Bali Medical Journal

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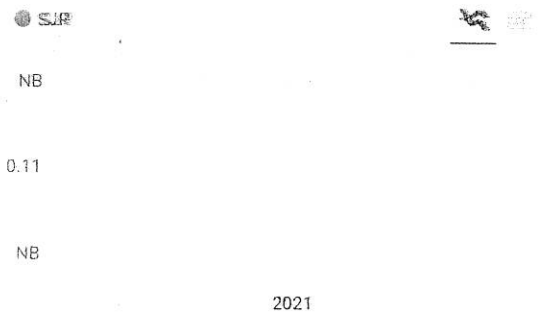

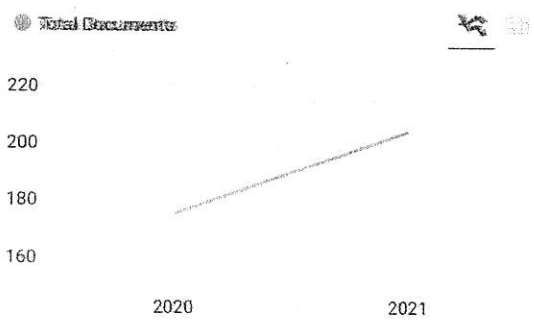

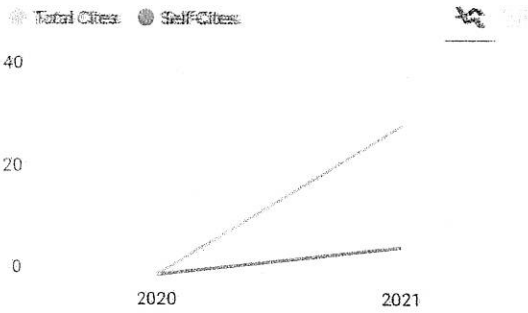

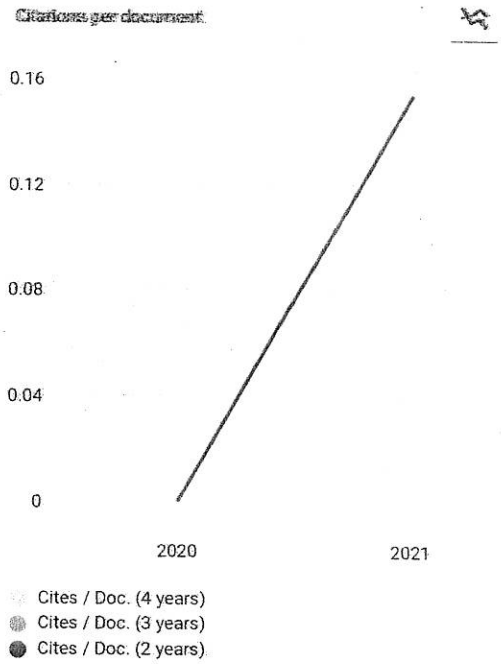

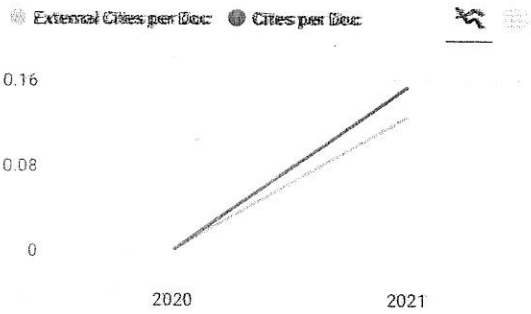

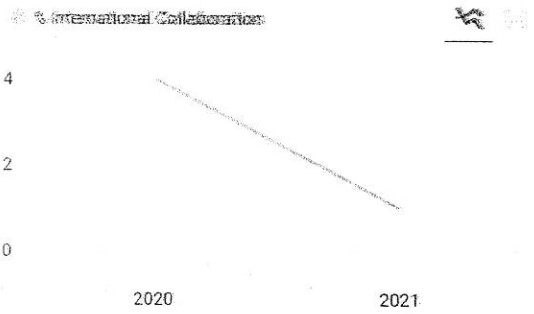

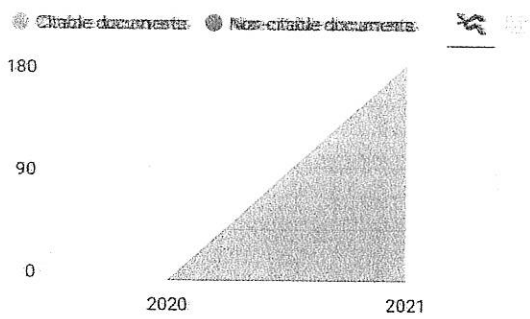

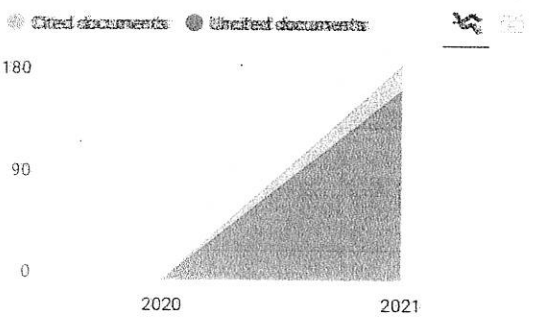

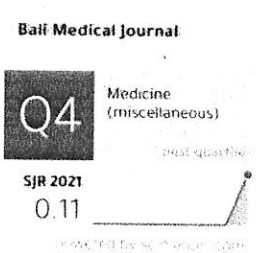

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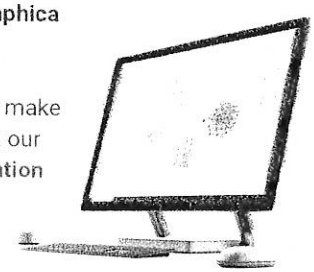

