Impact of Diabetic Complications and Glycemic Control on Diabetes Distress Among Individuals with Type 2 Diabetes Mellitus: A Meta-Analysis

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Abstract

Diabetes distress (DD) is a psychological condition frequently experienced by individuals with type 2 diabetes mellitus (T2DM). It arises from the emotional and behavioral burden of managing diabetes and can be influenced by various clinical factors. Among these, diabetic complications and poor glycemic control are considered important determinants that may increase the risk of DD. Understanding these associations is crucial for developing effective interventions to improve both mental health and clinical outcomes in patients with T2DM. This meta-analysis aimed to evaluate the impact of diabetic complications and glycemic control on diabetes distress among adults with T2DM. This meta-analysis used the PICO framework: Population = adults with T2DM; Intervention = presence of diabetic complications and poor glycemic control; Comparison = no complications and good glycemic control; Outcome = diabetes distress. Articles were obtained from Google Scholar, PubMed, and ScienceDirect. The keywords used included: "diabetes distress" OR "diabetic complications" OR "glycemic control" AND "type 2 diabetes mellitus" AND "cross-sectional". Eligible studies were cross-sectional, published between 2013 and 2025, full-text, in English, and reported adjusted odds ratios (aOR). Data were analyzed using Review Manager 5.3. Fifteen studies from Ethiopia, Bangladesh, India, Singapore, Vietnam, Iran, Germany, Malaysia, USA, South Africa, Egypt, and Norway were included. Diabetic complications significantly increased the risk of diabetes distress (aOR = 2.14; 95% CI: 1.77–2.58; $p < 0.001$). Poor glycemic control was also associated with higher odds of diabetes distress (aOR = 2.09; 95% CI: 1.05–1.13; $p < 0.001$). Diabetic complications and poor glycemic control significantly increase the risk of diabetes distress among adults with T2DM. These findings highlight the importance of integrated strategies to prevent complications and improve glycemic control.

Keywords: diabetes distress, diabetic complications, glycemic control, type 2 diabetes, adults.

Introduction

Type 2 diabetes mellitus (T2DM) is a major global health problem, affecting more than 462 million people worldwide (verywell health, 2023). Among individuals with T2DM, *diabetes distress* (DD) defined as the negative emotional state associated with the ongoing demands of diabetes self-management has emerged as a prevalent psychological condition that significantly impacts treatment adherence and quality of life. According to a meta-analysis, the global prevalence of DD among patients with T2DM is approximately 36% (Perrin et al., 2017). In China, pooled prevalence has been reported as high as 53.2%, with regional variations ranging from 23% in the northern region to 66% in central China). In South Asia, the prevalence is estimated at 44%, with the highest in Pakistan (85%) and the

lowest in Sri Lanka (25%) (Liu et al., 2023). In India, pooled prevalence is around 33% (range 21%–45%) (Sinha et al., 2024).

Recent evidence emphasizes the association between DD and key clinical outcomes in T2DM. A comprehensive meta-analysis of 61 studies (2001–2024) involving over 19,000 participants found that DD (along with depression) was significantly correlated with poor glycemic control (HbA1c) ($r = 0.23$) and reduced self-care behaviors ($r = –0.19$), despite substantial heterogeneity across studies ($I^2 \approx 97\%$) (X. Zhang et al., 2025). Several regional studies have further highlighted the high burden of DD and its associated factors: In Iran, 48.6% of older adults (≥60 years) with T2DM experienced DD, with significant predictors including diabetes complications, sedentary lifestyle, BMI ≥25, and disease duration <10 years (Ebrahimi et al., 2020). In Bangladesh, 52.5% of patients reported DD, with predictors such as rural residence, presence of complications, insulin use, and severe depression (Kamrul-Hasan et al., 2022). In Jordan, the prevalence of DD was approximately 53%, with emotional distress as the most dominant dimension; risk factors included female gender, presence of complications, and medication non-adherence (Hiasat et al., 2023).

