



The Acceptance and Commitment Therapy (ACT) Reduce Stress in Patients With Type 2 Diabetes Mellitus

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Abstract

Background/Aim: Diabetes mellitus patients may be more vulnerable to stress due to the requirement for lifestyle changes and blood sugar management. Stress occurs when people sense a mismatch between their available resources and the expectations put on them, especially when the expectations are believed to be excessive in comparison to the preceding circumstance. The purpose of this study was to look at the effectiveness of the acceptance and commitment therapy (ACT) as a stress-reduction intervention in patients with type 2 diabetes mellitus (T2DM) by enhancing their psychological well-being.

Methods: A total of 40 people were allocated to either the intervention or control groups at random. The intervention group got counselling on the pillars of diabetes control, followed by a stress level pre-test. Following that, the ACT intervention was carried out. After completing the post-test, the control group got the same intervention. The ACT module and a questionnaire to evaluate stress levels in T2DM patients were used in this study.

Results: Following the ACT session, the measuring findings for stress levels in the intervention group showed a reduction. Both the intervention and control groups saw stress reduction; however, the intervention group had a greater reduction.

Conclusions: The ACT intervention reduced stress levels in the intervention group. ACT appeared as the variable having the largest effect on lowering stress levels after taking into account variables such as duration of suffering, education, sex and age-related to T2DM.

Key words: Stress levels; Type 2 diabetes mellitus; Acceptance and commitment therapy.

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Introduction

Diabetes mellitus (DM) with severe consequences is one of the national issues that need greater attention.¹⁻³ According to Basic Health Research statistics in Indonesia, there are 10 million diabetics and 17.9 million persons at risk of developing the condition. Meanwhile, East Java Province ranks eighth in Indonesia in terms of diabetes prevalence, with a prevalence of 6.8 %. This result is one notch higher than DKI Jakarta, which

is ranked tenth with a prevalence of 6.6 %. Meanwhile, North Maluku ranks first with a frequency of 11.1 %. While Surabaya has a greater incidence, it is ranked sixth.⁴

DM is a chronic condition with a long treatment period and high treatment expenses and the prevalence of DM is growing.⁵⁻⁷ DM patients may be more vulnerable to stress since they must

change their lives or maintain their blood sugar levels under control. One of the factors that causes stress in persons with type 2 DM (T2DM) is having unrealistic expectations. When expectations are judged to be excessive and distinct from the prior circumstance, stress occurs.^{8,9}

DM can be caused by a variety of variables, including heredity/genetic factors, obesity, lifestyle changes, poor food, medicines that impact blood sugar levels, a lack of physical exercise, the aging process, pregnancy, smoking and stress.¹⁰⁻¹⁶ DM and stress have a very strong link, especially among city dwellers.¹⁶⁻¹⁹ Stress and an unhealthy lifestyle, along with more rapid technology improvements and numerous ailments being endured, cause a reduction in a person's condition, triggering stress. DM patients who are stressed may have difficulty managing their blood sugar levels. Stress increases the excretion of catecholamines, glucagon, glucocorticoids, endorphins and growth hormones.^{9,20,21}

Patients who were diagnosed with DM began to feel the emotional consequences of the circumstance and the disease remained for several months. Patients begin developing psychological problems including stress from the medical care they are receiving.^{19,22-25} Stress is the body's non-specific reaction to any disrupted bodily demands. Emotional stress can cause unpleasant or harmful sentiments toward oneself and others.^{26,27} Intellectual stress will impair one's perception and capacity to solve issues, while social stress will impair one's interpersonal interactions.²⁸⁻³¹

The acceptance and commitment therapy (ACT) is a cognitive treatment that focuses on understanding self-emotions and actual behavioural interactions. Acceptance and care for individual values and behavioural principles are combined in ACT.³²⁻³⁵ Acceptance focuses on the feelings, ideas and mental states experienced without avoiding or altering the circumstance. Behavioural concepts are utilised to attain goals by focusing on individual values.³⁶