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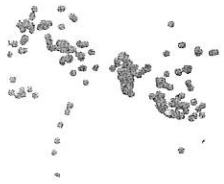

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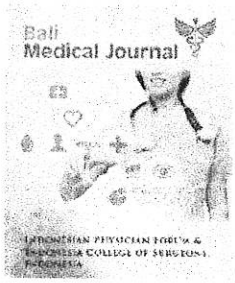

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The relationship between diabetes distress and HbA1C level in type 2 diabetes mellitus therapy patients: a systematic review

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ABSTRACT

Introduction: The success of therapy did not follow the increasing number of type 2 diabetes mellitus patients. This systematic review aimed to evaluate the relationship between diabetes distress and HbA1c in type 2 diabetes mellitus patients during therapy.

Methods: The authors systematically searched databases (PubMed, Cochrane library, and ScienceDirect) up to January 2021. Articles were screened according to PRISMA 2020 statements. The selection criteria of this study were patients' characteristics, type of therapy, and outcomes.

Results: The search started from 1.303 articles to 17 eligible articles. Furthermore, seventeen studies included 11,976 patients. The mean HbA1c level was around 6.4% to 9.9%. The result of diabetes distress scores were five studies with low scores, eight moderate scores, and two high scores. Emotional burden and regimen-related distress were the highest domain score. Age, health facilities, and type of therapy affected diabetes distress. The correlation between diabetes distress and HbA1c was dominant in the range of 0.15 to 0.26.

Conclusion: Diabetes distress had a low-moderate correlation with HbA1c. The dominant domains were emotional burden and regiment-related distress. There were two mechanisms of effect, direct by hormones and indirect through medication adherence, self-management, and 12 months of quality of life.

Keywords: Diabetes Distress, HbA1c, Type 2 Diabetes Mellitus, Therapy
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INTRODUCTION

Diabetes is a chronic disease that caused 1.5 million deaths in 2012, and about 90% of people with diabetes had type 2 diabetes mellitus (T2DM).[1] The improvement of therapy was still low; however, the number of T2DM patients was increasing.[2-4] Physicians, patients, and the healthcare systems were a factor that influenced therapy.[5] Psychological conditions affected 30% of therapy because they had a role in the patient's condition.[5] The most common problem is stress. Patients have reached target therapy still less than 50% of the population, mainly in Asia.[2-4] In one hospital in Taiwan, 83.5% of patients did not reach the therapeutic target (HbA1c > 7%).[3] In South Korea, 55.5% of patients had poor glycemic control (mean HbA1c = 8.08%).[3] This finding was the same in 2013; there was no improvement in reaching therapeutic targets in five years.[3] However, Indonesia has the same condition that only 30.8% of patients achieve the targeted therapy.[4]

The DAWN (Diabetes, Attitudes, Wishes, Needs) study conducted a large cross-country research on patients and healthcare professionals in the management of diabetes.[6] Diabetes distress (DD) was the most common and interfered with patient self-management.[6] It was the negative feelings like worries, anxiety, and threats because of diabetes.[7] The DAWN 1 study, with 5,104 samples from 13 countries, 41% of patients had DD.[7] The DAWN 2 study was conducted in 18 countries with 8,596 samples, and there were 44.6% DD patients.[7] Farm et al. found that there was moderate DD in 620 patients in primary clinics and tertiary hospitals in two provinces of Indonesia.[8]

Diabetes distress was a major issue in T2DM patients, and it was a widespread problem.[9,10] Perrin et al. supported that diabetes distress was under-recognized and inadequately treated in Type 2 diabetes.[10] The growth of diabetes distress without DD reached around 17% and became high DD in 18 months.[9] The effect of diabetes distress was poor glycemic control, low treatment compliance, poor self-management behavior, and high risky lifestyle behavior.[9,11] Gonzales et al. found that diabetes distress affects medication adherence and A1C directly or through perceived control.[12]

Diabetes distress and fasting blood sugar have a significant relationship.[8] In Taiwan, Chen et al. analyzed that diabetes distress with increasing empowerment significantly correlated with blood glucose.[2] Diabetes distress has a positive correlation that contrasts with empowerment.[2] Diabetes distress is a psychosocial condition that has a more significant impact than decisional balance for insulin injection, health knowledge,

and self-efficacy.

To evaluate the relationship between diabetes distress and HbA1c level in type 2 diabetes mellitus patients during therapy, the authors performed a systematic review to summarize the correlation between the two variables. The analysis is according to the scoring instrument, mechanism of correlation in each study, and the factor that affects diabetes distress. The first systematic review analyzes those variables to find effective target intervention.

