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Psychometric Assessment of Individuals with Type 2 Diabetes in High and Moderate Distress

Chhavi Mehra[1], Annie Mattilda Raymond[1]*, Ankitha Sequeira[1], Jeny Joseline[1], Shivtosh Kumar[1]

ABSTRACT

Background and Aim: Diabetes distress is an emotional state arising from the challenges of living with diabetes. This study aims to assess the diabetes distress score (DDS) among individuals with type 2 diabetes (T2D) and subsequently analyze their progress after three months of therapy. **Methodology:** A total of 536 participants were screened employing the DDS self-report 17 questionnaire. Of these, 213 individuals with high DDS were recommended for one-on-one psychological consultation along with health coach consultation to manage T2D, whereas 218 individuals with moderate DDS were recommended only for health coach consultation. **Results:** All participants underwent a 90-day assessment of their DDS. Participants with high DDS experienced a significant reduction as compared to those at moderate distress. The baseline DDS (DDS-Q0) of high distress was 3.4 ± 0.7, with scores for Physician Distress (PD), Emotional Distress (ED), Regimen Distress (RD) and Interpersonal Distress (IPD) being 3.4 ± 0.7, 3.8 ± 1, 3.7 ± 1, and 2.7 ± 1.3, and the DDS-Q1 score was 2.7 ± 1.1, with scores for PD, ED, RD, and IPD being 2 ± 1.2, 3 ± 1.3, 2.9 ± 1.3, and 2.2 ± 1.4, respectively. For individuals at moderate risk, the baseline DDS-Q0 score was 2 ± 0.28, with domain scores for PD, ED, RD, and IPD of 2 ± 0.28, 2.2 ± 0.68, 2.3 ± 0.64, and 1.4 ± 0.56, and the DDS-Q1 score was 1.9 ± 0.69, with domain scores for PD, ED, RD, and IPD of 1.5 ± 0.82, 2.1 ± 0.89, 2.1 ± 0.97 and 1.5 ± 0.91, respectively. Furthermore, individuals with high distress experienced an average HbA1c reduction of $1.2\pm1.3\%$, a decrease in fasting blood sugar (FBS) by 22.6 ± 66.8 mg/dl, and a weight loss of 1.8 ± 3.4 kg. Those with moderate distress saw a decrease in HbA1c, FBS, and weight by $0.98\pm1.48\%$, 21 ± 48.86 mg/dl, and 2.0 ± 2.7 kg, respectively. **Conclusion:** Participants with high DDS and who got clinical support showed a substantial improvement, with a 20.9% reduction in distress scores, compared to an improvement rate of 4.02% among those who were at moderate distress. This suggests that early identification and targeted support can improve outcomes for individuals. with high distress. Future studies will be needed to observe long-term trends and achieve better results for individuals with moderate DDS.

Keywords: *Type 2 Diabetes, Diabetes Distress Scale, Mental Health, Personal Coaching, Emotional Wellbeing*

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[1]RAGUS HEALTHCARE PVT LTD, 17/N, 18th Cross Rd, Sector 3, HSR Layout, Bengaluru, Karnataka
*Corresponding Author

Global prevalence of diabetes is soaring, posing a significant and escalating public health challenge [1]. This trend is particularly concerning for type 2 diabetes, characterized by elevated blood sugar levels, with projections indicating millions more individuals will be impacted by 2045 [2]. Beyond straining healthcare systems, this chronic condition has a significant impact on individuals and families, causing emotional distress, financial strain, and potential complications [3].

In 2019, approximately 463 million people globally were affected by diabetes, representing a prevalence of 9.3%. By 2024, the prevalence rate is estimated to be 9.9%, with around 578 million individuals affected [4]. Looking further ahead, projections for 2030 anticipate a rise to 10.2% (approximately 700 million people), and by 2045, the prevalence is expected to reach 10.9%. These figures underscore diabetes as a significant and escalating public health challenge, emphasising the ongoing need for effective global strategies in prevention and management [5]. This trend can be attributed to factors like ageing populations, rapid urbanisation, and increasingly obesogenic environments [6].

One key indicator for monitoring diabetes is glycemic control, measured by glycated haemoglobin (HbA1c). Recent studies show a direct correlation between HbA1c levels and diabetes prevalence, highlighting the importance of effectively managing blood sugar [7, 8]. As the diabetes epidemic surges globally, a concerning trend emerges: a rise in diabetes distress [9,10]. Individuals managing this chronic condition face a significant emotional burden, experiencing a range of negative emotions like worry, fear, and feeling overwhelmed. These challenges stem from the demands of daily diabetes management, making it a condition that significantly impacts both physical and emotional well-being [10].