When compared to other therapies, ACT employs acceptance to increase psychological flexibility, behaviour change, acceptance and attentiveness. Anxiety, substance abuse, work stress, chronic pain and smoking among patients all decreased after the ACT intervention was provided. ACT differs from other cognitive behaviour treatments in that it focuses on the clarity of individual life

objectives as well as the acceptance of value-emphasising beliefs.³⁷⁻⁴³

This study intended to fill a gap in prior research by investigating the use of the ACT in lowering stress in T2DM patients. Despite the fact that various prior studies have been conducted to assess the efficiency of ACT in diabetes control,⁴⁴⁻⁴⁹ there have been no studies particularly investigating the use of ACT to alleviate stress in T2DM patients. Furthermore, the study varied from past research in that it compares the effectiveness of ACT with other mindfulness techniques.⁴⁹ Aim of this study was to give a better knowledge of the effectiveness of ACT in lowering stress in T2DM patients and lead to the development of more effective therapies to reduce diabetic patients' stress levels.

Methods

This research was conducted in June-July 2019 at the Islamic Hospital A Yani Surabaya, Indonesia. Before the start of the experiment, both the control and intervention groups were given an initial stress level questionnaire to determine their baseline stress levels. Participants in both groups were also given complete diabetes management information.

The intervention group participated in the ACT intervention program that consisted of four weekly sessions carried out over four weeks. Each class, which lasted around 30 to 45 minutes, was devoted to a certain topic. At the end of each session, participants were asked to reflect on their development and discoveries, which they wrote in a researcher-designed logbook. In the fourth week, a post-test was administered in conjunction with the control group, utilising a predefined questionnaire to assess stress levels. A simple random sampling procedure was used to determine the proper sample size, which might include up to 40 respondents. Furthermore, DM individuals with regular blood sugar level management and no substantial health issues were chosen using sequential sampling. Both the control and intervention groups had a maximum of 20 participants.

The inclusion criteria included a set of key criteria that persons participating in both the control

and intervention groups must meet. Before the intervention, participants were asked to complete a stress level questionnaire to develop a basic understanding of their stress levels, which served as a baseline. Furthermore, before the intervention period, all people in both groups were exposed to complete diabetes management information. Participants assigned to the intervention group were required to actively participate in the ACT intervention. Attending four weekly sessions over four weeks was required for this intervention. Following that, participants in the intervention group were invited to participate in introspection, writing their own experiences and developmental insights in a notebook thoughtfully provided by the researchers after each session. As the fourth week approached, all individuals performed a post-test evaluation utilising a rigorously constructed questionnaire, which was administered concurrently with the control group, to determine stress levels.

The exclusion criteria included restrictions that guide the identification and exclusion of persons judged unfit for participation in the study. Individuals who did not reply to the first stress level questionnaire were mostly excluded from the analysis. Individuals who did not get comprehensive diabetes management information did not fulfil the study's inclusion criteria. Participants who refused or showed reluctance to participate in the ACT intervention were removed from the intervention group. As a result, people in the intervention group who were unwilling or unable to submit their thoughts within the offered logbook may have resulted in inadequate data collection. Individuals who did not complete the post-intervention evaluation in the fourth week were also excluded from the final analysis. Finally, DM individuals with significant health issues or irregular blood sugar level management were not eligible to participate in the study.

Instruments

The stress level questionnaire utilised in this study was adapted from the Post Traumatic Stress Disorder (PTSD) Checklist Civilian Version (PCL-C), a well-established instrument that has undergone rigorous validation and has been extensively employed in previous research endeavours.⁵¹ The PCL-C serves as a comprehensive tool designed to assess stress levels and their ramifications on individuals.

This questionnaire comprises a series of inquiries intentionally crafted to discern the magnitude of stress experienced by participants. The exact number of items in this questionnaire was conformed to the structure and content of the original PCL-C, which underpins the questionnaire development for this study. Typically, the PCL-C consists of approximately 17 to 20 items, contingent upon the version and modifications adopted for the specific investigation. Each individual question item within the questionnaire pertained to symptoms or sentiments associated with stress levels.