METHODS

Data sources and searches

Published articles were selected from three databases [PubMed, Cochrane library, and ScienceDirect]. We searched the articles up to January 2021. We used the following keyword ((Type 2 Diabetes Mellitus) OR (T2DM)) AND ((diabetes-related distress) OR (Diabetes distress)) AND (HbA1c) AND (therapy). We exported the studies to Mendeley to manage the references and remove duplicates.

Selection of studies

This systematic review is based on standard preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 statements. The flow of articles was selected according to this guideline. The articles used English languages and had samples over 19 years old. Microsoft Excel and Mendeley recorded the results, managed references, and eliminated duplicated studies.

The first and second authors independently screened articles. If there were any different opinions between the two authors, we discussed them and asked the third author's opinion until we got a consensus. The selection is according to inclusion and exclusion criteria. The articles chosen were cross-sectional and cohort; the sample age was over 19 years old, and HbA1c became an indicator of blood sugar assessment, diabetes distress examination, and an analysis of the relationship between diabetes distress and HbA1c. The exclusion criteria were patient had received psychological therapy and was in a psychotic condition.

Quality Assessment

All authors discussed and assessed the quality of the articles. Quality assessment in cross-sectional and cohort studies using the Newcastle Ottawa Scale. Assessment according to screening, comparability, and outcome in each study. Assessment indicators for each aspect of cross-sectional and cohort studies are based on validated assessment standards. Ratings each object gets one star and will be a total at the end. Total scores over 7-8 include good category, 3-6 were fair categories, and <3 were poor categories.

Data extraction and Data analysis

The authors extract data by sorting between study characteristics and outcomes. The indicators taken for study characteristics are study design, place, sample amount, mean age, duration of type 2 diabetes mellitus, therapy method (oral medication, insulin injection, combination, and no medication), and diabetes distress instrument. The outcome table explained the HbA1c level, diabetes distress score, significance level (p-value), and Pearson correlation value (r). The domain of diabetes distress was defined in different tables.

The first author extracted all data. The second and third authors cross-checked the data. The second author was concerned about the type of therapy, HbA1c level, demography, and outcomes. The third author specifically checked data about the DD instrument, the score of DD, demography, and outcomes. If there were any articles with incomplete data, all authors examined the reason and explanation for the missing data from the article. The articles with precise descriptions and supporting the analysis were still included in this systematic review. DD score and HbA1c were required data for analysis; the authors agreed minimally that the articles statistically explained the correlation, although the articles do not describe the data

Firstly, we separated the tables to analyze the characteristics and outcomes. Furthermore, we analyzed the demography with diabetes distress levels to identify factors that affect diabetes distress—statistic values interpretation like significance level and Pearson correlation between diabetes distress and HbA1c. Next, we determined the flow of the impact of diabetes distress on HbA1c, either direct or indirect. The last result was the aspects that affect diabetes distress and the correlation between diabetes distress and HbA1c. All authors analyzed the correlation of each data and summarized it.

RESULT

Begin with 1,303 studies from 254 in PubMed, 72 in Cochrane library, and 977 in ScienceDirect (Figure 1). A total of 981 studies were removed with automation tools and 47 duplicate studies. Three hundred twenty-two studies were initially screened, and 256 were excluded (Figure 1). There were 66 studies selected according to inclusion and exclusion criteria-three with samples aged under 19 years and duration of diagnosis less than three months. Twenty studies were not cohort or cross-sectional studies. Two studies had not identified the correlation between diabetes distress and HbA1c. HbA1c was not a marker in the two studies. Six studies with samples received a psychological intervention, six studies on depressed patients, and nine studies used diabetes distress as an outcome (Figure 1). The total number of excluded studies is 49 studies. The number of included studies was 17 studies, with 15 cross-sectional studies and two cohort studies. Fourteen studies were a good category, and three other studies had fair from the Newcastle Ottawa Scale assessment (Table 1).

Seventeen studies were selected, and they had 11,976 patients. Sixteen studies with samples from one region and eight studies from Asia (Table 2). One study with samples from 18 countries.[13] The study sample in this systematic review was 11,976 patients (96.06%) from the initial samples-the dominant study from Asia, eight studies in 7 countries, followed by America. According to data from the diabetes center, one study with varied samples from many nations. This study described data from various health facilities (Table 2). Of fifteen