Paradoxically, while lifestyle changes are crucial for managing HbA1c, they can also contribute to diabetes distress. This complex interplay between self-care demands and emotional well-being necessitates a deeper understanding of diabetes distress. This emotional response, triggered by the demands of daily self-management and the potential for long-term complications, significantly impacts self-care and well-being [12]. Several factors, including diabetes type, treatment methods, social consequences, dietary restrictions, and obesity, can influence the severity of diabetes distress. Mild diabetes distress can be progressed to severe distress or depression if left untreated [13].

Prior research demonstrates a link between diabetes distress and self-care behaviours, as well as HbA1c levels [14]. The prevalence of distress varies across populations, with existing studies suggesting significant associations between high distress for both genders [15]. To effectively assess this emotional burden, the diabetes distress scale-17 (DDS-17) has emerged as a valuable tool. This 17-item scale measures distress across four key domains: emotional distress (ED), physician-related distress (PD), regimen distress (RD), and interpersonal distress (IPD) [16]. Notably, research shows a clear connection between high distress scores on the DDS-17 and poorer glycemic control, as evidenced by higher HbA1c levels and difficulty in maintaining healthy blood sugar levels [17].

Several studies depicted that a concerning proportion of adults with type 2 diabetes (T2D) experience significant ED related to their condition. Studies from India reported a prevalence ranging from 41% to 58%, with some indicating even higher rates (Vidya K, 2021, Patra S, 2021, and Gupta S, 2022, respectively) [18-20]. This highlights the widespread burden of diabetes distress among individuals with T2D, impacting not just their physical health but also their emotional well-being. The prevalence rates of diabetes distress among individuals with

type 2 diabetes between 2021 and 2022 are summarised in the table below, based on various studies.

Table 1: Characteristics of included studies in the meta-analyses to determine the prevalence of diabetes distress in people with T2D (Note: NR represents Not reported)

Study lead	Sample size	Mean age	Male	Female	Distress scale	Prevalence rate (%)
Vidya K, 2021	140	NR	82	58	DDS-17	58.57
Patra S, 2021	200	51.34	127	63	DDS-17	41.50
Gupta S, 2022	133	48.2	105	28	DDS-17	51.13

Diabetes-related distress is influenced by various factors including individual coping strategies, health beliefs, and personal characteristics, which can moderate the effectiveness of interventions aimed at reducing distress [21]. By addressing these underlying factors, we can tailor intervention that addresses the specific needs of each individual. This targeted approach can empower them to break the cycle of distress, improve self-care behaviours, and ultimately achieve better glycemic control, leading to a higher quality of life and overall well-being in managing their type 2 diabetes.

Existing research has made valuable contributions to our understanding of diabetes distress. However, a crucial gap remains in our knowledge: the nuances of distress experienced by individuals at varying levels. Limited data exists on the psychometric assessment of moderate and high distress, hindering the development of targeted interventions that cater to specific needs.

This study aims to address this gap by examining the psychometric characteristics of diabetes distress in individuals diagnosed with type 2 diabetes, focusing on varying levels of distress: low, moderate, and high levels to gain deeper insights into their experiences. Utilizing the well-validated DDS-17, we aim to assess its effectiveness in identifying individuals with these specific distress levels and explore potential differences in their characteristics as compared to those experiencing lower distress.

Enhancing our understanding of moderate and high levels of diabetes distress allows us to develop targeted interventions that cater to the unique needs of this population in managing diabetes. This approach aims to improve self-care behaviours, enhance glycemic control, and ultimately elevate the overall quality of life for individuals with type 2 diabetes through personalized dietary recommendations, lifestyle interventions, and optimised T2D management strategies.

METHODOLOGY
Aims and Objective
This retrospective study aims to conduct a psychometric assessment of individuals with type 2 diabetes experiencing varying levels of distress, specifically focusing on those with moderate and high distress.

Primary objective:
- To evaluate the effectiveness of the DDS-17 in identifying individuals with different levels of diabetes distress in participants with type 2 diabetes.
- To virtually assess the importance of personalized coaching to analyse the reduction in DDS score among participants with type 2 diabetes over 90-days.