Although numerous studies have examined the prevalence and risk factors of diabetes distress (DD), few have specifically integrated two major clinical factors, diabetic complications and glycemic control within a single global meta-analysis using a robust methodology. Existing limitations, such as variations in study design and methodological heterogeneity, further highlight the need for an updated and comprehensive meta-analysis

This study aims to answer the question: to what extent do diabetic complications and glycemic control influence the risk of diabetes distress among individuals with type 2 diabetes mellitus (T2DM)? The novelty of this research lies in its evidence-based analysis that combines data from multiple countries to generate a more accurate pooled estimate. The findings are expected to support the development of more effective clinical and psychosocial interventions to improve the quality of life among individuals with T2DM

Methods

1. Study Design

Several databases were used in this study, including Google Scholar, PubMed, BMC, ScienceDirect, and Springer Link. This research is a systematic review and meta-analysis conducted following the PRISMA flow diagram guidelines. The keywords used were: "diabetes distress" OR "diabetic complications" OR "glycemic control" AND "type 2 diabetes mellitus" AND "cross-sectional". Eligible studies were cross-sectional in design, published between 2013 and 2025, available in full text, written in English, and reported adjusted odds ratio (aOR).

2. Meta Analysis Procedure

The meta-analysis was carried out in five main steps as follows: 1) Formulating the research question using the PICO framework: P (Population): Individuals with type 2 diabetes mellitus (T2DM), I (Intervention/Exposure): Presence of diabetic complications and poor glycemic control, C (Comparison): Absence of diabetic complications and good glycemic control, O (Outcome): Diabetes distress. 2) Search for primary study articles from various electronic and non-electronic databases. 3) Conduct screening and critical assess-ment of primary research articles. 4) Perform data extraction and synthesize effect estimates into RevMan 5.3. 5) Interpret and conclude the results.

3. Inclusion Criteria

The author developed inclusion criteria, namely English language articles with cross-sectional studies published

between 2013-2025. The analysis used is a multivariate analysis using an adjusted odds ratio (aOR). The subjects of the study were adults aged ≥ 18 years, and the results analyzed were diabetes distress

4. **Exclusion Criteria.**

   The exclusion criteria in this study are RCT (randomized controlled trials) studies, quasi experiments, research protocols, preliminary studies, non-full text articles (aOR)

5. **Operational Definition of Variables**

   Diabetes distress (DD) is defined as patient concerns about disease management, support, emotional burden, and access to care, is an important condition distinct from depression. Diabetic complications is are the long-term consequences of chronic hyperglycemia that can cause damage to multiple organs, particularly the eyes, kidneys, nerves, heart, and blood vessels. Glycemic control is the ability of individuals with diabetes to maintain blood glucose levels within the recommended range through a combination of medical therapy, lifestyle modification, and monitoring. Type 2 diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia resulting from insulin resistance and impaired insulin secretion. It is the most common form of diabetes and is often associated with lifestyle factors and genetic predisposition. A risk factor is defined as an attribute, characteristic, or exposure that increases the likelihood of developing a disease or health condition.

6. **Instruments**

   Primary studies that have been screened will undergo a critical assessment or review of the study to determine eligibility. The assessment instrument used the Critical Appraisal Cross Sectional Study Checklist consisting of 11 questions for Meta-analysis

7. **Data Analysis**

   The search results of the articles were collected with the help of Prisma diagrams. Lead articles that fit the inclusion criteria were analyzed using the RevMan 5.3 application to calculate the effect size and heterogeneity of the study. The results of data processing were represented (aOR, 95% confidence interval, and p-value) and presented in the form of forest plots and funnel plots.

Results

After the initial search and article collection, all retrieved studies were synthesized and reviewed, followed by the selection of studies that met the eligibility criteria. All stages of the selection process followed the PRISMA flow diagram, as presented in Figure 1. The initial search yielded 6,216 articles. After removing duplicates, 5,913 articles remained. The next step involved screening articles based on their type, resulting in 4,081 articles. Further screening was conducted by examining the study subjects, title or topic relevance, and analytical design (reporting adjusted odds ratio [aOR]), yielding 45 articles. After applying the inclusion and exclusion criteria, a total of 15 full text cross sectional studies were finally selected for inclusion in the meta-analysis.