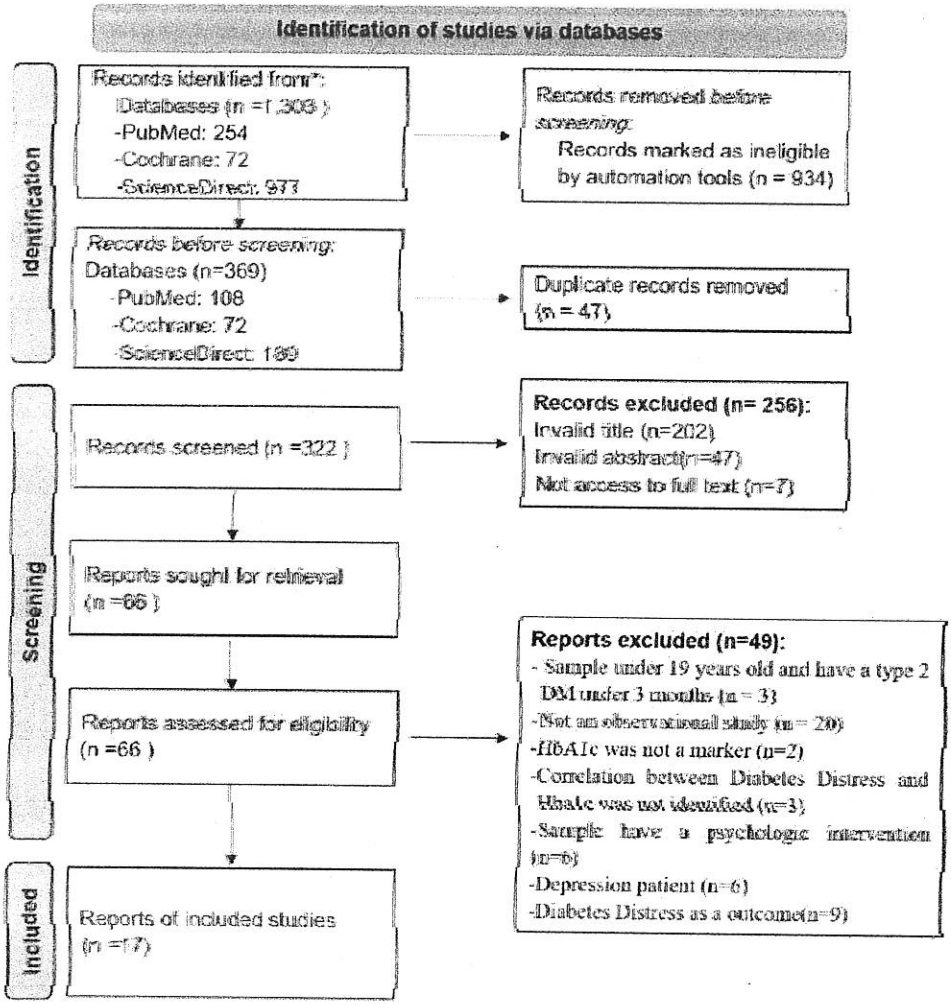

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020.

studies, five were at primary care, one at a healthcare institution, two at hospitals, one at a university hospital, one at an endocrinology clinic, one at major medical care, one at a diabetes outpatient clinic, and three at diabetes centers. Two other studies in more than one health facility area. There are urban and suburban areas.[14] In addition, there are additions in rural areas.[15]

Of seventeen studies, six studies had a mean sample age of over 60 years, and one of them reached up to 70 years (Table 2). The other ten studies had ages 50 to 60 years. One further study described the average age with the percentage in each age range, with the dominant age being 50 to 64 years. Fifteen studies reported the duration of the sample undergoing T2DM therapy. A total of nine studies had a duration of more than ten years, and six studies with 7 to 10 years.

Not all studies report the type of therapy patients. Eleven studies described the percentage of patients who did therapy into four categories (Table 3). Two studies had total samples that were all insulin or oral medication.[13,24] There were three studies with samples in four categories; 2 studies were dominant with oral antihyperglycemic therapy samples, and 1 study was diet alone. The other five studies were in only two types; 3 were predominant with oral antihyperglycemic, 1 study in combination, and one on insulin therapy. One study reported a disproportionate sample percentage of 90% in oral antihyperglycemic therapy but about 57% in another category.[15]

Twelve studies used the 17-DDS instrument (Table 4). Three of them use other countries' versions, such as Korean, Arabic, and Chinese. Four other studies used the PAID Scale, and two of them were Chinese versions. One recent study used 12 DFS-Ars to assess a patient's level of distress.

The outcomes of the studies were diabetes distress score, HbA1c level, significance (p-value), and Pearson correlation (r). The diabetes distress score is related to the instrument so that the mean and indicator are different. Two studies did not report mean DD scores. However, Aghili et al. still wrote the result of diabetes distress statistics.[16] Sukkarieh-Haraty et al. published the analysis of distress in a statistic.[24] One study reported the percentage of samples that scored 0-3 (65%) and >3 (2%) because there were two sample categories and there is no data as a mean score. Seven of the 14 studies included low DD levels, the other five studies were moderate, and two studies had high DD levels.

The target of therapy is HbA1c below 7%. Only one study reported reaching the target.[20] Another 14 studies had a mean HbA1c above 7% (Table 4). There is one study that reported the percentage of HbA1c >7% (64%) and HbA1c <7% (36%). One study did not record HbA1c levels. Sixteen studies were significant, and one other study was not significant in total diabetes distress score.[13] Ten studies described the correlation between HbA1c and DD with the Pearson correlation. Two other studies are not directly related.[14,19] The other five studies did not report any correlation values. One high correlation study (0.69), 3 moderate correlation studies (0.2-0.5), and 6 low correlation studies (< 0.2).

