

Prevalence of Diabetic Neuropathy in Patients with Type 1 Diabetes in Iran: A Systematic Review and Meta-Analysis

Aryoobarzan Rahmatian¹, Mahsa Rizehbandi², Fariba Shokri³, * Elham Bastani⁴

¹ Assistant Professor of Neurology, School of Medicine, Ilam University of Medical Sciences, Ilam, Iran.

² Assistant Professor of Internal Medicine, Department of Internal Medicine, School of Medicine, Shahid Mostafa Khomaeini Hospital, Ilam University of Medical sciences, Ilam, Iran.

³ Assistant Professor of Pulmonary Diseases, Department of Internal Medicine, School of Medicine, Shahid Mostafa Khomaeini Hospital, Ilam University of Medical sciences, Ilam, Iran.

⁴ Assistant Professor of Internal Medicine, Department of Internal Medicine, School of Medicine, Shahid Mostafa Khomaeini Hospital, Ilam University of Medical sciences, Ilam, Iran.

Abstract

Background: Diabetic Neuropathy (DN) is one of the prevalent complications of Type 1 Diabetes (T1D), which reduces the patient's ability to maintain his/her balance by reducing proprioception.

Methods: In this meta-analysis, conducted by the use of PARISMA and SMART checklists, articles published on the prevalence of DN in T1D patients in Iran were included in the study. The search was carried out by two specialists in internal medicine who were well versed in the subject of search and meta-analysis articles; and the validity of the search was confirmed by a third person who had a specialist degree in pulmonary (internal medicine). After entering references into Endnote 8 software and removing duplicate articles, data extraction was performed and analysis was done using CMA3 software.

Result: The prevalence of DN in 10 reviewed articles was 33.3% (confidence interval (CI) =23.5-44.7), and in 3 articles, mild and moderate DN status was reported, and the prevalence of mild DN was 32.6% (confidence interval (CI) = 19.1-49.7) and the average DN was equal to 6.8% (confidence interval (CI) = 2.6-16.5). Also, the prevalence of DN in people over 15 years old was reported as 30.9% (confidence interval (CI) = 15.9-51.5) and in people under 15 years old was 43.1% (confidence interval (CI) = 28.5-59.1).

Conclusion: It is suggested that further meta-analysis studies be conducted on the other complications of diabetes in these patients.

Key Words: diabetes' complications, Diabetic neuropathy, Meta-analysis, Systematic review, Type 1 Diabetes.

* Please cite this article as: Rahmatian A, Rizehbandi M, Shokri F, Bastani E. Prevalence of Diabetic Neuropathy in Patients with Type 1 Diabetes in Iran: A Systematic Review and Meta-Analysis. Int J Pediatr 2023; 11 (06):17935-17946. DOI: **10.22038/ijp.2023.71776.5249**

*Corresponding Author:

Elham Bastani, Assistant Professor of Internal Medicine, Department of Internal Medicine, School of Medicine, Shahid Mostafa Khomaeini Hospital, Ilam University of Medical sciences, Ilam, Iran. Email: bastani2012elham@gmail.com

Received date: Apr.14,2023; Accepted date: May.13,2023

1- BACKGROUND

Diabetes is a chronic disease involving a large number of patients and is considered as a prevalent disease all around the world (1-3). Diabetes is a complex network of environmental and genetic risk factors and various injuries that are both the cause and risk factor of other diseases. So, diabetes is associated with various diseases including cardiovascular diseases, eye diseases, kidney failure, and disability (4-6).

Various factors such as obesity, improper diet and inactivity are effective in the increase of this disease, and for this reason, these patients require special self-care and self-management behaviors (7-9). Type one diabetes occurs in childhood and adolescence and type two occurs in adulthood (10). Patients in childhood and adolescence periods are sensitive and experience a decrease in their life quality (11-13). T1D is the common type of diabetes, which occurs at a younger age. So, the patient is involved with acute and chronic complications of the disease from the lower ages (14-16).

Diabetes has various complications such as blood pressure disorders (17, 18), diabetic foot ulcers (19, 20), retinopathy, nephropathy, and neuropathy. Diabetic Neuropathy (DN) is one of the prevalent complications of diabetes, which reduces the patient's ability to maintain the balance by reducing proprioception (21, 22). In fact, DN reduces the patient's bodily sensory feedback by damaging the proprioceptive sense and can disturb the balance of the person. As a result, compared to healthy people, patients with DN experience impaired balance while standing, and thus, there is a disturbance in their daily life, especially in performing daily activities (23-25). Moreover, these patients experience disturbances in sleep, recreational and social activities, mood and enjoyment of life, and in sleep and emotional reactions compared to diabetic

and non-diabetic controls (26, 27). In fact, the pains caused by the patients leave negative effects on various aspects of the patient, so appropriate interventions should be done to reduce the pain of the patients (28-31).

In Iran, various studies have been conducted on the prevalence of DN among T1D patients. In a study of Toopchizadeh et al. (32) (2016), in Tabriz, Iran, on a sample with the average age of 12.73, the overall prevalence of DN was reported to be 57.5%. Ghaemi et al. (33) (2018), in Mashhad, Iran, studying a sample with an average age of 28.3, reported that the overall prevalence of DN was 21.5%. And in another meta-analysis by Vasigh et al. (2018) with a sample size of 484 patients with T1D, it was reported to be 28.2% ((CI) = 19.5-39.1) (34). The findings of these studies demonstrate the inconsistencies between the reports regarding the prevalence of DN, in Iran.