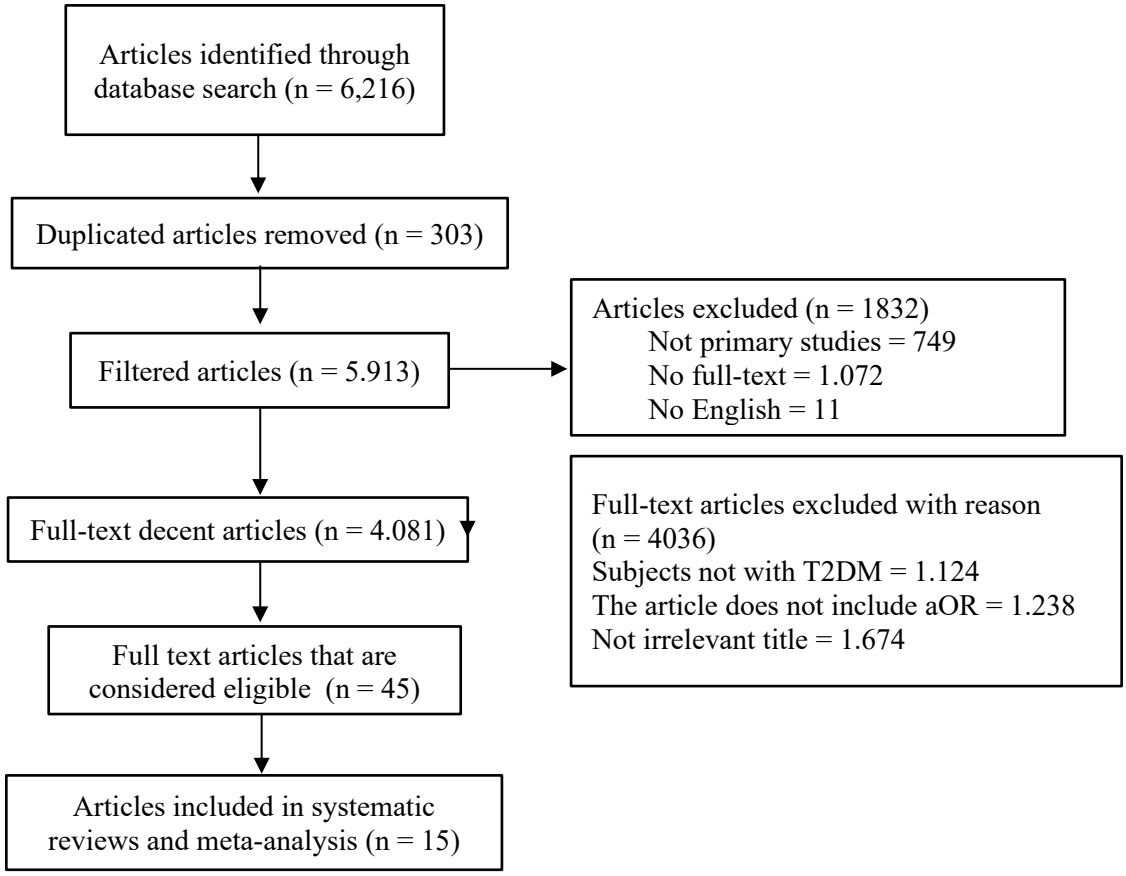

Figure 1. PRISMA flowchart

Table 1. The quality assessment result of impcat of diabetic complications and glycemic control on diabetes distress among individuals with type 2 diabetes mellitus with a cross-sectional study

Primer Study	Criteria											Total
	1	2	3	4	5	6	7	8	9	10	11	
Azadbakht et al. (2020)	2	2	1	2	2	2	2	2	2	2	2	21
Borie et al. (2024)	2	2	2	2	2	2	2	2	2	2	2	22
Geleta et al. (2021)	2	2	1	2	2	2	2	2	2	2	2	21
Islam et al. (2014)	2	2	1	2	2	1	2	2	2	2	2	20
Lamoureux et al. (2024)	2	2	2	2	2	2	2	2	2	2	2	22
Naik et al. (2024)	2	2	1	2	2	2	2	2	2	2	2	21
Yong Du et al. (2022)	2	2	1	2	2	2	2	2	2	2	2	21
Aufi et al. (2025)	2	2	1	2	2	1	2	2	2	2	2	20
Hilde et al. (2025)	2	2	2	2	2	2	2	2	2	1	2	21
kaur et al. (2013)	2	2	2	2	2	2	2	2	2	2	2	22
Mahtab et al. (2021)	2	2	1	2	2	2	2	2	2	1	2	20
Nguyen et al. (2020)	2	2	1	2	2	2	2	2	2	1	2	20
Ramkisson et al. (2016)	2	2	2	2	2	2	2	2	2	1	2	21
Sayed et al. (2022)	2	2	1	2	2	2	2	2	2	1	2	20
Verdecias et al. (2023)	2	2	1	2	2	2	2	2	2	1	2	20