The evaluation methodology of this questionnaire entailed participants responding to each question item based on their personal experiences and emotions. Each item presented response options that elucidate the extent to which participants have encountered the symptoms or emotions encapsulated within the posed questions. Generally, a Likert scale was employed as the response metric, encompassing a range of values such as "Not at all" to "Very strongly." Participants were prompted to select the response that most accurately aligns with their personal experiences and feelings. The cumulative values of the responses attributed to each question item were aggregated to compute a composite score. This cumulative score reflected the perceived stress level of participants. Higher scores denoted heightened levels of stress. Typically, the PCL-C employs predefined cut-off points that facilitate the categorisation of stress levels, such as "No stress," "Mild stress," "Moderate stress," and so forth.

The entire procedure was conducted to ascertain the baseline stress levels of subjects prior to the implementation of the intervention and to juxtapose alterations in stress levels subsequent to the intervention's execution. The data gleaned from this questionnaire were instrumental in discerning the impact of the intervention on stress levels, furnishing a foundational framework for subsequent analytical processes within the purview of this study.

The weekly therapy sessions in this study encompassed a diverse range of topics meticulously curated to address various dimensions of stress management and emotional well-being. These sessions served as comprehensive platforms for engaging participants in constructive discussions and experiential exercises. During the inaugural session, participants delved into an exploration

of the fundamental concept of stress, gaining a comprehensive understanding of stressors, physiological responses and the intricate interplay between stress and emotional and physical health. The subsequent session focused on cultivating mindfulness and acceptance techniques, offering participants practical tools to enhance their present-moment awareness and reduce the impact of persistent rumination. Guiding participants towards a deeper level of self-awareness, the third session centred on values and commitment, encouraging participants to unearth their core values and correlate them with their life aspirations. This linkage between values and psychological well-being underscored the importance of alignment between one's actions and intrinsic values, ultimately nurturing emotional resilience during times of stress. The concluding session centred on fostering positivity and future-oriented thinking. Participants embarked on a journey of recognising the potency of positive self-affirmations in bolstering self-esteem and subsequently, in managing stress. Moreover, the session imparted techniques for formulating realistic goals and strategies to pave a proactive path for the future. Throughout this four-week intervention, each meticulously orchestrated session combined experiential exercises, guided discussions and reflective practices to equip participants with invaluable skills and insights. The holistic impact of these sequential sessions contributed to the overarching research objective, which was to assess the efficacy of the ACT intervention in alleviating stress levels among participants, thereby enriching their overall emotional well-being.

Data analysis

Multiple linear regression with a significance threshold of $p < 0.05$, as well as the statistical tests paired t-test and independent t-test, were employed to analyse the data.

Ethical consideration

The Islamic Hospital A Yani Surabaya's Ethical Review Board approved this study with permission No 017. EC.KEP.RSIAY.06.19. Prior to data collection, all participants provided informed consent, assuring their voluntary participation and the protection of their rights. Throughout the study, anonymity and secrecy were scrupulously observed. Personal information and identities of participants were kept with the utmost care and data were gathered and analysed in an aggregated and de-identified way. To guarantee fair-

ness and eliminate prejudice, individuals were randomly assigned to intervention and control groups. It is worth emphasising that following the trial, there are plans to deliver the intervention program to the control group, providing fair benefits for all participants. These ethical issues were prioritised and presented in accordance with best standards, assuring the ethical integrity and protection of the participants throughout the study process.

Results

The research had 20 participants in the control group and 20 participants in the intervention group. Most respondents were in the 41-55 year range, female and with a high school education level. Finally, respondents with DM for less than 6 years made up the biggest group. There were no difference in the characteristics of respondents, such as age, gender, education and length of DM suffering, between the control and intervention groups (Table 1).

Table 1: Demographic characteristics of the respondents

Characteristics	Control group (n = 20)		Intervention group (n = 20)		p-value
	N	%	N	%	
Age (years)					
25-40	4	20	4	20	0.715**
41-55	13	65	12	60	
> 56	3	15	4	20	
Gender					
Male	6	30	4	20	0.520*
Female	14	70	16	80	
Last education					
No school	2	10	1	5	1.000**
Elementary school	4	20	3	15	
Secondary school	3	15	5	25	
High school	10	50	9	45	
Diploma/S1/S2	1	5	2	10	
Duration of DM					
< 6 years	14	70	13	65	0.117*
> 6 years	6	30	7	35	