Secondary objective:
- To investigate the traits and experiences of individuals experiencing moderate to high levels of diabetes distress.

Study design and site

This retrospective study was conducted virtually on participants with type 2 diabetes who enrolled in the Sugarfit's Diabetes Reversal and Management Program (SDRMP). This program adheres to standardised protocols to ensure consistency in data collection and participant care across several locations in India. The study period spanned from October 2023 to February 2024.

SDRMP focuses on reversing diabetes by significantly improving blood sugar levels and enhancing overall health outcomes. The program adopts a holistic approach to diabetes management, integrating personalized coaching for diet, exercise, and lifestyle adjustments with existing medication regimens. This combined approach strives for sustainable and long-term diabetes management, with the potential to reduce reliance on medication. By emphasising lifestyle changes, the program achieves better blood sugar control, weight management and an overall healthier lifestyle, thereby potentially enhancing the quality of life for individuals living with type 2 diabetes.

Study subjects:

A total of 534 individuals with type 2 diabetes were enrolled in the SDRMP. Of these, 309 were males and 225 were females.

Inclusion criteria:
- Participants must have been enrolled in the study and completed the DDS test at both baseline and after 3 months. Only individuals who recorded moderate or high distress on the DDS were included in the study.

Exclusion criteria:
- Participants who recorded low distress on the DDS were excluded from the study.
- The final analysis comprised participants who experienced moderate or high distress, totaling 240 men and 189 women. These individuals were further categorized based on their specific distress levels.

Psychometric assessment method:

SDRMP employs a rigorous psychometric assessment methodology to evaluate individuals with type 2 diabetes who experience varying levels of distress. The DDS-17, a validated questionnaire, systematically assesses distress levels related to diabetes management across multiple domains: emotional distress, physician-related distress, regimen-related distress, and interpersonal distress. This provides a thorough understanding of participants' psychological challenges.

Distress levels are quantitatively calculated using established formulas based on participants' responses to the DDS-17 questionnaire. These calculations provide quantitative measures of distress severity, enabling healthcare providers within the SDRMP to tailor interventions and support strategies to the unique needs of each individual. The DDS-17 questionnaire was used to assess diabetes-related distress among participants. This scale consists of 17 items, each rated on a 6-point Likert scale ranging from 1 (not a problem) to 6 (a very serious problem).

Calculation of diabetic distress score for each subscales, and total DDS score:
For each subscale, the average score was calculated by summing the responses to the relevant items and dividing by the number of items in that subscale as provided in table 2.

Table 2: Calculation of diabetic distress score for each subscales

Subscale	Items Assessed	DDS-17 Questionnaire Items	Formula for Average Score
ED	1, 4, 7, 10, 14	1. Feeling that diabetes is taking up too much of my mental and physical energy every day. 4. Feeling angry, scared and/or depressed when I think about living with diabetes. 7. Feeling that I will end up with serious long-term complications, no matter what I do. 10. Feeling that diabetes controls my life. 14. Feeling overwhelmed by the demands of living with diabetes.	$\dfrac{\sum (\text{Item scores for } 1, 4, 7, 10, 14)}{5}$
PD	2,5,11,15	2. Feeling that my doctor doesn't know enough about diabetes and diabetes care. 5. Feeling that my doctor doesn't give me clear enough directions on how to manage my diabetes. 11. Feeling that my doctor doesn't take my concerns seriously enough. 15. Feeling that I don't have a doctor who I can see regularly enough about my diabetes.	$\dfrac{\sum (\text{Item Scores for } 2, 5, 11, 15)}{4}$
RD	3, 6, 8, 12, 16	3. Not feeling confident in my day-to-day ability to manage diabetes. 6. Feeling that I am not testing my blood sugars frequently enough.	

Subscale	Items Assessed	DDS-17 Questionnaire Items	Formula for Average Score
		8. Feeling that I am often failing with my diabetes routine. 12. Feeling that I am not sticking closely enough to a good meal plan. 16. Not feeling motivated to keep up my diabetes self management.	$$\dfrac{\sum(\text{Item Scores for } 3, 6, 8, 12, 16)}{5}$$
ID (IPD)	9, 13, 17	9. Feeling that friends or family are not supportive enough of self-care efforts (e.g. planning activities that conflict with my schedule, encouraging me to eat the "wrong" foods). 13. Feeling that friends or family don't appreciate how difficult living with diabetes can be. 17. Feeling that friends or family don't give me the emotional support that I would like.	$$\dfrac{\sum(\text{Item Scores for } 9, 13, 17)}{3}$$
Total DDS Score	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	As stated earlier.	$$\dfrac{\sum(\text{Item Scores for } 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17)}{17}$$

In this retrospective study on diabetic distress among type 2 diabetes participants, researchers utilized the DDS-17 questionnaire to categorise distress levels and guide tiered support within the program. Distress levels were categorised into three groups based on a 6-point Likert scale ranging from: little or no distress (scores below 2), moderate distress (scores between 2 and 2.9), and high distress (3 or above).