The graphic presents two variables with a horizontal line of diabetes distress score and a vertical line of HbA1c level (%) (Figure 2). The red vertical line is the mark for the diabetes distress category-the horizontal line is an HbA1c target mark. Nine of 12 studies support that a high diabetes distress score has a high HbA1c (Figure 2). One study with high diabetes distress and HbA1c level.[22] Seven studies have moderate diabetes distress with HbA1c level >7%.[2,3,13,15,18,21,26] In one study, the result was low diabetes distress with HbA1c level <7%.[20] The other three studies have opposite results, low diabetes

Table 1. **Newcastle Ottawa Scale.**

Quality Assessment Criteria	Aghili R *et al.*, 2016	Asuzu CC *et al.*, 2017	Chen SY *et al.*, 2019	Chew BH *et al.*, 2018	Choi WH *et al.*, 2017	Darawad MW *et al.*, 2017	Hsu *et al.*, 2018	Kuniss *et al.*, 2017	Lin *et al.*, 2017	Linetzky B *et al.*, 2016	Lum ZK *et al.*, 2018	Mirghani *et al.*, 2016	Nanayakkara N *et al.*, 2016	Sukkarieh-Haraty O *et al*, 2019	Walker RJ *et al.*, 2019	Wardian *et al.*, 2017	Winchester RJ *et al.*, 2016
Selection																	
Representativeness of the exposed cases	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selection of the non-exposed cases	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Ascertainment of exposure	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Selection of outcome parameters clearly specifed in methods	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Comparability																	
Study controls for age and sex?	-	-	-	-	-	-	-	-	-	-	-	*	-	-	-	-	-
Study controls for the history of HbA1c??	-	-	-	-	*	-	-	-	-	-	-	-	-	-	-	-	-
Outcome																	
Assessment of outcome?	*	*	*	*	*	-	*	*	*	*	*	*	*	*	*	*	-
Was *follow-up long enough* for outcomes to occur?	-	-	-	*	-	-	*	-	-	-	-	-	-	-	-	-	-
Non-response rate	*	*	*	*	*	*	*	*	*	*	*	*	*	-	*	*	*
Total Score	7	7	7	8	8	6	8	7	7	7	7	8	8	6	7	7	6

distress, but the HbA1c level >7%.[17,19,25]

Diabetes distress has four domains; emotional burden, physician-related distress, regimen-related distress, and interpersonal distress (Table 5). Four studies listed the mean score, and two of them also recorded the correlation between HbA1c and DD. The four studies show the mean value of DD is medium and high. Both studies had low correlations for HbA1c in the EB and RD domains and low values in the other two domains. The value of all studies is significant.

DISCUSSION

This systematic review presents a significant relationship between diabetes distress and HbA1c levels. Only Mirghani et al. had result significant correlation with the domain score but not the total score.[22] Emotional burden and regimen-related distress are strong predictors of glycemic control.[22] The dominant low correlation is because HbA1c level is affected by diabetes distress and other factors. However, diabetes distress is a strong determinant compared with other psychosocial such as depression. Lee et al. supported diabetes distress as an effective target intervention to improve glycemic control.[28] Ten of 17 studies found that DD was directly positively correlated with HbA1c level. Diabetes distress can increase the cortisol hormone, which suppresses insulin production.[3] The impact of low insulin is increasing HbA1c. Nevertheless, Chew et al. did not find a correlation between diabetes distress and HbA1c level.[15] Differences in population culture such as family, social network, and health mindset influenced stress and glycemic control.[15]

Five of 17 studies found that medication adherence is a mediator between diabetes distress and HbA1c level. Medication adherence is the most specific and easy adherence practice in therapy.[16] High diabetes distress enhances poor medication adherence. Then, it will increase HbA1c levels.[13,15,16] Medication adherence is a critical role in treatment, so failing this step will disturb T2DM therapy. Mirghani et al.'s finding supported that T2DM patients feel desperate and overwhelmed with this condition.[22] It induced poor adherence and concerned poor glycemic control. Diabetes distress affects self-efficacy, then the impact is 0.26 points of self-management.[14] Self-management influenced the HbA1c level.[14] It was consistent with studies in China and Thailand that self-management was the key to diabetes management and a

predictor of blood glucose.[29] Interventions in self-management can be effective because improving it one point reduces the risk of suboptimal T2DM therapy.[11] Twelve months of quality of life (QoL) months also mediates the two variables in two of 17 studies. Diabetes distress affects QoL through life satisfaction and motivation, so it takes time before the HbA1c level.[19] Diabetes distress disturbs self-care in the long term. The impact of low self-care on HbA1c is disturbing diet, exercise, and blood glucose management. If it is less than six months, the effect of diabetes distress is not apparent, especially when the level of diabetes distress is still low.