Note: Answer 2= Yes; Answer 1= Can't tell; Answer 0= No

Table 1 showed quality assessment result of articles with a cross-sectional study included in meta-analysis. The quality of the 15 primary studies included in this meta-analysis was assessed using the Critical Appraisal Skills Programme (CASP) checklist for cross-sectional studies, which comprises 11 questions evaluating the methodological rigor, validity, and applicability of each study. Overall, the total quality scores of the included studies ranged from 20 to 22, indicating that all studies met the minimum quality criteria and were considered suitable for inclusion in the meta-analysis.

These questions evaluate whether each study addressed a clearly focused research issue and used an appropriate methodological approach to answer the research question. The appraisal also examined whether study participants were recruited in an acceptable manner, whether the measurements of exposure and outcome were conducted accurately to minimize bias, and whether data collection methods adequately addressed the research objectives. In addition, the checklist assessed whether the sample size was sufficient to reduce the role of chance, whether the results were clearly presented with identifiable main findings, and whether the data analysis was conducted rigorously. Further evaluation considered the clarity of the study conclusions, the applicability of the results to the local or target population, and the overall value and contribution of the research. Based on this assessment, all included studies were deemed to have acceptable methodological quality and were suitable for inclusion in the meta-analysis.

Table 2 describes a summary of primary research of the impact of diabetic complications and glycemic control on diabetes distress with a cross-sectional design, a meta-analysis was carried out on 15 articles originating from the country of Ethiopia, Bangladesh, India, Singapore, Vietnam, Iran, Germany, Malaysia, USA, South Africa, Egypt, and Norway. The largest research population was found in a study conducted by Kaur et al. (2013) namely 2.508 respondents, and the study with the smallest population, namely the study conducted by Nguyen et al (2020) as many as 138 respondents

Table 2. Description of the primary studies of impcat diabetic complications and glycemic control on diabetes distress among individuals with type 2 diabetes mellitus (cross-sectional study)

Author (Year)	Study Period	Country	Study Design	Sample Size	P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	aOR (CI 95%)
(Azadbakht et al., 2020)	December 2018 to February 2019	Iran	Cross sectional	519	Patients with mean age (SD) 68.38	Presence of diabetic complications	Without diabetic complications	Diabetes Distress	aOR = 3.10 (2.06 to 4.66)
(Borie et al., 2024)	1 May to 31 August 2022	Ethiopia	Cross sectional	844	Patients ≥ 18 years old, mean (SD) 48.04	Presence of diabetic complications	Without diabetic complications	Diabetes Distress	aOR = 1.74 (1.28 to 2.37)
(Geleta et al., 2021)	1 January to 30 March 2020	Ethiopia	Cross sectional	321	Patients ≥ 18 years old. Mean age (SD) 41.3	Presence of diabetic complications	Without diabetic complications	Diabetes Distress	aOR = 1.98 (1.00 to 3.92)
(Islam et al., 2014)	January to June 2012	Bangladesh	Cross sectional	165	Patients 40 - 60 years old with mean age of 52.47 (SD)	Presence of diabetic complications and poor glycemic control	Without diabetic complications Normal glycemic control	Diabetes Distress	aOR= 3.92 (1.09 to 14.10) aOR = 1.56 (1.16 to 2.10)
(Lamoureux et al., 2024)	May 2024	Singapore	Cross sectional	970	Patients with mean age (SD) 61.0	Presence of diabetic complications	Without diabetic complications	Diabetes Distress	aOR = 2.36 (1.36 to 4.10)
(Naik et al., 2024)	September to November 2021	India	Cross sectional	260	Patients with a mean age (SD) of 56.5	Presence of diabetic complications	Without diabetic complications	Diabetes Distress	aOR = 2.31 (1.10 to 4.87)
(Du et al., 2022)	August to December 2017	Germany	Cross sectional	1.367	Patients with a mean age (SD) of 66.2	Presence of diabetic complications	Without diabetic complications	Diabetes Distress	aOR = 1.80 (1.10 to 2.95)