Here, a total of 534 participants (309 males and 225 females) were screened for assessment, and there were two inclusion criteria of the study: participants had to be diagnosed with type 2 diabetes, and participants needed to be actively enrolled in the SDRMP. Based on these scores, the individuals experiencing high distress (scores 3 or above) received the most comprehensive support, including both one-on-one psychological consultations and empathetic health coach consultations. Those with moderate distress (scores between 2 and 2.9) were recommended for health coaching within the program. Even participants with little to no distress (scores below 2) received health coaching for ongoing support and guidance.

SDRMP's tailored emotional support, guided by participant surveys categorising emotional burden and distress levels, addresses both physical and psychological aspects of diabetes management, highlighting its commitment to comprehensive care. This approach identifies individuals experiencing high and moderate distress, enabling targeted interventions within the program's comprehensive care framework.

Comprehensive care approach:
This study includes DDS assessment along with interventions such as dietary adjustments, physical fitness programs, and psychological consultations. The holistic approach of the SDRMP ensures that all aspects of diabetes management are addressed, combining psychological, nutritional, and physical strategies to create a comprehensive care plan. By acknowledging and addressing emotional distress, the program creates a more supportive environment, potentially improving overall diabetes management and quality of life.

Psychological consultations:
Participants experiencing high distress were offered a personalized, one-on-one virtual psychological consultation, focused on addressing diabetes-related emotional challenges. In this 60-minute session, tailored support, coping strategies, and guidance were provided based on each individual's DDS-17 scores to help manage the psychological impact of diabetes. Additionally, health coaches were trained by psychologists to enhance their ability to offer comprehensive support.

Nutritional counselling:
Nutritional counselling is another cornerstone of the SDRMP. In this counselling, participants received personalized guidance on dietary choices and meal planning, tailored to their specific nutritional needs and health goals. This approach not only targets effective blood sugar management but also promotes well-balanced dietary habits for long-term health benefits. Each meal plan will specify the particular nutrient distribution, with around 50% carbohydrates, 30% fats, and 20% proteins, to ensure balanced nutrition for people with type 2 diabetes. Additionally, strategies such as grainless meals and intermittent fasting (12 or 14-hour windows) were incorporated. Personalized precise, achievable interventions and goals were set for each participant to enhance adherence and achieve optimal outcomes.

Physical activity plans:
The SDRMP incorporates meticulously designed physical activity plans based on personalized nutrition. These plans are tailored to each participant's fitness level and any existing health conditions, encouraging participants to seamlessly integrate regular exercise into their diabetes management routine. The physical activities include cardio exercises, strength training, resistance training, yoga, yoga nidra sessions, and meditation/mindfulness practices. By combining these tailored exercise routines with nutritional counselling and emotional support strategies, the SDRMP fosters a holistic approach to diabetes care, empowering individuals to achieve lasting wellness goals.

Statistical analysis:
The data were analyzed using specific statistical methods to assess the impact of the SDRMP on distress levels and related health outcomes among participants with type 2 diabetes. Descriptive statistics, including mean and standard deviations, were calculated for baseline and post-intervention (i.e. after 90 days) distress levels, as well as for other health parameters such as HbA1c, FBS, BMI and weight.

Paired-t test (Wilcox signed rank test) was conducted to assess the significant changes in outcomes of health parameters, including HbA1c and weight, from baseline to post-intervention along with examination of changes in sub-domains of the DDS-17 (ED, PD, RD, and IPD) across the intervention period. Then, Mann Whitney U test was conducted to compare the changes in difference in HbA1c and weight among individuals with HD and MD.