Emotional burden and regimen-related distress are two dominant domains in diabetes distress. They can be strong predictors of glycemic control. Emotional burdens are present in patients who feel hard to do routines as type 2 diabetes mellitus patients, and the lack of social support will reinforce this.[24,26] The regimen-related distress is identical to being irregular in monitoring blood glucose and therapy so that it is related to the type of therapy.[3,26] Physician-related distress through hurried communication disturbs glycemic control because the patients do not understand what to do.[13] High emotional burden and regimen-

Table 2. **Summary of Studies Characteristics.**

No	Author, year	Study Design	Place (Country; Healthcare)	Sample	Mean age (years)	Duration T2DM (years)
1	Aghili et al.,2016[16]	Cross-Sectional	Iran; Major medical clinic	380	54.73 ± 8.00	8.94 ± 6.5
2	Asuzu et al.,2017[17]	Cross-sectional	Southeastern United States; Primary care	615	61.3 ± 10.9	12.3 ± 9.1
3	Chen et al.,2019[9]	Cross-sectional	Taiwan; Endocrinology clinic	255	56.58 ± 10.92	13.37 ± 8.87
4	Chew et al.,2018[15]	Cross-Sectional	Malaysia; Urban, suburban, and rural health clinics	338	60.6 ± 10.1	9.8 ± 5.9
5	Choi et al.,2018[8]	Cross-sectional	South Korea, University hospital	171	59.55 ± 9.75	12.36 ± 8.53
6	Darawad et al.,2017[18]	Cross-sectional	Jordania; Hospital	325	55.3 ± 13.2	NR
7	Hsu et al.,2018[19]	Cross-Sectional	Southern Taiwan; Diabetes Outpatient clinic	382	58.78 ± 11.48	10.03 ± 7.29
8	Kuniss et al.,2017[20]	Cohort	Germany; Primary care	336	72.3 ± 9.7	12.4 ± 10.2
9	Lin et al.,2017[14]	Cross-Sectional	China; Suburban and urban outpatient departement	254	55.26 ± 0.63	8.15 ± 0.42
10	Linetzky et al.,2017[13]	Cross-sectional	Argentina, Brazil, Canada, China, Germany, India, Israel, Italy, Japan, Mexico, Russia, Saudi Arabia, South Korea, Spain, Turkey, United Arab Emirates, UK, and United States, including Puerto Rico; Primary care	4341	61.77 ± 11.02	12.65 ± 7.98
11	Lum et al., 2018[21]	Cross-sectional	Singapore; Healthcare Institution	246	59.9 ± 7.6	9.4 ± 8.8
12	Mirghani, 2016[22]	Cross sectional	Sudan; Diabetes center	89	59.64 ± 9.60	9.14 ± 8.1
13	Nanayakkara et al.,2016[23]	Cross sectional	Australia; Diabetes center	2552	63 ± 13	12 ±10
14	Sukkarieh-Haraty et al.,2019[24]	Cross sectional	Lebanon; Hospital	280	58.24 ± 13.48	7.83
15	Walker et.al, 2019[25]	Cross sectional	United States; Primary care	615	61.3 ± 10.9	12.3 ± 9.1
16	Wardian et al.,2017[26]	Cohort	United States; Diabetes center	436	59.9	16.9
17	Winchester et al.,2016[27]	Cross-sectional	United States; Primary clinic	361	18–49 years (10.6%) 50–64 years (43.0%) 65–74 years (29.1%) 75–89 years (17.3%)	NR

Abbreviation:
NR: Not Reported

related distress will suppress glycemic control, and the HbA1c will increase.[17,18]

Age significantly affects the level of diabetes distress. The higher risk of diabetes distress, the younger the patient is first diagnosed with type 2 diabetes.[16] Seven of 17 studies have the same finding.[5,14,18,20-22,26] T2DM patients during working age will inhibit activities and disturb need compliance. The longer the duration of experiencing type 2 DM, the higher the DD score.[20] However, Wardian et al. supported this statement.[26] Previous studies did not show the same result because those conclusions were from some sample groups.[20] This finding aligns with other studies that duration does not affect DD but can affect self-care.[18,19]

The finding of the present systematic review is different from the previous study about the effect of the level of health facilities on diabetes distress. In primary care, the level of diabetes distress is low. The glycemic control is better than at the secondary or tertiary level because, at the tertiary level, the patient has blood sugar levels that are more uncontrolled.[14,20] Nevertheless, primary care has a higher level of distress because it is associated with physician capability in the previous study.[8] The difference in findings is because each country has different standards of health care facilities.

The type of patient therapy can affect the level of diabetes distress. The type of therapy is the group of regimen-related distress. In patients who use therapy, there is a tendency for high levels of distress because it is related to strictness in the use of insulin, namely in terms of time, dose, and fear of hypoglycemia.[2,26] Patients with combination therapy need accuracy in insulin therapy and consume oral antihyperglycemic drugs.[3] Therefore, the type of therapy does not explicitly affect diabetes distress because each treatment has some concerns. The patients will feel anxiety and stress if they do therapy for a long time, whatever the type of therapy.

This systematic review implies that diabetes distress is significantly related to *HbA1c with a low correlation. Nevertheless,* it can be the target of intervention and improve the success of therapy. The first limitation of this study is that it does not proceed to a meta-analysis due to the various types of studies and instruments. By analyzing the meta-analysis, it will be more quantitative to see the correlation of two variables and the effect of diabetes distress on HbA1c. Second, the correlation between the two dominant variables is weak, so further research is needed. The other cause because HbA1c is not only affected by psychological conditions but many factors.