2- OBJECTIVE

DN is very important and determining its prevalence is a priority. Although a meta-analysis study has already been conducted in this field in Iran (34), due to the fact that this study is up-to-date and includes more and newer articles, the present investigation is performed with the purpose of finding the prevalence of DN in T1D patients in Iran.

3- METHODS

In this meta-analysis, articles published on the prevalence of DN in T1D patients in Iran were included. The search keywords included type 1 diabetes, neuropathy, peripheral neuropathy, child, adolescence, diabetic neuropathy, Iran, and IDDM (Insulin-Dependent Diabetes Mellitus), in the domestic databases of Iran and international databases.

The search was carried out by two specialists in internal medicine and pediatrics who were well versed in the

subject of search and meta-analysis articles, and the validity of the search was confirmed by a specialist in pulmonary (internal medicine). The original studies investigating the prevalence of DN in T1D patients were included in the study, and the meta-analysis and case report articles were excluded. After entering references into Endnote 8 software and removing duplicate articles, data extraction was performed and analyses were done using CMA3 software.

4- RESULT

As demonstrated in **Fig. 1**, in the initial search, 628 articles were found, and

the meta-analysis stage began after the final screening with 10 articles. These articles were published between the years 2001 (Sarshar et al. (35)) and 2018 (Ghaemi et al. (33)) with the sample size in the range of 24 patients in the study by Sarshar et al. (35) to 146 patients in the study by Hasani et al. (36). The total sample size in all articles included 730 patients. The lowest prevalence rate of neuropathy was 12.5%, in the study of Sarshar et al. (35), in Gonabad city; and the highest prevalence rate was reported as 67%, in the study by Ranjbar Omrani et al. (37), in Shiraz.