(Aufi et al., 2025)	June to August 2023	Bangladesh	Cross sectional	250	Patients with a mean age (SD) of 51.03	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 2.80 (1.32 to 5.91)
(Riise et al., 2025)	Hunt Data 2017 to 2019	Norway	Cross sectional	1.954	Patients ≥ 20 years old. Mean age (SD) 67.3	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 1.30 (0.90 to 1.88)
(Kaur et al., 2013)	2013 (not explicitly reported)	Malaysia	Cross sectional	2508	Patients with a mean age (SD) of 56.6	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 1.64 (1.29 to 2.08)
(Niroomand et al., 2021)	January to June 2017	Iran	Cross sectional	820	Patients with a mean age (SD) of 58.91	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 9.43 (6.62 to 13.45)
(Nguyen et al., 2020)	February to March 2020	Vietnam	Cross sectional	138	Patients with a mean age (SD) of 53.8	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 5.49 (1.26 to 23.92)
(Ramkisson et al., 2016)	2016 (not explicitly reported)	South Africa	Cross sectional	401	Patients with a mean age (SD) of 53.70	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 1.04 (1.00 to 1.08)
(Ahmed et al., 2022)	September 2020 to June 2021	Egypt	Cross sectional	403	Patients ≥ 18 years old. Mean age (SD) 46	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 1.21 (0.71 to 2.06)
(Verdecias et al., 2023)	November 2019 to July 2022	USA	Cross sectional	473	Patients with a mean age (SD) of 51.55	Poor glycemic control	Normal glycemic control	Diabetes Distress	aOR = 2.29 (1.13 to 4.64)

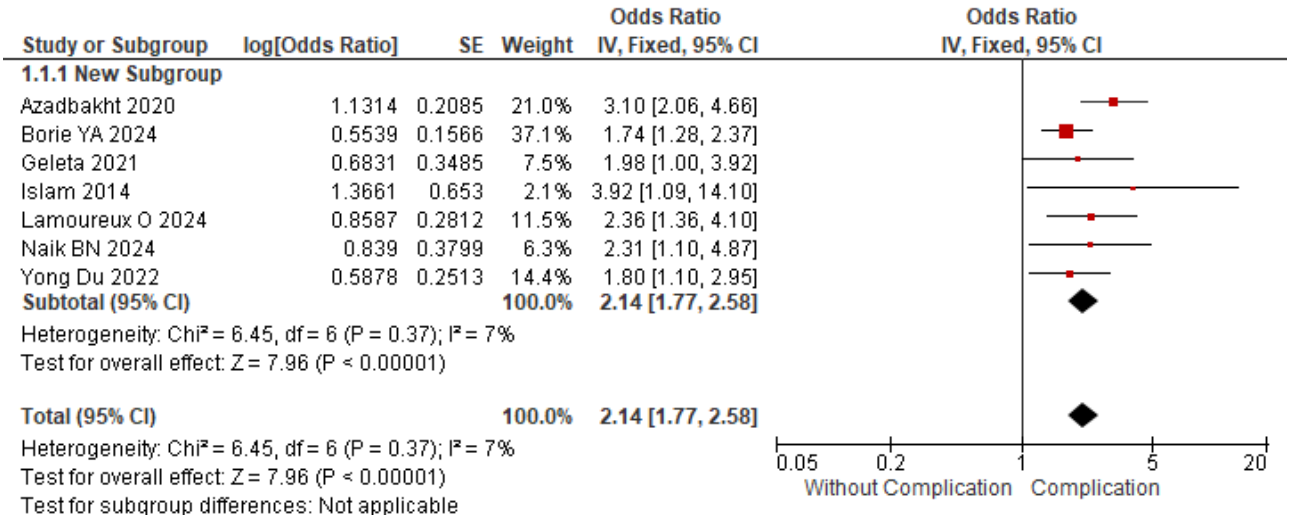

Figure 2. Association diabetic complications and diabetes distress

Figure 2 presents a forest plot about the association of diabetic complication on risk diabetes distress. The results of the study showed the presence of diabetic complications influenced the risk of diabetes distress, and the effect was statistically significant. Adults were 2.14 times more likely to have diabetes distress (aOR= 2.14; 95% CI = 1.77 to 2.58; $p < 0.001$). The forest plot also showed a little heterogeneity of estimates between studies (I^2= 7%). Thus, the average calculation of the effect estimate is carried out using the fixed effect mode approach.