Table 3: Statistical Significance of Health Parameters in High and Moderate Distress Groups

Parameters	p-value for High distress	p-value for Moderate distress
HbA1c	$p < 0.001$	$p < 0.001$
Weight	$p < 0.001$	$p < 0.001$

Table 4: Representation of p-Values for Distress Sub-Domains in Moderate and High Distress Groups

Distress subdomains	p-value for HD	p-value for MD
ED	$p < 0.001$	$p < 0.05$
PD	$p < 0.001$	$p < 0.001$
RD	$p < 0.001$	$p < 0.05$
IPD	$p < 0.001$	$p < 0.01$

Improvements in HbA1c Levels and Weight Reduction Across Distress Groups
- **High Distress Group:** Participants in the high distress group exhibited significant improvements in both HbA1c levels and weight reduction. HbA1c levels saw a substantial decrease ($p < 0.001$). This strongly suggests that the intervention was highly effective in reducing blood sugar levels in this group. Additionally, significant weight loss was observed ($p < 0.001$), further reinforcing the efficacy of the intervention in this population.
- **Moderate Distress Group:** Individuals with moderate distress also experienced substantial reductions in both HbA1c levels and weight. The p-values for HbA1c ($p < 0.001$) and weight reduction ($p < 0.001$) were highly significant, underscoring the intervention's effectiveness across different levels of diabetes distress.

Psychological and Physical Well-Being Improvements
- **High Distress Group:** The high distress group showed significant decreases across all measured distress domains. For high distress (HD), the p-values for various parameters indicate significant results, with each showing p-values of less than 0.001. Specifically, the parameters for emotional distress (ED), physical distress (PD), regimen distress (RD), and interpersonal distress (IPD) all fall within this strong level of significance, reflecting a consistent trend of low p-values across all evaluated aspects of high distress.
- **Moderate Distress Group:** For participants in the moderate distress group, the intervention led to significant reductions in overall distress score. ED and RD have p-values of less than 0.05, indicating statistical significance at a 95% confidence level. IPD shows a p-value of less than 0.01, reflecting strong significance at a 99% confidence level. PD exhibits the highest significance with a p-value of less than 0.001, indicating a 99.9% confidence level in its findings. Overall, all categories demonstrate varying degrees of statistical significance, with physical distress being the most notable. These results highlight the intervention's capacity to enhance both the

psychological and physical well-being of individuals with diabetes, regardless of their initial distress levels.

Mann-Whitney U Test Results: HbA1c and Weight

The results of the Mann-Whitney U test indicated that there was no statistically significant difference in overall HbA1c levels among the groups, with a p-value of 1. However, a slight improvement in glycemic control was observed despite the lack of statistical significance. In contrast, there was a noteworthy impact on weight management, as reflected by a significant p-value of less than 0.5.

Table 5: Mann-Whitney U Test Results: Overall Glycemic Control and Weight Changes

Parameters	p-value
HbA1c	$p = 1$
Weight	$p < 0.5$

The findings collectively highlight the SDRMP's efficacy in concurrently addressing both the psychological and physical dimensions of diabetes care, leading to improvements in distress levels, HbA1c, and weight management across participant groups with type 2 diabetes. Furthermore, the potential long-term benefits of weight reduction may enhance glycemic control as participants continue to adopt healthier lifestyles. Overall, the findings suggest that while immediate changes in HbA1c may not be evident, the significant impact on weight provides a foundation for future improvements in glycemic management among participants.

RESULTS

The study's results provide a comprehensive overview of the impact of the SDRMP on participants' diabetes distress levels and various clinical parameters over a 90-day period. These findings highlight the program's effectiveness in reducing both psychological and physiological burdens associated with type 2 diabetes.

Participant demographics

The demographic characteristics of the study participants are summarised in the table 6 depicted below.

Table 6: Demographic characteristics of the study participants

Demographic variable	HD group	MD group	LD group	Aggregate
Number of Participants	211	218	105	534
Gender (M/F)	113/98	127/91	69/36	309/225
Age (Years)	49.6±12.2	52.78±10.47	52.87±11.7	51.52±11.5

Distress score assessment

All participants underwent a 90-day assessment of their diabetes distress levels. The results are summarised as follows:

- **High distress group**: The baseline DDS score (DDS-Q_0) for this group was 3.4±0.7. After 90 days (DDS-Q_1), the score significantly reduced to 2.7±1.1, indicating a 21% decrease in overall distress. Notable reductions were observed in physician distress (PD), emotional distress (ED), regimen distress (RD), and interpersonal distress (IPD) scores.