* $p < 0.05$ based on the Pearson Chi-square test; ** $p < 0.05$ based on the Chi-square Fisher's exact test; DM: diabetes mellitus;

Before the intervention, stress levels in the control group were 25.93 ± 3.88 , but after the intervention, they climbed to 26.93 ± 3.24 ($p < 0.001$) (Table 2). Meanwhile, baseline stress levels in the intervention group were $25.93 \pm$

3.43, but after the intervention, they climbed to 30.73 ± 2.83 ($p < 0.001$). Prior to doing regression analysis, relevant assumptions such as normality, homoscedasticity and independence were investigated. All these assumptions have been satisfied, which validates the results.

Table 2: Changes in the respondent of stress level before and after being given the acceptance and commitment therapy (ACT)

Respondents	Stress level (mean ± SD)		95 % CI	T	p-value
	Before	After			
Control group	25.93 ± 3.88	25.93 ± 3.88	-1.37; -0.63	5.58	< 0.001
Intervention group	25.93 ± 3.43	25.93 ± 3.43	-5.54; -4.07	13.33	< 0.001

* $p < 0.05$ based on paired t-test; CI: Confidence interval;

Table 3: The value of the difference in respondents' stress levels before and after being given the acceptance and commitment therapy (ACT)

Stress level	Control group	Intervention group	Mean difference	95% CI	p-value
Value difference	1.00 ± 0.98	4.80 ± 1.97	3.8	-4.61; -3.0	< 0.001*

* $p < 0.05$ based on independent t-test; CI: confidence interval;

Table 3 shows the differences in stress levels before and after ACT delivery for both the control and intervention groups. The stress level in the control group was 1.00 ± 0.98 before the ACT intervention, however it jumped to 4.80 ± 1.97 after the session ($p < 0.001$). The mean difference between pre- and post-intervention stress levels was 3.80 ($p < 0.001$). Similarly, before the ACT session, the stress level in the intervention group was 1.00 ± 0.98 , and after the intervention, it climbed to 4.80 ± 1.97 . The mean difference in stress levels between pre- and post-intervention evaluations was 3.80 as well ($p < 0.001$).

Table 4: Results of bivariate analysis of risk factors related to the stress level

Risk factors	p-value*
Age of respondent	0.666
Gender	0.497
Education	0.027
Duration of DM	0.802
ACT intervention	0.000

* $p < 0.25$; DM: diabetes mellitus, ACT: acceptance and commitment therapy;

According to bivariate data analysis results, ACT ($p < 0.001$) and education ($p = 0.027$), had a significant influence on the stress level (Table 4). This variable were subjected to multiple linear regression analysis (Table 5).

Table 5: Results of linear regression analysis of the acceptance and commitment therapy (ACT) intervention on stress levels

Risk factor	B	β	p-value*
Constant	25.82		< 0.001
ACT intervention	3.69	0.52	< 0.001
Education	0.79	0.25	0.021

* $p < 0.05$ based on linear regression;

The constant value for stress levels reflecting a change in stress without any input from other factors is 25.82, as shown in Table 5. The findings of the linear regression analysis revealed that the ACT intervention had the greatest effect on the reduction in stress levels. The stress level is assessed to be 25.82 using the linear regression approach. Stress decreases by 3.69 for every gradual frequency of ACT session. Every extra degree of education reduces stress by 0.79.

Discussion

The homogeneity test performed in this study revealed no significant differences between respondents in the intervention and control groups. DM was found to be prevalent in those aged 41 to 55. Age is one element that increases

stress levels in relation to DM features. The results of this study are in accordance with previous studies which stated that the productive age of 30-50 years is old adulthood, when a person prefers to work more, increasing the potential of stress, however at the age of > 50 years, one merely adjusts to what has been achieved in old age.⁵²⁻⁵⁶

This condition can affect both male and female diabetes individuals who are stressed. Gender is a risk factor for stress; women are more prone to stress than males in terms of blood sugar regulation. Women are more easily agitated when it comes to adhering to a DM intervention program. Overall, women tend to be more affected by psychological stress than males. Furthermore, women in older age have a higher risk of cardiovascular disease, myocardial infarction and stroke death than males.⁵⁷⁻⁶⁰