CONCLUSIONS

In this study, diabetes distress and HbA1c have a low-moderate relationship, but it can be an effective target intervention for improving type 2 diabetes mellitus therapy. Diabetes distress has one direct mechanism hormones. The indirect effect of diabetes distress is through medication adherence, self-management, and 12 months of quality of life. Age, health facilities, and type of therapy can affect diabetes distress. Furthermore, emotional burden and regimen-related distress are the most dominant domain in diabetes distress, and they can be the specific target for intervention.

Table 3. **Summary of Type Therapies Studies.**

No	Author,year	Therapy (%)			
		Oral medication	Insulin ± oral medication	Insulin	No Medication/ Diet only
1	Aghili et al.,2016[16]	54,80%	38,40%	5%	1,80%
2	Asuzu et al.,2017[17]	NR	NR	NR	NR
3	Chen et al.,2019[2]	NR	72,90%	27,10%	NR
4	Chew et al.,2018[15]	90%	NR	47,50%	10,94%
5	Choi et al.,2018[3]	64,30%	35,70%	-	-
6	Darawad et al.,2017[18]	NR	NR	NR	NR
7	Hsu et al.,2018[19]	NR	NR	NR	NR
8	Kuniss et al.,2017[20]	26,20%	14%	17,80%	42,00%
9	Lin et al.,2017[14]	59,50%	40,50%	-	-
10	Linetzky et al.,2017[13]	NR	NR	100%	NR
11	Lum et al., 2018[21]	60,60%	29,30%	1,60%	8,50%
12	Mirghani, 2016[22]	91,10%	NR	8,90%	NR
13	Nanayakkara et al.,2016[23]	NR	NR	74%	26%
14	Sukkarieh-Haraty et al.,2019[24]	100%	NR	NR	NR
15	Walker et.al, 2019[25]	NR	NR	NR	NR
16	Wardian et al.,2017[26]	NR	NR	56,90%	17,60%
17	Winchester et al.,2016[27]	NR	NR	NR	NR

Abbreviation:
NR: Not Reported

Table 4. **Summary of variables result and outcome studies.**

No	Author,year	DD Instrument	DD Score (/max score)	HbA1c (% (mmol))	Outcomes	
					p-value	r
1	Aghili et al.,2016[16]	DDS17	NR	7.78 ± 1.7 (62)	<0.001	0.173
2	Asuzu et al.,2017[17]	DDS17	1.6 ± 0.7/6 (low)	7.9 ± 1.8 (63)	<0.001	0.69
3	Chen et al.,2019[9]	Short-Form PAID Scale (Chinese)	10.98/32 (low)	8.33 ± 1.49 (68)	< 0.05	0.144
4	Chew et al.,2018[15]	DDS17	2.3 ± 1.4/6 (moderate)	8.3 (67)	<0.05	NR
5	Choi et al.,2018[5]	DDS17 (Korean)	2.25 ± 0.56/6 (moderate)	7.37 ± 1.27 (57)	<0.05	NR
6	Darawad et al.,2017[18]	DDS17 (Arab)	47.2 ± 14.5/85 (high)	7.88 ± 1.78 (63)	<0.05	0.153
7	Hsu et al.,2018[19]	PAID Scale (Chinese)	7.61 ± 7.02 / 32 (low)	7.39 ± 1.11 (57)	<0.01	NR*
8	Kuniss et al.,2017[20]	PAID scale	3.9 ± 7.0/43.75 (low)	6.4 ± 1.0 (46)	<0.001	0.253
9	Lin et al.,2017[11]	DDS17 (Chinese)	38.94 ± 0.81/90 (low)	>7% = 64% <7% = 36%	<0.01	NR*
10	Limetzky et al.,2017[13]	DDS17	2.27 ± 1.13/6 (moderate)	8.13 ± 1.75 (65)	< 0.01	0.171
11	Lum et al., 2018[21]	PAID Scale	26.2/80 (moderate)	8.6 ± 1.5 (70)	<0.01	0.235
12	Mirghani, 2016[22]	DDS17	3.67 ± 0.64 (high)	9.9 ± 2.60 (85)	>0.05	0.176
13	Nanayakkara et al.,2016[23]	DDS17	0-3 (65%) >3 (2%) (dominant low)	8±2 (64)	<0.001	NR
14	Sukkarieh-Haraty et al.,2019[24]	12-item DFS-Ar	NR	7.73 ± 2.2 (61)	<0.05	NR
15	Walker et.al, 2019[25]	DDS17	1.6 ± 0.7/6 (low)	7.9 ± 1.8 (63)	<0.001	0.25
16	Wardian et al.,2017[26]	DDS17	2.8/6 (moderate)	8.38 (68)	<0.05	NR
17	Winchester et al.,2016[27]	DDS17	1.4/6 (low)	NR	<0.05	0.179

Abbreviation:
(*): No direct correlation
NR: Not Reported
DDS17: 17-item Diabetes Distress Scale
PAID Scale: Problem Areas in Diabetes scale
12-item DFS-Ar: The 12- item Diabetes Fatalism Scale- Arabic