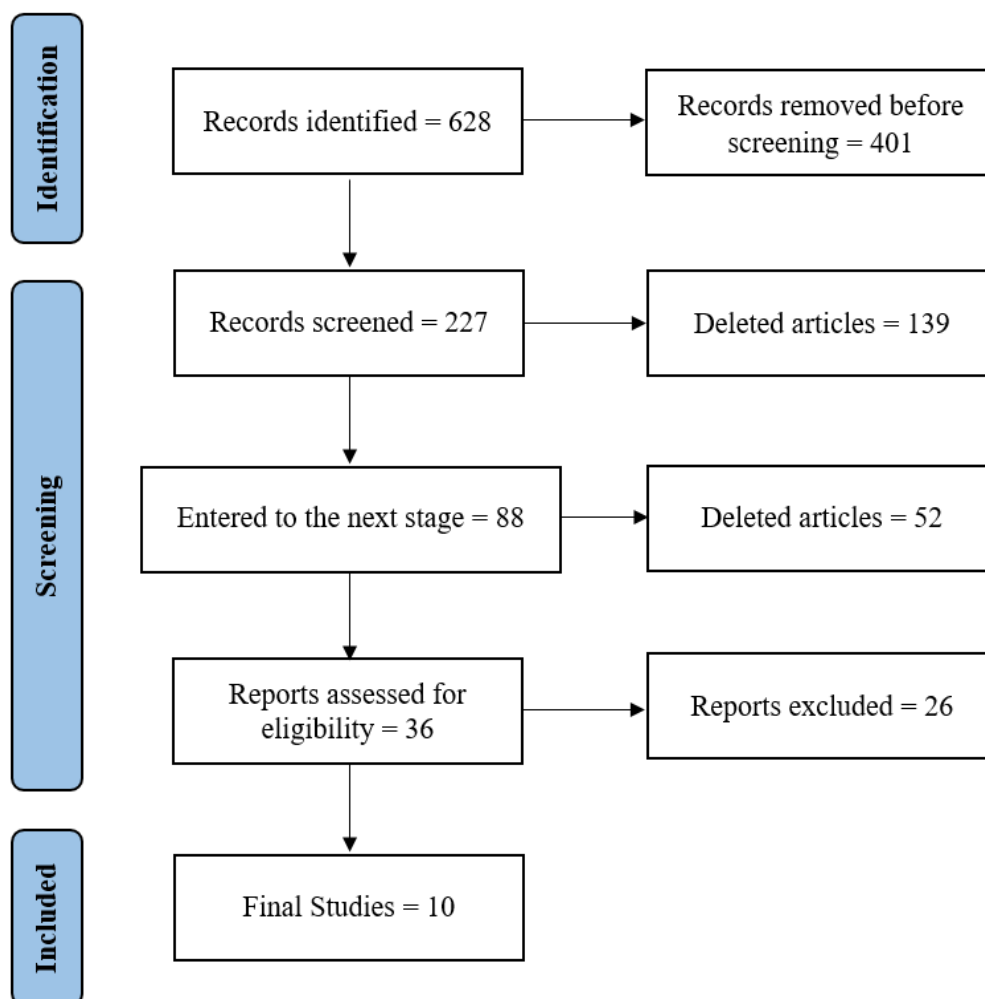


Fig. 1: Flowchart for systematic review

Table-1: Specifications of the articles included in the meta-analysis stage

No.	Author	Years	Location	Age M(SD)	Male N (%)	Female N (%)	Duration of illness	N	Mild PN	Moderate PN	Prevalence N (%)
1	Toopchizadeh et al (32)	2016	Tabriz	12.73(0.43)	15(37.5%)	25(62.5%)	6.63(0.25)	40	35%	7.5%	23(57.5%)
2	Kiani et al (38)	2013	Hamedan	28.2(10.6)	-	-	9.5(7.2)	79	-	-	17 (21.5%)
3	Ghaemi et al(33)	2018	Mashhad	16.68(6.98)	23(46%)	27(54%)	8.36(3.79)	50	-	-	12 (24%)
4	Olfatifar et al (39)	2017	Hamedan	16.37(8.71)	62(52.1%)	57(47.9)	10.03(8.92)	119	-	-	44(37.65%)
5	Abbasian et al (40)	2008	SHahroud	-	-	-	-	40	-	-	13(32.5%)
6	Khorasani (41)	2018	Neishabour	10.8(3.38)	26(43.3%)	34(56.7%)	34.89(32.88) month	60	38.3%	6.7%	27(45%)
7	Sarshar et al (35)	2001	-	-	-	-	-	24	-	-	3(12.5%)
8	Hasani et al (36)	2013	Isfahan	11.9(3.3)	62(42.5)	84(57.5)	3.8(2.9)	146	-	-	45(30.8%)
9	Ranjbar Omrani et al (37)	2002	shiraz	20.4(12.8)	-	-	-	92	-	-	62(67%)
10	Karamifar et al (42)	2007	shiraz	18.16(5.22)	34(42.5)	46(57.5)	-	80	7.5%	5%	11(13.75)

The prevalence of DN was 33.3% in the 10 reviewed articles (confidence interval (CI)=23.5-44.7), and in 3 articles, mild and moderate DN status were reported; the prevalence of mild DN was 32.6% (confidence interval (CI)=19.1-49.7) and the average DN was equal to 6.8%

(confidence interval (CI)=2.6-16.5) (Fig. 2-4). Also, the prevalence of DN in people over 15 years of age was reported to be 30.9% (confidence interval (CI)=15.9-51.5) and in people under 15 years old was 43.1% (confidence interval (CI)=28.5-59.1) (Fig. 5 and 6).