The outcomes of research at the highest levels of education indicated that high school had the most data in the intervention group. Some studies that support this research mention that the more information a person gains, the more competent they are to manage with stress than individuals with a lower degree of education. A lack of understanding in dealing with challenges at work might lead to stress.⁶¹⁻⁶⁹

According to the findings, the majority of respondents had DM for at least 6 years. Those with DM who have had the condition for a longer period of time have less stress as they become accustomed to the treatment regimen.^{8, 70-72}

Age, current education and duration of DM can all impact stress levels. However, how everyone controls the stress that arises in his body can also alter stress levels. Stress management is the ability to use (human) resources effectively to overcome mental and emotional disorders or disorders caused by responses, such as identifying habits or things that cause stress, changing habits that can cause stress/coping with unhealthy stress, socialising with others, making time to relax and living a healthy lifestyle.^{9, 57, 73, 74}

The findings of evaluating variable stress levels in T2DM patients in the intervention group revealed that stress levels decreased following the ACT intervention. Prior to receiving ACT, respondents reported feeling stressed. The majority of responders were between the ages of 41 and 55. Indeed, in some studies it has been mentioned that

in terms of stress levels, the elderly prefer to heed the advice of health practitioners and are more responsible, orderly and thorough in controlling their DM2 condition. However, there are other reasons why the elderly are unable to handle stress when coping with diabetes, including restricted access and availability of psychiatric therapies, patients' limited time, money and mobility and fear of stigmatisation. The failure of health personnel to recognise and treat DM is thus a barrier to stress management.⁷⁵⁻⁷⁹

Female T2DM patients are better able to manage their diabetes following therapy because males engage in greater physical activity outside the home than women and consume more calories due to erroneous food composition.⁸⁰⁻⁸² This contradicts study by Anne et al, which demonstrates that males are more engaged in enforcing certain regulations than women. Furthermore, males often consume everything given by their family, unless their family has prepared an appropriate dinner for them.⁸³

According to previous study, DM patients who have received information on the disease would have a reasonable degree of awareness would adhere to treatment and prevention more successfully.^{8, 84-86} Although T2DM patients had a high degree of awareness of infection transmission, there is potential for improvement. It is usually assumed that communities that are more informed about this disease would adhere to preventative and treatment measures more efficiently.⁸⁷⁻⁹⁰

The severity of diabetes is a further variable that impacts stress levels in the management of T2DM. According to Hilliard et al research, the longer a person suffers from diabetes, the lower the degree of stress experienced since they are acclimated to the treatment procedure, however for someone who has just been diagnosed with diabetes, the stress level is considerably greater.⁹¹

Stress can be avoided in T2DM patients by following the DM management pillars of meal planning or diet control, physical activity, hyperglycaemic therapy and health education. However, the most crucial aspect of diabetes control is meal planning or diet management.^{81, 92-96} Patient education is a key pillar in DM management for optimising interventional treatment. If education is delivered successfully, it can increase patient adherence and illness self-management, allowing patients to avoid stress.⁹⁷

ACT is a cognitive behavioural therapy that examines a person's clinical behaviour and experiences. The aim of ACT therapies are to improve well-being and reduce individual suffering. Unpleasant experiences is altered in accordance with the ACT philosophical thought. These experiences include increasing impairment as well as felt tension, stress and chronic discomfort. Acceptance and awareness of both good and unpleasant events, as well as supportive ideals are all part of the ACT intervention.^{42, 98}

The ACT intervention has a considerable impact on the applicability of activities given by health staff to patients with T2DM in disease management.⁹⁹⁻¹⁰⁴ ACT is a variant of cognitive behavioural therapy (CBT) that focuses on improving persons with T2DM's perspectives on illness acceptance and psychological well-being.¹⁰⁵⁻¹⁰⁹ The purpose of the ACT intervention, which also involves families in its execution, is stress management in patients with T2DM. Making contracts with the patient's family to manage the stress of T2DM patients and to be more positive is the first stage in the ACT intervention.^{8, 57, 110-112}