Table 7: Distress score assessment among high distress group

Time Point	PD score	ED score	RD score	IPD score	DDS score
DDS-Q0	3.4±0.7	3.8±1	3.7±1	2.7±1.3	3.4±0.7
DDS-Q1	2±1.2	3±1.3	2.9±1.3	2.2±1.4	2.7±1.1

- **Moderate distress group**: The baseline DDS score for this group was 2±0.28. After 90 days, the score reduced to 1.9±0.69, marking a 4.02% decrease. Improvements were also seen in PD score, ED score, RD score, and IPD score, though the changes were less pronounced compared to the high distress group.

Table 8: Distress score assessment among moderate distress group

Time Point	PD score	ED score	RD score	IPD score	DDS score
DDS-Q0	2±0.28	2.2±0.68	2.3±0.64	1.4±0.56	2±0.28
DDS-Q1	1.5±0.82	2.1±0.89	2.1±0.97	1.5±0.91	1.9±0.69

Clinical parameters assessment

The clinical parameters observed in this study provide insight into the health status and progress of participants across different distress levels.

- **High risk group:** Clinical parameters also showed significant improvement. In the high distress group, HbA1c levels decreased from 8.7±1.8% to 7.4±1.3%, a 14.36% reduction. Fasting blood sugar (FBS) levels dropped from 155.5±55.8 mg/dL to 130±45.1 mg/dL, a 16.41% reduction. Body mass index (BMI) fell from 27.4±4.3 kg/m² to 26.8±4.2 kg/m², a 2.17% decrease, and weight reduced from 74.8±12.7 kg to 73.4±12.1 kg, a 2.42% reduction.

Table 9: Clinical parameters assessment among high distress group

Parameter	Q0 (Baseline)	Q1 (After 90 days)	Percentage Change (%)
HbA1c	8.7±1.8%	7.4±1.3%	14.36%
FBS	155.5±55.8 mg/dL	130±45.1 mg/dL	16.41%
BMI	27.4±4.3 kg/m²	26.8±4.2 kg/m²	2.17%
Weight	74.8±12.7 kgs	73.4±12.1 kgs	2.42%

- **Moderate risk group:** Similarly, the moderate distress group showed favourable outcomes. HbA1c levels fell from 8.5±1.75% to 7.11±1.08%, a 16.36% reduction. FBS levels decreased from 153.85±54.24 mg/dL to 117.75±28.23 mg/dL, a 23.46% reduction. BMI declined from 27.17±4.15 kg/m² to 26.16±3.94 kg/m², a 3.71% decrease, and weight dropped from 75.1±14.05 kg to 72.28±13.19 kg, a 2.77% reduction.

Table 10: Clinical parameters assessment among moderate distress group

Parameter	Q0 (Baseline)	Q1 (After 90 days)	Percentage Change (%)
HbA1c	8.5±1.75%	7.11±1.08%	16.36%
FBS	153.85±54.24 mg/dL	117.75±28.23 mg/dL	23.46%
BMI	27.17±4.15 kg/m²	26.16±3.94 kg/m²	3.71%
Weight	75.1±14.05 kgs	73.02±13.19 kgs	2.77%

These results highlight the effectiveness of the SDRMP in significantly reducing distress levels and improving key health parameters, particularly for those with higher initial distress. The most substantial improvements were seen in the high distress group, demonstrating the program's effectiveness in addressing both psychological and physical aspects of diabetes management. These results underscore the value of a comprehensive, personalized approach to diabetes care, combining dietary guidance, physical activity plans, and emotional support to achieve significant health benefits.

DISCUSSION

A substantial number of individuals with type 2 diabetes encounter diabetes distress, which poses a significant health challenge that adversely affects their overall well-being [22]. Following their diagnosis, patients are confronted with the necessity of implementing demanding lifestyle modifications to effectively manage their condition and avert complications. This rigorous regimen, which encompasses medication adherence, dietary changes, exercise, and blood glucose monitoring, can impose a considerable emotional strain, potentially impeding their commitment to necessary self-care practices [23].

There is a well-established correlation between elevated diabetes distress and deteriorating health outcomes. Research indicates that higher levels of distress are connected to various adverse factors, such as poor glycemic control, inadequate self-care behaviours, diminished self-efficacy in diabetes management, and a lower quality of life, independent of clinical depression [24]. This underscores the critical need to incorporate a validated tool for assessing diabetes distress within routine diabetes care. Identifying patients who are experiencing high distress levels provides clinicians with meaningful insights into possible obstacles to successful diabetes management [25].