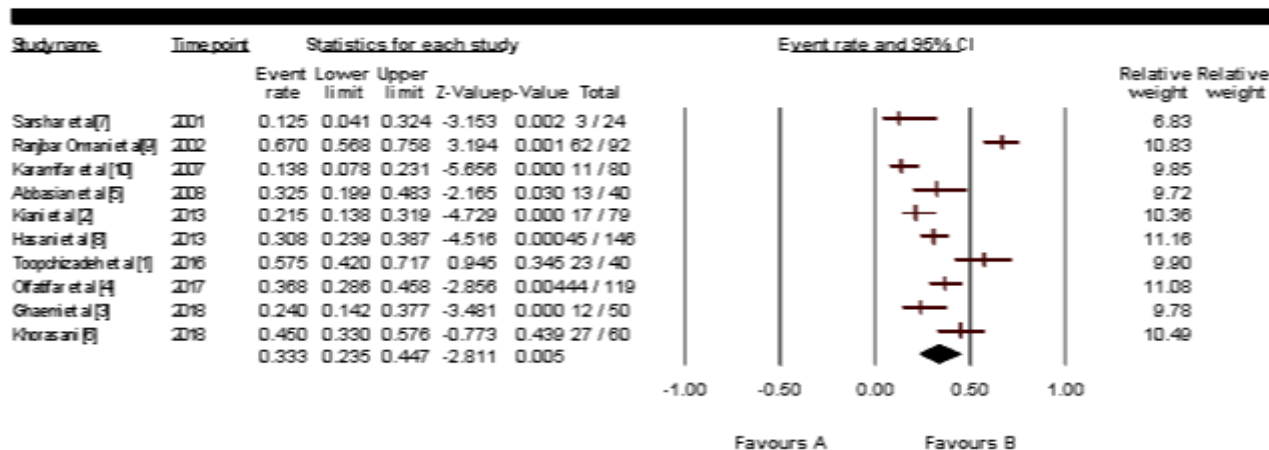


Fig 2: Prevalence of DN in patients with T1D in Iran

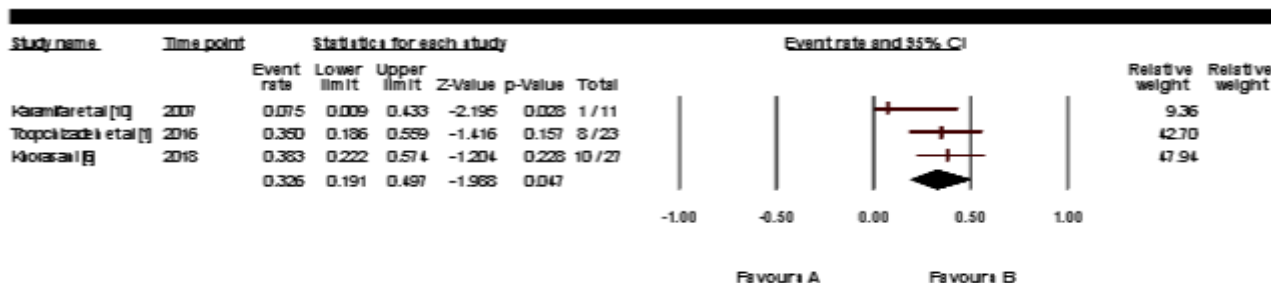


Fig. 3: Prevalence of mild DN in patients with T1D in Iran

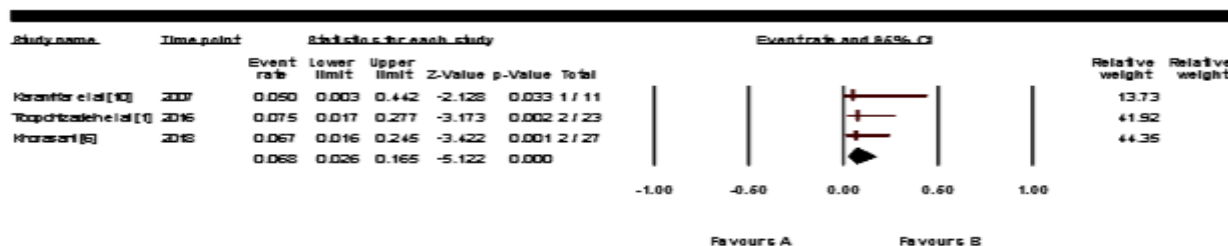


Fig. 4: Prevalence of moderate DN in patients with T1D in Iran

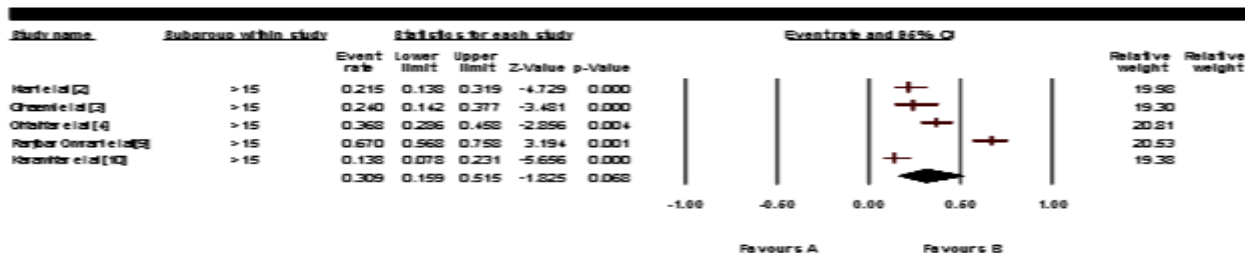


Fig. 5: Prevalence of DN in patients with T1D in Iran

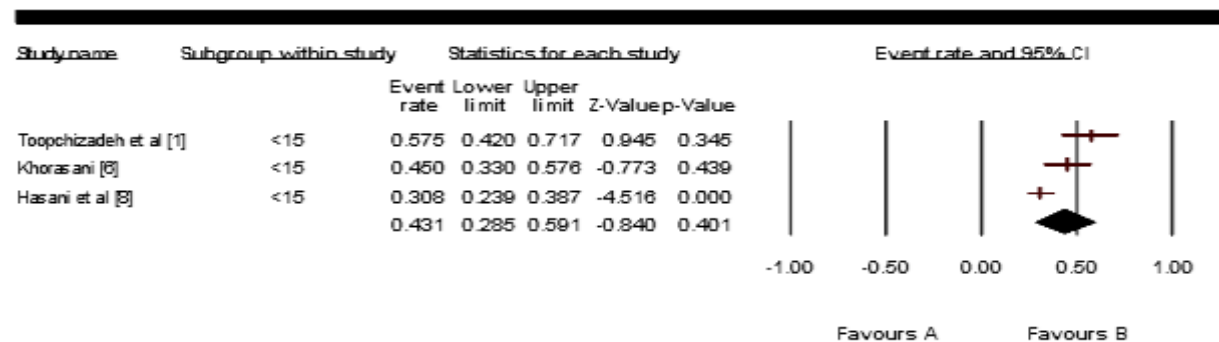