ACT intervention, according to the results of multivariate linear regression analysis, was a process-oriented treatment used to enhance psychological components in the individual's efforts to regulate himself and prevent undesired thoughts and sensations as a barrier to valued and successful action.¹¹²⁻¹¹⁴ ACT was the variable with the greatest impact on stress reduction. T2DM patients' stress is caused by unstable blood sugar levels as a result of irregular control and limits in exams with health services.¹¹⁵⁻¹¹⁷

The Meleis transition theory method can promote adaptive coping and client responsiveness by enhancing the psychology and management of T2DM patients in coping with changes in their health.¹¹⁸ ACT interventions are used to help people reach their health goals. The health counselling technique is carried out continually by the challenges encountered by patients for diabetics to become self-sufficient. The advantage of this strategy is that T2DM patients can actively engage in the decision-making process by following the prescribed treatment guidelines with or without the assistance of a health practitioner.¹¹⁹⁻¹²⁷

The ACT method emphasises assisting people with T2DM to speak about what bothers them

the most about their condition, what they want to change the most, the support they can gain for change and the hurdles or challenges that must be reduced to encourage healthy habits.^{85, 128, 129} The primary purpose of the health coach is not to teach or offer counsel to patients, but rather to focus on specific concerns and challenges that are unique to each T2DM patient based on the context of the patient's life.¹³⁰⁻¹³²

Education level is another element that impacts the stress faced by DM patients when treating their DM2 condition. The majority of patients have a high school diploma. The amount of formal education forms the foundation for patients to accomplish anything, to comprehend and comprehend something more, or to accept and reject something.¹³³ A well-educated individual is more mature in the process of self-change, making it simpler to absorb external influences that are positive, objective and open to learning about many health topic.^{29, 67, 134, 135}

The development of constructive coping skills in the face of stresses is intended to give T2DM patients with a better knowledge.^{61, 93, 136} Patients with T2DM who have undergone ACT therapies have a positive attitude and participate in necessary activities to reduce stress levels.^{45, 47, 57, 137}

Through the deployment of successful DM management pillars to achieve stable blood sugar levels so that patients may minimize stress, ACT intervention can improve the positive view on DM management. The ACT intervention begins with an assessment of the patient's condition and then defines goals that address the problem of physical changes in the form of unstable blood sugar levels. T2DM patients' have psychological alterations due to stress caused by their DM condition. The following stage is to examine the problem, decide on potential possibilities and effect change by recognising and determining the commitment to action. This level is attained when T2DM patients comprehend the benefits of stress management in T2DM therapy.⁸

ACT treatments are psychological interventions that involve behaviour modification, acceptance and attention and acceptance to increase psychological flexibility and are more successful than other therapies. Anxiety, substance usage, stopping smoking, work stress and chronic pain all improved following the ACT session. ACT differs from other cognitive behavioural

treatments in that it focuses entirely on the frequency of cognition and individual content.^{38, 40, 108, 113, 138, 139}

The advantage of ACT therapies is that T2DM patients may participate more actively in what has been generated by following the specified intervention guidelines, with or without the assistance of health experts.^{44, 119, 140-146}

Conclusion

The study's findings show that stress levels in the intervention group dropped when ACT was implemented. Furthermore, when evaluating characteristics related to DM such as length of suffering, education, gender and age, the ACT intervention appeared as the element having the highest impact in lowering stress levels. Based on these findings, it is critical for healthcare practitioners to emphasise the importance of T2DM patients evaluating their capacity to engage in health-promoting behaviours, such as stress management, as a method of effectively managing their medical condition. Incorporating ACT as a regular component in the therapy of T2DM patients can aid in the immediate and continual resolution of patient concerns. By applying these guidelines, healthcare practitioners can better help T2DM patients on their path to better health. Furthermore, policymakers and healthcare system stakeholders should explore incorporating ACT therapies into routine care for T2DM patients in order to improve patient outcomes and overall diabetic management.

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Conflict of interest

None.