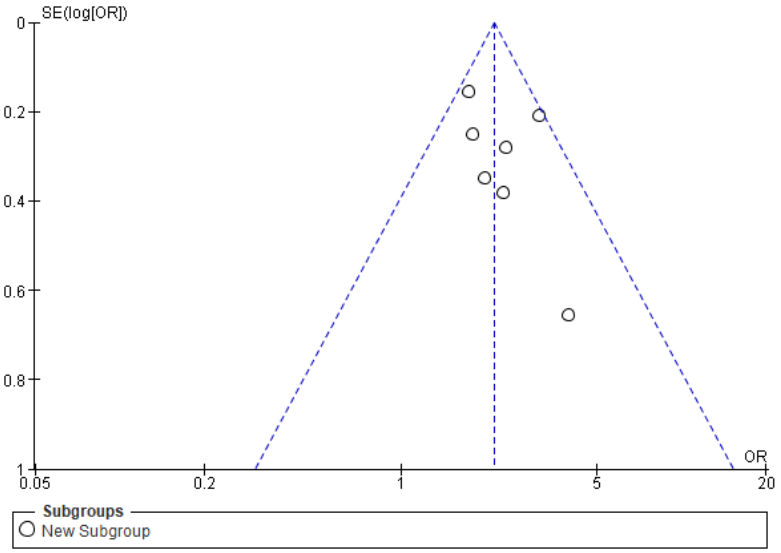

Figure 3. Association diabetic complications and diabetes distress

Figure 3 shows a funnel plot about the association of diabetic complications on the risk of diabetes distress. The funnel plot shows that the estimated effect is evenly distributed to the right and left of the average vertical line. Thus the plot funnel indicates the absence of publication bias

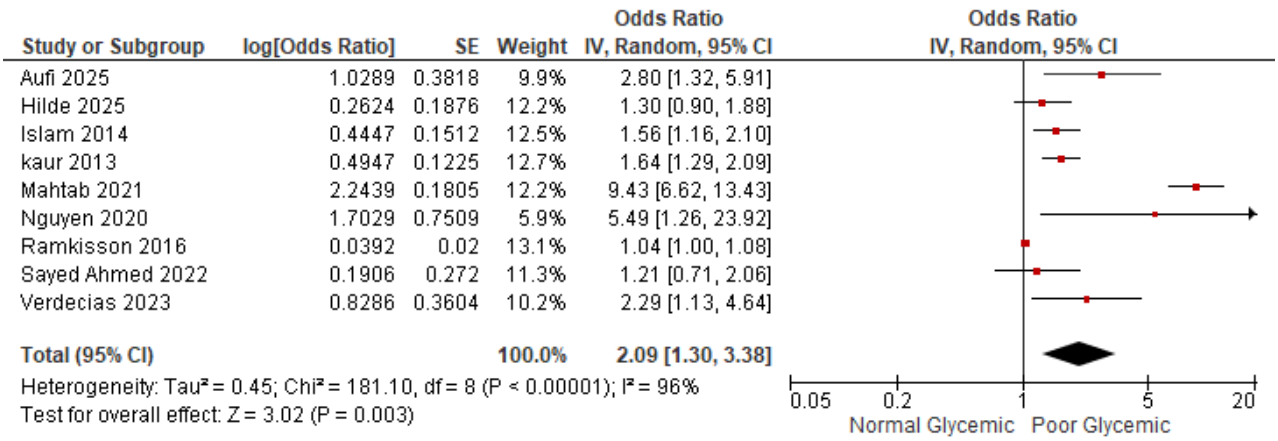

Figure 4. Association glycemic control and diabetes distress

Figure 4 presents a forest plot about the association of glycemic control on risk diabetes distress. The results of the study showed poor glycemic control increased the risk of diabetes distress, and the effect was statistically significant. Adults were 2.09 times more likely to have diabetes distress (aOR= 2.09; 95% CI = 1.30 to 3.38; p = 0.003). The forest plot showed a large heterogeneity of estimates between studies (I^2= 96%). Thus, the average calculation of the effect estimate is carried out using the random effect mode approach.