Fig. 6: Prevalence of moderate DN in patients with T1D in Iran

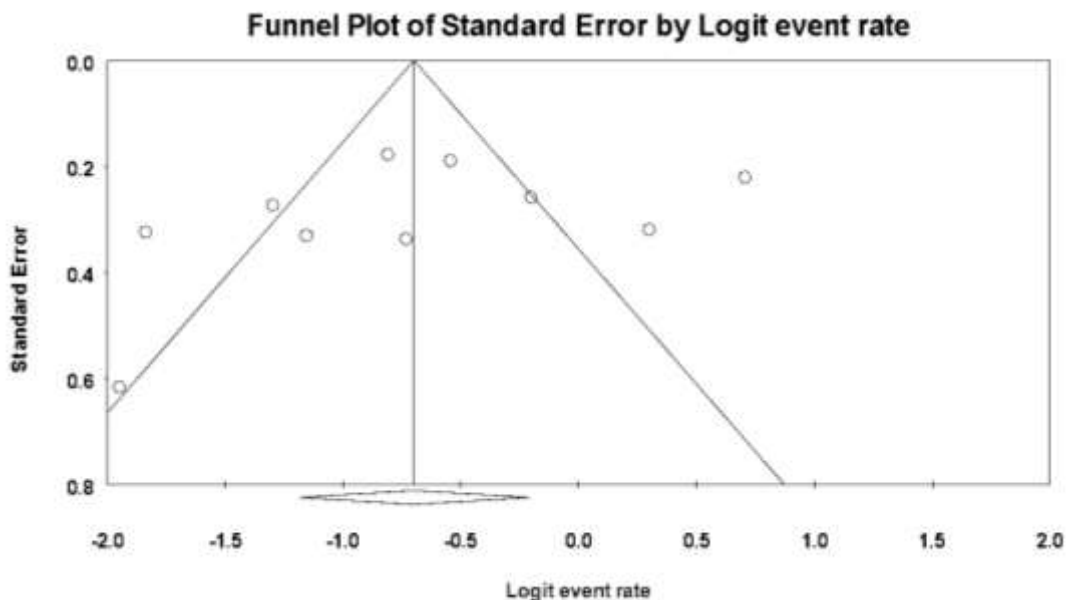


Fig. 7: Phenol plot in the meta-analysis

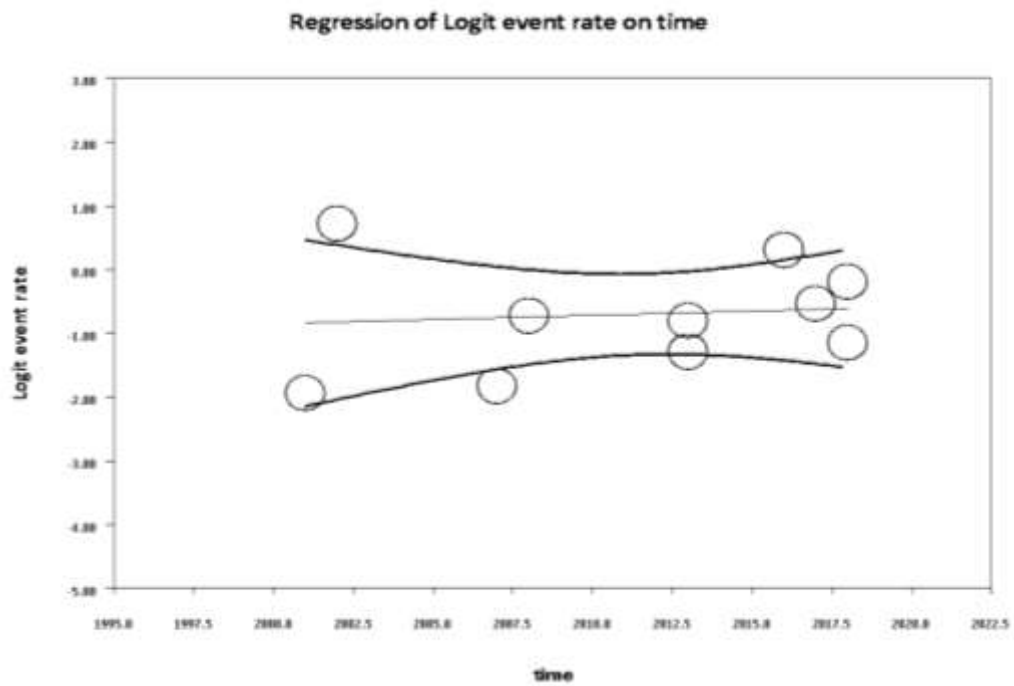


Fig. 8: Meta regression of the relationships between the articles' publication years and prevalence of neuropathy

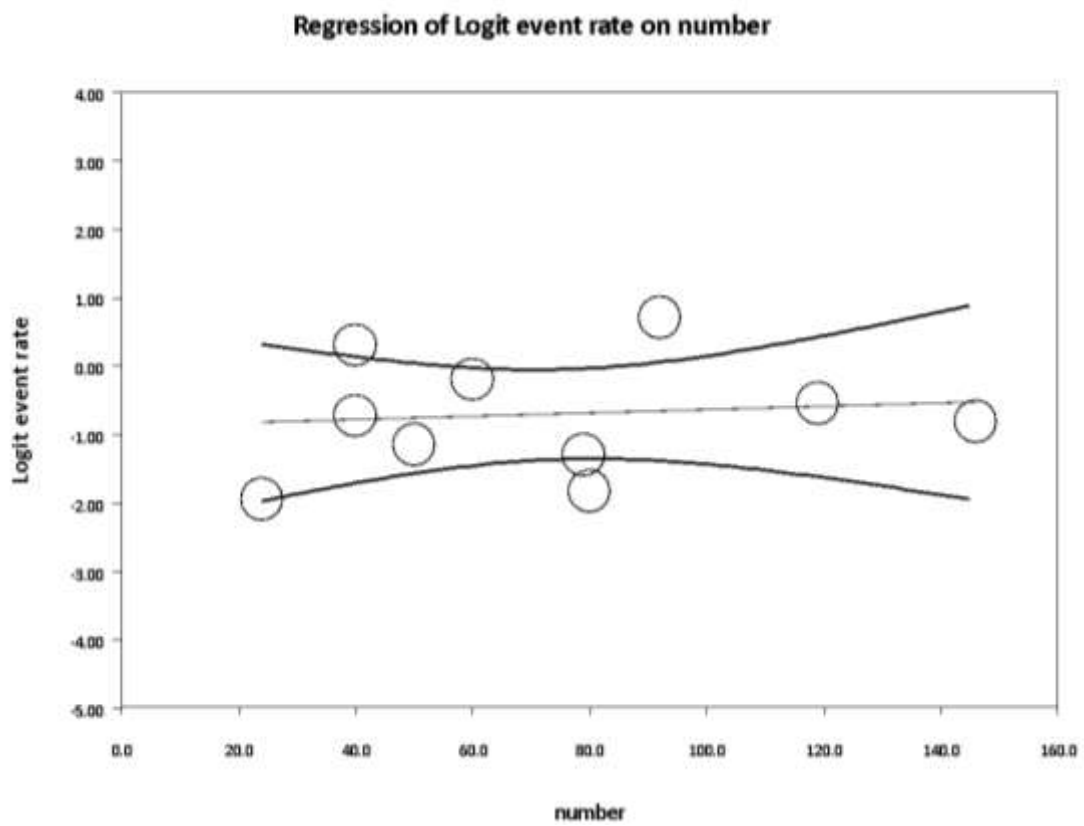


Fig. 9: Meta regression of the relationship between the number of patients and prevalence of neuropathy