Table 5. **Summary of diabetes distress domain.**

No	Author, year	Domain Diabetes Distress								p
		Emotional Burden		Physician-related distress		Regimen-related distress		Interpersonal distress		
		Mean	r	Mean	r	Mean	r	Mean	r	
1	Choi et al.,2018[5]	2.46	NR	1.86	NR	2.41	NR	2.14	NR	<0.05
2	Darawad et al.,2017[18]	15.2	0.193	10	-0.017	14	0.151	7.1	-0.04	<0.05
3	Mirghani, 2016[22]	4.08 ± 0.88	0.221	3.75 ± 1.13	-0.009	3.35 ± 1.43	0.331	3.445 ± 0.92	-0.129	<0.05
4	Wardian et al.,2017[26]	2.108 ± 1.15	NR	1.261 ± 0.76	NR	2.137 ± 1.06	NR	1.50 ± 0.89	NR	<0.05

Abbreviation:
NR: Not Reported

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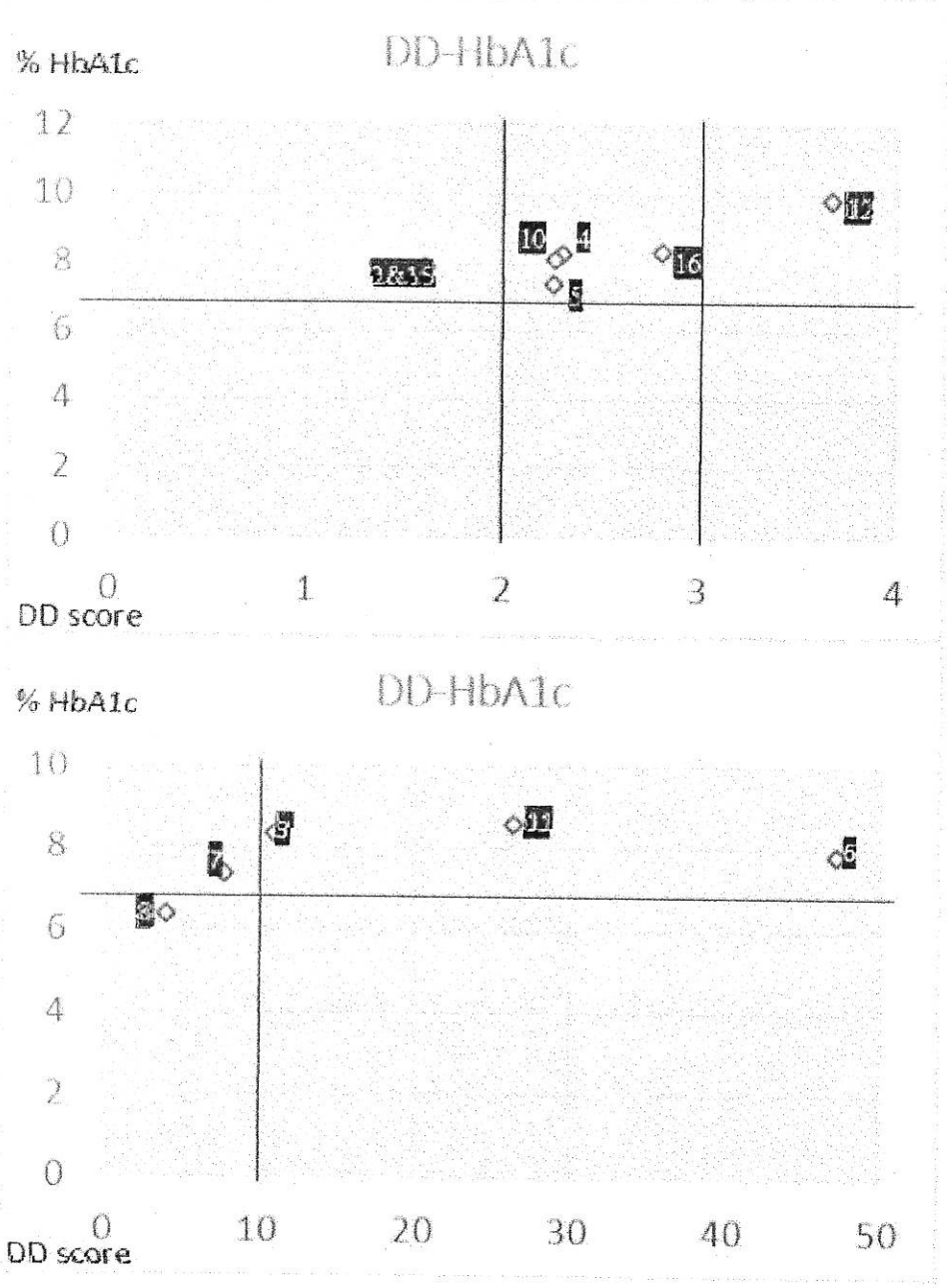
CONFLICT OF INTEREST

The authors declared there is no conflict of interest regarding this study between authors and other organizations or people that influence the objectivity of research.

AUTHOR CONTRIBUTOR

The first and third authors created and discussed the concept. The first and second authors created the study design and searched literature with selected articles. All authors analyzed the result and wrote some notes. After we concluded the last analysis, the first author wrote and prepared the manuscript. The second and third authors reviewed and evaluated it.



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