the effect of knowledge, attitude and practice on self-management in patients with type 2 diabetes. *Acta Diabetol*. 2016;53(6):1015-23. doi: 10.1007/s00592-016-0905-6 pmid: 27624577
21. Maleki S, Rakhshani F, Masoudi G, Ansari-Moghaddam A.
27. 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 pmid: 30017505
28. Powell CK, Hill EG, Clancy DE. The relationship between health literacy and diabetes knowledge and readiness to take health actions. *Diabetes Educ*. 2007;33(1):144-51. doi: 10.1177/0145721706297452 pmid: 17272800
29. Islam SM, Niessen LW, Seissler J, Ferrari U, Biswas T, Islam A, et al. Diabetes knowledge and glycemic control among patients with type 2 diabetes in Bangladesh. *Springerplus*. 2015;4:284. doi: 10.1186/s40064-015-1103-7 pmid: 26101736
30. Deepa M, Bhansali A, Anjana RM, Pradeepa R, Joshi SR, Joshi PP, et al. Knowledge and awareness of diabetes in urban and rural India: The Indian Council of Medical Research India Diabetes Study (Phase I): Indian Council of Medical Research India Diabetes 4. *Indian J Endocrinol Metab*. 2014;18(3):379-85. doi: 10.4103/2230-8210.131191 pmid: 24944935
31. Gautam A, Bhatta DN, Aryal UR. Diabetes related health knowledge, attitude and practice among diabetic patients in Nepal. *BMC Endocr Disord*. 2015;15:25. doi: 10.1186/s12902-015-0021-6 pmid: 26045031
32. Rezaei M, Valiee S, Tahan M, Ebtekar F, Ghanei Gheshlagh R. Barriers of medication adherence in patients with type-2 diabetes: a pilot qualitative study. *Diabetes Metab Syndr Obes*.

- 2019;12:589-99. doi: 10.2147/DMSO.S197159 pmid: 31118722
33. West JD, Goldberg KL. Diabetes self-care knowledge among outpatients at a Veterans Affairs medical center. Am J Health Syst Pharm. 2002;59(9):849-52. doi: 10.1093/ajhp/59.9.849 pmid: 12004464
34. Al-Qazaz HK, Sulaiman SA, Hassali MA, Shafie AA, Sundram S. Diabetes knowledge and control of glycaemia among type 2 diabetes patients in Penang, Malaysia. J Pharmaceut Health Service Res. 2012;3(1):49-55. doi: 10.1111/j.1759-8893.2011.00073.x