4- DISCUSSION

Identification, diagnosis, and statistical reports related to diseases and their complications are useful in preventing the newer complications of them (43-46). DN is one of the chronic complications of diabetes, although its exact causes are unknown, but it seems that hyperglycemia in patients can be one of its important causes. Also, there is no known treatment for patients with DN and the existing treatments are performed to relieve the symptoms of the disease. For this reason, determining its prevalence is a priority (47, 48). In the present meta-analysis, the prevalence of DPN in 10 reviewed articles was found to be 33.3% (confidence interval (CI) = 23.5-44.7), and in 3 articles, mild and moderate neuropathy was reported, and the prevalence of mild neuropathy was 32.6% and average neuropathy was 6.8% (confidence interval (CI) = 2.6–16.5).

In Iran, two meta-analysis studies have been published about the prevalence of DPN in patients with diabetes (34, 49). In the study by Vasigh et al. (2018), the prevalence of DPN was reported as 28.2% ((CI) = 19.5-39.1) among the sample size of 484 patients in five analyzed studies (34). However, in the present study, the sample size of 730 patients and the number of 10 studies have been analyzed. It seems that the difference in the prevalence of DPN and its increase from 28.2% in Vathiq et al.'s study to 33.3% in the present study is due to the increase in the sample size and the increase in the number of analyzed articles. Also, in the study of Sobhani et al. in 2014, the prevalence of DPN in patients with diabetes (type 1 and 2) was analyzed in 21 articles published between 1999 and 2014. According to the current results, the prevalence of DNP was 87-16% and its overall prevalence was 53% (95% CI: 41-65) (49). Considering that the study of Sobhani et al. (49) examined patients with T1D and T2D and

most of the patients were in the second stage of diabetes, the prevalence of DPN is higher than that reported in the present study (33.3%). However, in the study by Andrei Cristian in Romania, the prevalence of DNP in T1D was 28.70% and in type 2 diabetes was 50.70% (50).

The prevalence of DNP has also been reported in studies published in other countries. In the study by Abdel-Motal et al. in Arabic countries with 2243 patients with T1D, the prevalence of peripheral neuropathy (PN) in Arabic countries was reported as 18%. Also, the prevalence of PN in age groups below 16 years was reported as 9.5% and in the age group above 16 years was 59.1% (47), which is not in line with the present results; so that in this study, the prevalence in people under 15 years old (43.1%) was higher than that among people over 15 years of age (30.9%). Among the causes of this difference, we can mention the difference in the demographic characteristics of the research units, including the country of residence, geographical conditions, literacy level, sample size, etc. On the other hand, in a study by Yovera-Aldana et al., the prevalence of PN in patients with T1D and T2D was investigated. In patients under 18 years old, the overall prevalence of PN in T1D was reported as 54.85 (45), which is consistent with the results of the present study indicating that the prevalence of PN in T1D was high.

5- CONCLUSION

Considering the high prevalence of DNP in patients with type 1 diabetes in Iran, it is necessary to take preventive measures to reduce DNP in these patients. It is also suggested that other meta-analysis studies be conducted regarding the other complications of diabetes in these patients.

6- COMPETE OF INTERESTS

None.

7- REFERENCE

1. Ayele K, Tesfa B, Abebe L, Tilahun T, Girma E: Self-care behavior among patients with diabetes in Harari, Eastern Ethiopia: the health belief model perspective. *PloS one* 2012, 7(4):e35515.
2. Ali A, Khan A, Butt Ar: Prevalence of Risk Factors of Diabetic Nephropathy and Their Association with Estimated Gfr in Patients of Type 2 Diabetes Mellitus. *Gomal Journal of Medical Sciences* 2023, 21(1):31-36.
3. Najim MK, Lahhob QR, Abbas HJ, Alidrisi HA, Ibrahim ZJ, Budaiwi ZK, Abdul-Jabbar ZH, Kadham MJ, Maatook MA: Association of serum apelin and atherogenic indices in patients with primary thyroid diseases. *Eurasian Chemical Communications* 2023, 5(7):588-597.
4. Tol A, Sharifirad G, Eslami AA, Alhani F, Tehrani MM, Shojaezadeh D: Factors influencing self-management behavior in type-2 diabetes patients: a strategy proposed to be adopted when planning theory/model based interventions. *Journal of School of Public Health & Institute of Public Health Research* 2012, 9(4):21-32.
5. Tayebi Myaneh Z, Rashvand F, Abdolahi F: Relationship between sleep quality and self-management in type II diabetes patients. *Hayat* 2020, 26(3):238-250.
6. Rajaa Taher H, Habib Saifalla P: Study of the level of signal-regulated kinase 5 (ERK5) in patients with coronary heart disease with and without diabetes mellitus type 2. *Eurasian Chemical Communications* 2023, 5(5):425-440.
7. Azizi M, Aarsalani N, Mohammadi Shahboulaghi F, Hosseinzadeh S, Rajab A: The effect of self-care education on the control of diabetes complications, medications and HbA1C in adolescents with type 1 diabetes. *Hayat* 2017, 22(4):350-361.
8. Khalid Hussein M, Habib Saifalla P: Estimation of insulin resistance and creatine kinase among Iraqi patients with type 2 diabetes mellitus. *Eurasian Chemical Communications* 2022, 4(12):1193-1200.
9. Abbas Al-Ameri M, M. Al-Rubaei Z: Vascular endothelial growth factor –A (VEGF-A) and its receptor (VEGFR-2) in rheumatoid arthritis patients with type 2 diabetes mellitus. *Eurasian Chemical Communications* 2022, 4(12):1201-1208.
10. Kazeminezhad B, Taghinejad H, Borji M, Tarjoman A: The effect of self-care on glycated hemoglobin and fasting blood sugar levels on adolescents with diabetes. *Journal of Comprehensive Pediatrics* 2018, 9(2).
11. Mazlominezhad A, Moghadam FA: Evaluation of quality of life and self-efficacy in adolescents with amblyopia. *Journal of Medicine and Life* 2022, 15(4):499-503.
12. Solati H, Sahebalzamani M, Adhami Moghadam F: Effect of Family-Based Care Training by Tele-nursing on Emotional Reactions in Mothers of Children with Bone Marrow Transplantation. *Journal of Mazandaran University of Medical Sciences* 2021, 30(192):156-161.
13. Göthesson J, Håkansson L, Olinder AL, Hanberger L, Mörelius E, Nilsson S, Forsner M: Children's and adolescent's narratives about pain and negative experiences in diabetes treatment. *Journal for Specialists in Pediatric Nursing* 2023, 28(1):e12396.
14. d'Annunzio G, Accogli A, Tallone R, Bolloli S, Lorini R: Environmental factors and type 1 diabetes mellitus in the pediatric age group. In: *Genes and Autoimmunity-Intracellular Signaling and Microbiome Contribution*. edn.: IntechOpen; 2013.