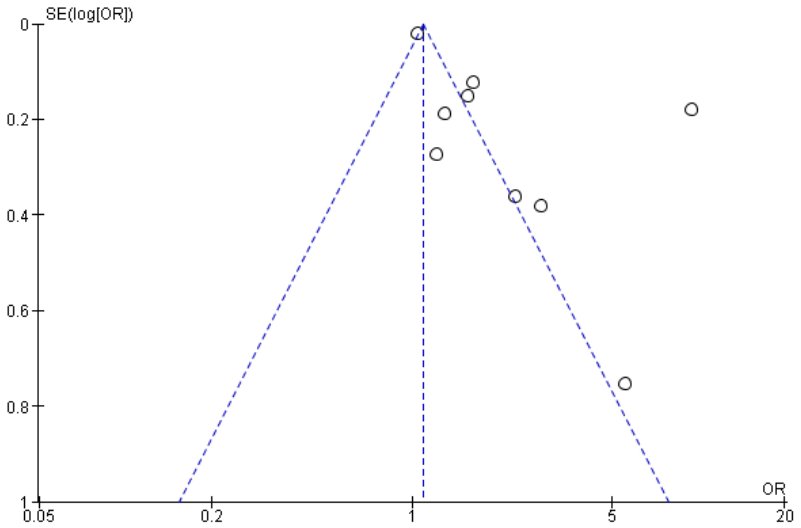

Figure 5. Association glycemic control and diabetes distress

Figure 5 presents a funnel plot about the sociation glycemic control and diabetes distress. The plot funnel shows that the distribution of the effect estimate is more located to the right than to the left of the average vertical line of the estimate. Thus, the plot funnel indicates the existence of publication bias. Because the distribution of the estimated effect is asymmetric distribution (more to the right of the vertical line of the average estimate in the funnel plot), which is the same as the diamond image of the average estimated effect to the right of the vertical line of the null hypothesis in the forest plot, the bias of the publication tends to overestimate the effect of glycemic control.

Discussion

This systematic review and meta-analysis aimed to examine the extent to which diabetic complications and glycemic control influence the risk of diabetes distress among adults with type 2 diabetes mellitus (T2DM). The two independent variables analyzed were the presence of diabetic complications and glycemic control, while the dependent variable was the risk of developing diabetes distress. This study focuses on two key risk factors contributing to diabetes distress, which is essential because diabetes distress can significantly affect treatment adherence and patients' quality of life.

1. Diabetic complications with diabetes distress

A total of seven studies from various countries were included to assess the impact of diabetic complications on the risk of diabetes distress. All selected studies employed a cross-sectional design. The meta-analysis results demonstrated a significant association between diabetic complications and the risk of diabetes distress. Adults with diabetic complications were found to be 2.14 times more likely to experience diabetes distress compared to those without complications (aOR = 2.14; 95% CI = 1.77–2.58; $p < 0.001$). This association was consistent across studies, as reflected by the low heterogeneity ($I^2 = 7\%$), suggesting that the impact of diabetic complications on diabetes distress is relatively stable across different populations and settings.

In general, diabetic complications, whether microvascular or macrovascular, can increase the psychological burden among patients. The presence of such complications not only adds difficulties to daily medical management but also triggers emotional distress, including feelings of anxiety, frustration, and worry about the progression of the disease, which ultimately contributes to the development of diabetes distress (Wardian & Sun, 2014)

From a clinical and psychosocial perspective, diabetic complications both microvascular and macrovascular can intensify emotional distress by increasing treatment complexity, functional limitations, and concerns about disease progression. Complications such as neuropathy, retinopathy, or cardiovascular disease often require more intensive medical management, frequent monitoring, and lifestyle restrictions, which may contribute to feelings of frustration, fear, and loss of control. These emotional responses are central components of diabetes distress, which differs conceptually from clinical depression and is specifically related to the demands of diabetes self-management.

Recent studies further support this mechanism by emphasizing the role of illness burden and perceived disease severity in shaping emotional responses among patients with T2DM. Evidence from recent observational studies suggests that individuals with multiple or advanced complications report higher distress levels due to worries about future disability, increased dependence on healthcare services, and diminished quality of life.