The psychological distress associated with diabetes in India continues to be notably under-recognized in diabetes care. Our study's findings resonate with earlier research conducted in comparable contexts, emphasising the ongoing manifestation of diabetes distress as a pivotal aspect of managing type 2 diabetes in India (Gupta et al., 2016; Patra et al., 2021). These findings emphasise the urgent need to integrate routine screening and effective management strategies for diabetes distress into the Indian healthcare framework, aiming to enhance overall diabetes outcomes.

This study aimed to assess the level of diabetes-related distress among participants with T2DM enrolled in the SDRMP. This comprehensive program addresses both the physical and psychological aspects of diabetes management, tailoring interventions based on individual needs identified through distress assessment using the DDS-17 scale. This study contributes to the field by demonstrating the effectiveness of the DDS-17 in assessing diabetes distress among individuals with T2DM enrolled in the SDRMP.

Among participants reporting no distress, scores within various distress domains were remarkably low, indicating a different experience in managing their diabetes. The physician distress (PD) score registered at 1.2 at baseline, with a slight decrease to 1.1, illustrating a difference of only 0.1. Emotional distress (ED) exhibited a marginal increase from 1.3 to 1.4, reflecting stability rather than significant deterioration. Regimen distress (RD) remained constant at 1.4, likely due to the consistent support provided by health coaches. However, a distinct pattern emerged in interpersonal distress (IPD), which rose from 1.0 to 1.42, revealing a potential challenge in interpersonal relationships, even among those who typically report low distress levels.

Our investigation included individuals experiencing various levels of distress, highlighting differences in emotional and physical health outcomes. Notably, the high distress group showcased substantial improvements across all evaluated distress dimensions as clearly provided in **Figure 1**. Changes in scores for this group were significant: PD altered by 1.3 ± 1.3, ED decreased by 0.8 ± 1.3, RD reduced by 0.8 ± 1.4, and IPD diminished by 0.5 ± 1.6. This yielded an overall variation in the diabetes distress scale (DDS) score of 0.7 ± 1.0, underscoring the intervention's effectiveness for those facing higher levels of distress.
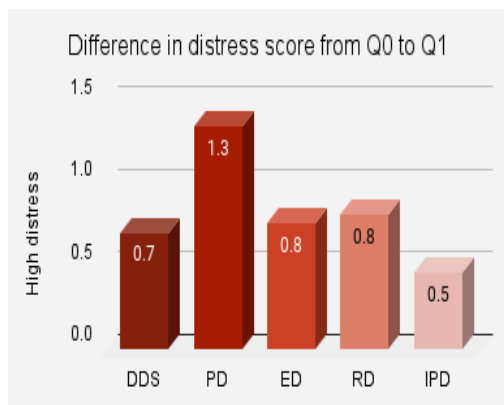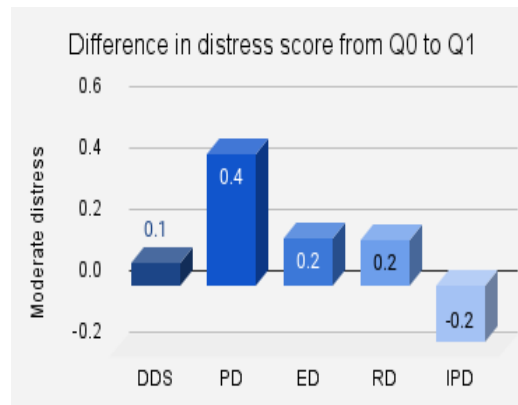

Figure: 1

Figure: 2

Conversely, the moderate distress group exhibited less pronounced improvements as clearly depicted in **Figure 2**. The scores for this group indicated lower changes: PD shifted by 0.4 ± 0.81, ED by 0.2 ± 0.95, RD by 0.2 ± 1.02, and IPD by 0.2 ± 0.92, culminating in an overall DDS score variation of just 0.1 ± 0.67. This suggests a more subdued response to the intervention when contrasted with the high distress group.

When we juxtapose these findings with individuals experiencing no distress, it becomes evident that the intervention's impact is not uniform across all distress levels. For example, participants without distress likely experience more stable health indicators and report a higher quality of life, as they do not face the psychological burdens that can complicate diabetes management. Thus, the marked difference in score variations among the groups accentuates the importance of addressing diabetes distress in order to enhance overall health outcomes. This underscores the need for tailored interventions that account for the emotional states of individuals living with diabetes, as improved management strategies can lead to substantial improvements in both the physical health and psychological resilience.