15. Akram M, Riaz T, Elbossaty WF, Zafar S, Munir N, Saeed MM: Microorganisms in the Pathogenesis and Management of Type 1 Diabetes (T1D). Role of Microorganisms in Pathogenesis and Management of Autoimmune Diseases: Volume II: Kidney, Central Nervous System, Eye, Blood, Blood Vessels & Bowel 2023:427-439.
16. Borrego N, Bommakanti M, Radack J, Hamilton L, Wilson D: Polyglandular Autoimmunity: Two Cases of Type 1 diabetes (T1D) accompanied by Addison's disease (AD). 2023.
17. Borji M, Tarjoman A, Seymohammadi R, Salimi E, Otaghi M: Effects of continuous care model on blood pressure in patients with type ii diabetes. Journal of Clinical and Diagnostic Research 2018, 12(4):JC7-JC10.
18. James S, Perry L, Lowe J, Harris M, Colman PG, Craig ME: Blood pressure in adolescents and young adults with type 1 diabetes: data from the Australasian Diabetes Data Network registry. Acta Diabetologica 2023:1-7.
19. Karimian M, Gholami A, Farzaei MH, Stefanucci A, Mollica A, Mahmoudi Y, Shahrabady S, Tarjoman A, Borji M: The effect of angipars™ on wound healing in patients with diabetes: A systematic review. Journal of Chemical Health Risks 2020, 10(3):195-202.
20. Kleef DG, Hussein KR, Abbas HJ: Evaluation of procollagen 1 N propeptide for predicting osteomyelitis and epithelial neutrophil activator-78 for early wound healing in patients with diabetic foot. Eurasian Chemical Communications 2023, 5(5):441-449.
21. Malone JI, Gao X, Lorenzi GM, Raskin P, White NH, Hainsworth DP, Das A, Tamborlane W, Wallia A, Aiello LP: Retinopathy during the first 5 years of type 1 diabetes and subsequent risk of advanced retinopathy. Diabetes care 2023, 46(4):680-686.
22. Rasmussen VF, Thrysøe M, Karlsson P, Vestergaard ET, Kristensen K, Christensen A-MR, Nyengaard JR, Terkelsen AJ, Brock C, Krogh K: Early Gastrointestinal Neuropathy Assessed by Wireless Motility Capsules in Adolescents with Type 1 Diabetes. Journal of Clinical Medicine 2023, 12(5):1925.
23. Jung J, Kim M-G, Kang Y-J, Min K, Han K-A, Choi H: Vibration perception threshold and related factors for balance assessment in patients with type 2 diabetes mellitus. International Journal of Environmental Research and Public Health 2021, 18(11):6046.
24. Turcot K, Allet L, Golay A, Hoffmeyer P, Armand S: Investigation of standing balance in diabetic patients with and without peripheral neuropathy using accelerometers. Clinical Biomechanics 2009, 24(9):716-721.
25. Manafi H, Aminianfar A: Effect of whole body vibration on ankle joint proprioception and balance in patients with diabetic neuropathy. Koomesh 2022, 24(3):347-357.
26. Miri F, Gholami F, MOKABERIAN M: Effect of resistance training on general health, happiness and its correlation with glycemic control in diabetic men with peripheral neuropathy. 2021.
27. Abdulmlik S, Saifullah PH, A. Al-a'adhmi M: Evaluation of vitamin B12 and methylmalonic acid levels as markers with neuropathy in patients of type 2 diabetes mellitus. Eurasian Chemical Communications 2022, 4(10):956-965.
28. Hatefi M, Komlakh K, Nouri L: Investigating the effect of methylprednisolone pulse on the treatment of back pain. Romanian Journal of Military Medicine 2022, 125(2):264-268.