The findings of this study are consistent with research conducted in Iran involving 186 adult patients with type 2 diabetes mellitus. The study reported that nearly half of the respondents experienced diabetes distress. Further analysis revealed that individuals with multiple microvascular complications had significantly higher distress scores compared to those without any complications. These results support the findings of the present meta-analysis, which indicate that the presence of diabetic complications increases the likelihood of developing diabetes distress (Khashayar et al., 2022)

2. Glycemic control with diabetes distress

To examine the effect of glycemic control on diabetes distress, this meta-analysis included nine cross-sectional studies that met the eligibility criteria. Based on the forest plot analysis, the findings indicated that patients with poor glycemic control had a 2.09 times higher risk of experiencing diabetes distress compared to those with good glycemic control (aOR= 2.09; 95% CI = 1.30 to 3.38; p = 0.003). However, in contrast to the findings for diabetic complications, the association between glycemic control and diabetes distress exhibited substantial heterogeneity (I^2 = 96%), indicating considerable variability across studies.

Several factors may explain this high heterogeneity. Differences in HbA1c cut-off points, measurement tools for diabetes distress, population characteristics, and healthcare system contexts likely contributed to the variability in effect estimates. In addition, cultural perceptions of illness, access to diabetes education, and differences in treatment intensity may influence how patients interpret and emotionally respond to poor glycemic control. These variations highlight the complex and context-dependent nature of the relationship between glycemic control and diabetes distress.

Recent literature has increasingly emphasized the bidirectional relationship between glycemic control and diabetes distress. Poor or uncontrolled glycemic control over the long term may lead to a higher risk of severe diabetic complications. Poor glycemic control may increase emotional burden through feelings of guilt, self-blame, and perceived failure in managing the disease. Persistently elevated HbA1c levels can generate psychological burden, as patients may perceive themselves as unable to properly manage their condition.

These negative emotions often manifest as frustration and anxiety, thereby increasing the likelihood of diabetes distress. Persistent diabetes distress can, in turn, impair self care behaviors such as medication adherence, dietary regulation, and blood glucose monitoring, creating a vicious cycle that worsens glycemic control and increases the risk of long term complications (Fisher et al., 2010). This reciprocal cycle has been reported in recent studies, which suggest that psychological distress and metabolic control reinforce each other over time

The findings of this study are consistent with research conducted in China, involving 947 adult patients with type 2 diabetes mellitus. The study revealed that participants with poor glycemic control (HbA1c ≥ 7%) had significantly higher diabetes distress scores compared to those with normal glycemic control. The researchers recommended that efforts to improve glycemic control should be accompanied by psychosocial support to help prevent and reduce diabetes distress, as well as to mitigate the potential severity of the disease (Y. Y. Zhang et al., 2023)

Conclusion

The findings of this meta-analysis demonstrate that the presence of diabetic complications and poor or uncontrolled glycemic control significantly increases the risk of diabetes distress among adults with type 2 diabetes mellitus (T2DM). Based on the pooled analysis of seven eligible studies, individuals with diabetic complications were found to have 2.14 times higher risk of experiencing diabetes distress (aOR = 2.14; 95% CI = 1.77–2.58; p < 0.001), with low heterogeneity,

indicating consistent results across studies. Meanwhile, the pooled analysis of nine studies revealed that individuals with poor glycemic control had a 2.09 times higher risk of diabetes distress (aOR = 2.09; 95% CI = 1.30–3.38; p = 0.003), although high heterogeneity was observed, suggesting possible variations in population characteristics or measurement methods.

This meta-analysis has several limitations. First, all included studies employed a cross-sectional design, which limits the ability to establish causal relationships. Second, the high heterogeneity observed in the glycemic control variable indicates differences in study settings, population characteristics, and variable definitions that may have influenced the pooled results. Future research should consider conducting interventional or longitudinal studies to better clarify the causal pathways and explore the underlying mechanisms linking diabetic complications, glycemic control, and diabetes distress

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Author Contribution and Competing Interest

Arjuna Pratama Waruwu determines the topic of study, finds articles relevant to the title of the study, processes data, and then continues with the preparation of articles. Bhisma Murti contributed in terms of assisting the data processing process and compiling articles.

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