References

1. Azam M, Sakinah LF, Kartasurya MI, Fibriana AI, Minuljo TT, Aljunid SM. Prevalence and determinants of obesity among individuals with diabetes in Indonesia. *F1000Res* 2023. DOI: 10.12688/f1000research.125549.2.
2. Pratiwi C, Mokoagow MI, Made Kshanti IA, Soewondo P. The risk factors of inpatient hypoglycemia: A systematic review. *Heliyon* 2020 May 11;6(5):e03913. doi: 10.1016/j.heliyon.2020.e03913.
3. Sari Y, Yusuf S, Haryanto, Kusumawardani LH, Sumeru A, Sutrisna E, Saryono. The cultural beliefs and practices of diabetes self-management in Javanese diabetic patients: An ethnographic study. *Heliyon* 2022 Jan 29;8(2):e08873. doi: 10.1016/j.heliyon.2022.e08873.
4. KKR Badan Penelitian dan Pengembangan Kesehatan "Hasil Utama Riskesdas 2018" [Online]. 2018. [Accessed: 18-Jul-2023]. Available at: https://kesmas.kemkes.go.id/assets/upload/dir_519d41d8cd98f00/files/Hasil-riskesdas-2018_1274.pdf. Indonesian.
5. Shuyu Ng C, Toh MP, Ko Y, Yu-Chia Lee J. Direct medical cost of type 2 diabetes in singapore. *PLoS One*. 2015 Mar 27;10(3):e0122795. doi: 10.1371/journal.pone.0122795.
6. Gomes MB, Rathmann W, Charbonnel B, Khunti K, Kosiborod M, Nicolucci A, et al; DISCOVER investigators. Treatment of type 2 diabetes mellitus worldwide: Baseline patient characteristics in the global DISCOVER study. *Diabetes Res Clin Pract* 2019 May;151:20-32.
7. Hidayat B, Ramadani RV, Rudijanto A, Soewondo P, Suastika K, Siu Ng JY. Direct medical cost of type 2 diabetes mellitus and its associated complications in Indonesia. *Value Health Reg Issues* 2022 Mar;28:82-9.
8. Adu MD, Malabu UH, Malau-Aduli AEO, Malau-Aduli BS. Enablers and barriers to effective diabetes self-management: A multi-national investigation. *PLoS One* 2019 Jun 5;14(6):e0217771. doi: 10.1371/journal.pone.0217771.
9. Sharma K, Akre S, Chakole S, Wanjari MB. Stress-Induced Diabetes: A Review. *Cureus*. 2022 Sep 13;14(9):e29142. doi: 10.7759/cureus.29142.
10. Sharma A, Mittal S, Aggarwal R, Chauhan MK. Diabetes and cardiovascular disease: inter-relation of risk factors and treatment. *FJPS* 2020;6(1):130. doi: 10.1186/s43094-020-00151-w.
11. Wu FY, Yin RX. Recent progress in epigenetics of obesity. *Diabetol Metab Syndr* 2022 Nov 17;14(1):171. doi: 10.1186/s13098-022-00947-1.
12. Loos RJF, Yeo GSH. The genetics of obesity: from discovery to biology. *Nat Rev Genet*. 2022 Feb;23(2):120-33.
13. Asif M. The prevention and control the type-2 diabetes by changing lifestyle and dietary pattern. *J Educ Health Promot* 2014 Feb 21;3:1. doi: 10.4103/2277-9531.127541.
14. Mambiya M, Shang M, Wang Y, Li Q, Liu S, Yang L, et al. The play of genes and non-genetic factors on type 2 diabetes. *Front Public Health* 2019 Nov 19;7:349. doi: 10.3389/fpubh.2019.00349.