29. Karbasfrushan A, Karimiyarandi H: Role of vitamin D on knee osteoarthritis pain: a systematic review. *Eurasian Chemical Communications* 2022, 4(12):1241-1250.
30. Hatefi M, KomLakh K: Investigation of the effect of Duloxetine on pain status of patients with spinal cord injuries: a systematic review of drug therapy. *Eurasian Chemical Communications* 2022, 4(3):256-262.
31. Karimiyarandi H, Karbasfrushan A: EFFECT OF DULOXETINE ON PAIN RELIEF IN PATIENTS UNDERGOING ARTHROPLASTY SURGERY: A SYSTEMATIC REVIEW. *Gomal Journal of Medical Sciences* 2022, 20(4):213-220.
32. Toopchizadeh V, Shiva S, Khiabani N-Y, Ghergherechi R: Electrophysiologic pattern and prevalence of subclinical peripheral neuropathy in children and adolescents with type I diabetes mellitus in Iran. *Saudi medical journal* 2016, 37(3):299.
33. Ghaemi N, Hasanabadi H, Ashrafzadeh F, Sarvari S, Rahimi H, Hashemian S: Peripheral neuropathy in children and adolescents with insulin-dependent diabetes mellitus. *Iranian Journal of Child Neurology* 2018, 12(2):83.
34. Vasigh A, Abdi A, Borji M, Tarjoman A: The prevalence of neuropathy among type 1 diabetic adolescents in Iran: a systematic review and meta-analysis. *International journal of adolescent medicine and health* 2019, 33(4):20180223.
35. Sarshar N, Chamanzari H: The Survey of Complications in Thepatients of Gonabad Diabetic Clinic. 2003.
36. Hasani N, Khosrawi S, Hashemipour M, Haghghatiyan M, Javdan Z, Taheri MH, Kelishadi R, Amini M, Barekatein R: Prevalence and related risk-factors of peripheral neuropathy in children with insulin-dependent diabetes mellitus. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences* 2013, 18(2):132.
37. Omrani GHR, Soveid M, Rajaii H, Sadegholvaad Aa: The Incidence of Chronic Diabetic Complications During a 12 Years Period in Patients Referring To Clinics of Shiraz University Of Medical Sciences. *Journal of Diabetes and Metabolic Disorders* 2004, 3:68.
38. Kiani J, Moghimbeigi A, Azizkhani H, Kosarifard S: The prevalence and associated risk factors of peripheral diabetic neuropathy in Hamedan, Iran. *Archives of Iranian medicine* 2013, 16(1):0-0.
39. olfatifar M, Karami M, Hosseini SM, shokri P: Prevalence of Chronic Complications and Related Risk Factors of Diabetes in Patients Referred to the Diabetes Center of Hamedan Province. *Avicenna Journal of Nursing and Midwifery Care* 2017, 25(2):69-74.
40. Abbasian M, Delvarianzadeh M: Dietary intake of micronutrients in first-degree healthy, diabetic and IGT relatives of type II diabetic patients. *Journal of knowledge & health* 2008, 2(4):17-21.
41. Khorasani E: Prevalence of peripheral neuropathy and its related factors in diabetic children, Neishabour city, Iran. *International Journal of Pediatrics* 2018, 6(12):8707-8714.
42. Karamifar H, Moadab M, Karamizadeh Z, Amirhakimi G: Evaluation of peripheral neuropathy in patients with type 1 diabetes mellitus by bedside scoring procedure. 2007.
43. Daryabari SH, Asadollah A, Moghadam FA, Dorostkar R, Bahramifar A, Aghamollaei H: Detection of COVID-19 in tears of ICU-admitted patients with SARS-CoV-2 infection. *International Ophthalmology* 2022, 42(3):723-727.

44. Shokri M, Karimian M, Mansouri F, Mahdikhani S, Borji M, Solaimanizadeh L, Tarjoman A, Soltany B, Gholami A: Laboratory and radiologic findings in pediatrics with COVID-19: A systematic review. *Archives of Clinical Infectious Diseases* 2020, 15(3).
45. Yovera-Aldana M, Velásquez-Rimachi V, Huerta-Rosario A, More-Yupanqui M, Osoreo-Flores M, Espinoza R, Gil-Olivares F, Quispe-Nolazco C, Quea-Vélez F, Morán-Mariños C: Prevalence and incidence of diabetic peripheral neuropathy in Latin America and the Caribbean: A systematic review and meta-analysis. *PloS one* 2021, 16(5):e0251642.
46. Sahin SY, Kilit TP, Kocak FE: Effect of Methimazole on Serum Concentrations of Oxidative Stress Markers in Patients with Hyperthyroidism in the Population of Kutahya City, Turkey. *Gomal Journal of Medical Sciences* 2022, 20(3).
47. Abdel-Motal UM, Abdelalim EM, Abou-Saleh H, Zayed H: Neuropathy of type 1 diabetes in the Arab world: a systematic review and meta-analysis. *Diabetes research and clinical practice* 2017, 127:172-180.
48. D'Souza RS, Barman R, Joseph A, Abd-Elseyed A: Evidence-based treatment of painful diabetic neuropathy: a systematic review. *Current Pain and Headache Reports* 2022, 26(8):583-594.
49. Sobhani S, Asayesh H, Sharifi F, Djalalinia S, Baradaran HR, Arzaghi SM, Mansourian M, Rezapoor A, Ansari H, Masoud MP: Prevalence of diabetic peripheral neuropathy in Iran: a systematic review and meta-analysis. *Journal of Diabetes & Metabolic Disorders* 2014, 13:1-7.
50. BONDAR AC, POPA AR: Diabetic neuropathy prevalence and its associated risk factors in two representative groups of type 1 and type 2 diabetes mellitus patients from Bihor County. *Maedica* 2018, 13(3):229.