Furthermore, there is a marked need to extend the duration of the intervention period beyond the initial three months to achieve more comprehensive outcomes, particularly for participants experiencing IPD. As observed in the SDRMP, IPD underscores the emotional challenges participants encounter within their familial and social contexts while navigating diabetes management practices. Participants in the SDRMP are expected to adhere to a structured regimen that encompasses dietary adjustments, physical activity, and mindfulness exercises. This structured lifestyle can create complex dynamics within family systems, as changes may not only affect the individual managing diabetes but also those around them.

Making significant dietary changes, such as reducing the frequency of eating out and increasing vegetable consumption, can impose a considerable burden on both individuals living with diabetes and their family members. Family members might struggle to adapt to these new eating habits and lifestyle modifications, leading to frustrations and potential

tensions within the household. Reports from family members regarding their loved ones' weight loss and dietary changes suggest that while such changes can yield positive health outcomes for participants, they also require active engagement and cooperation from the entire family unit to be successful.

This interconnectedness emphasises the importance of cultivating a supportive environment, as the emotional well-being and compliance of participants are closely tied to their relationships with family members. If family dynamics fail to adapt positively to the necessary dietary and lifestyle changes followed by the SDRMP, it can exacerbate the interpersonal distress experienced by individuals within the program. Therefore, addressing interpersonal distress in the context of family support and adaptation becomes crucial. Enhancing the overall effectiveness of the program and promoting the well-being of participants necessitates active involvement and understanding from family members, ensuring that the journey towards better diabetes management is a collective effort.

Lastly, our investigation revealed that participation in the SDRMP, which incorporates assessments using the DDS-17, resulted in notable enhancements in glycemic control, as reflected by reductions in HbA1c and FBS levels alongside weight loss. By appraising the psychometric properties of the DDS-17 within this demographic, our study fortifies the rationale for utilizing the DDS-17 to gauge diabetes distress in individuals with T2DM. This individualised approach, informed by the distress levels identified through the DDS-17, holds promising potential to significantly bolster diabetes management and improve overall well-being for patients with T2DM.

Future research can further strengthen the generalizability of these findings by validating the DDS-17 in a more diverse population. Additionally, exploring the specific burden of distress experienced by participants can provide valuable insights for developing even more effective mitigation strategies. By delving deeper into the nuances of diabetes distress, we can pave the way for improved support systems and ultimately enhance the quality of life for individuals living with T2DM.

CONCLUSION

In conclusion, this study offers significant insights into the prevalence of diabetes-related distress among patients with T2DM. It highlights the importance of a comprehensive approach to diabetes management that takes into account not only the physical aspects of the disease but also the psychological impact it has on patients. The findings indicate a notable 21% reduction in DD scores among individuals experiencing high distress, as opposed to a 4.02% reduction in those with moderate distress. This emphasises the varied severity of distress and the need for tailored interventions.

Specifically, scores for PD, ED, RD, and IPD showed substantial reductions in the high distress group, with decreases of 39.8%, 20.10%, 21.74%, and 17.40%, respectively. In contrast, the moderate distress group experienced more modest reductions of 22.04%, 6.97%, 6.63%, and 13.33% in PD, ED, RD, and IPD scores, respectively. These results suggest that personalized interventions could be effective in alleviating diabetes-related distress and improving overall diabetes management.

The study acknowledges its limitations, including the reliance on a retrospective design and self-reported data through the DDS-17 questionnaire. Additionally, validation of the DDS-17 was limited to a specific timeframe within the study population. Future longitudinal cohort

studies are recommended to further explore the complexity of diabetes distress over time and to optimise individualised interventions. Overall, the findings reinforce the necessity of assessing and addressing diabetes-related distress in order to develop effective diabetes care strategies that cater to the emotional and psychological needs of patients.

Limitations

The main constraint of this study lies in the validation of DDS17, which was conducted solely among study participants within a restricted time frame. Thus, the replication and progression of our findings might be facilitated by acquiring data from longitudinal cohort studies conducted independently of intervention trials.

- Retrospective design limits the ability to establish cause-and-effect relationships.
- The study relies on self-reported data, which can introduce bias and affect the accuracy of the results.

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Conflict of Interest

The author(s) declared no conflict of interest.