15. Śliwińska-Mossoń M, Milnerowicz H. The impact of smoking on the development of diabetes and its complications. *Diab Vasc Dis Res* 2017 Jul;14(4):265-76.
16. Choudhury AA, Devi Rajeswari V. Gestational diabetes mellitus - A metabolic and reproductive disorder. *Biomed Pharmacother* 2021 Nov;143:112183. doi: 10.1016/j.biopha.2021.112183.
17. Utli H, Vural Dođru B. The effect of the COVID-19 pandemic on self-management in patients with type 2 diabetics. *Prim Care Diabetes* 2021 Oct;15(5):799-805.
18. von Deneen KM, Garstka MA. Neuroimaging perspective in targeted treatment for type 2 diabetes mellitus and sleep disorders. *Intelligent Medicine* 2022;4(4):209-20.
19. Farm BAS, Perwitasari DA, Thobari JA, Cao Q, Krabbe PFM, Postma MJ. Translation, revision, and validation of the diabetes distress scale for Indonesian type 2 diabetic outpatients with various types of complications. *Value Health Reg Issues* 2017 May;12:63-73.
20. Wong H, Singh J, Go RM, Ahluwalia N, Guerrero-Go MA. The effects of mental stress on non-insulin-dependent diabetes: determining the relationship between catecholamine and adrenergic signals from stress, anxiety, and depression on the physiological changes in the pancreatic hormone secretion. *Cureus* 2019 Aug 24;11(8):e5474. doi: 10.7759/cureus.5474.
21. Argyropoulos T, Korakas E, Gikas A, Kountouri A, Kostaridou-Nikolopoulou S, Raptis A, et al. Stress hyperglycemia in children and adolescents as a prognostic indicator for the development of type 1 diabetes mellitus. *Front Pediatr* 2021 Apr 26;9:670976. doi: 10.3389/fped.2021.670976.
22. Arifin B, van Asselt ADI, Setiawan D, Atthobari J, Postma MJ, Cao Q. Diabetes distress in Indonesian patients with type 2 diabetes: a comparison between primary and tertiary care. *BMC Health Serv Res* 2019 Oct 30;19(1):773. doi: 10.1186/s12913-019-4515-1.
23. Kusnanto K, Arifin H, Pradipta RO, Gusmaniarti G, Kuswanto H, Setiawan A, et al. Resilience-based Islamic program as a promising intervention on diabetes fatigue and health-related quality of life. *PLoS One* 2022 Sep 1;17(9):e0273675. doi: 10.1371/journal.pone.0273675.
24. Kalra S, Jena BN, Yeravdekar R. Emotional and psychological needs of people with diabetes. *Indian J Endocrinol Metab* 2018 Sep-Oct;22(5):696-704.
25. de Groot M, Golden SH, Wagner J. Psychological conditions in adults with diabetes. *Am Psychol* 2016 Oct;71(7):552-62.
26. Lawrance EL, Thompson R, Newberry Le Vay J, Page L, Jennings N. The impact of climate change on mental health and emotional wellbeing: a narrative review of current evidence, and its implications. *Int Rev Psychiatry* 2022 Aug;34(5):443-98.
27. Boluda-Verdú I, Senent-Valero M, Casas-Escolano M, Matijasevich A, Pastor-Valero M. Fear for the future: Eco-anxiety and health implications, a systematic review. *J Environ Psychol* 2022 Dec;84:101904. doi: 10.1016/j.jenvp.2022.101904.
28. Tsai N, Eccles JS, Jaeggi SM. Stress and executive control: Mechanisms, moderators, and malleability. *Brain Cogn* 2019 Jul;133:54-9.
29. Dwivedi YK, Hughes L, Baabdullah AM, Ribeiro-Navarrete S, Giannakis M, Al-Debei MM. Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *IJIm* 2022 Oct;66:102542. doi: 10.1016/j.ijinfomgt.2022.102542.
30. S. Jiang S, Ngien A. The effects of Instagram use, social comparison, and self-esteem on social anxiety: a survey study in Singapore. *Soc Med Soc* 2020 Apr;6(2):2056305120912488. doi: 10.1177/2056305120912488.
31. Salari N, Hosseinian-Far A, Jalali R, Vaisi-Raygani A, Rasoulpoor S, Mohammadi M, et al. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Global Health* 2020 Jul 6;16(1):57. doi: 10.1186/s12992-020-00589-w.
32. S. Fang S, Ding D. The differences between acceptance and commitment therapy (ACT) and cognitive behavioral therapy: A three-level meta-analysis. *J Context Behav Sci* 2023 Apr;28:149-68.
33. McLoughlin S, Roche BT. ACT: a process-based therapy in search of a process. *Behavior Therapy* 2022 Aug. doi: 10.1016/j.beth.2022.07.010.
34. Chapoutot M, Peter-Derex L, Bastuji H, Leslie W, Schendorff B, Heinzer R, et al. Cognitive behavioral therapy and acceptance and commitment therapy for the discontinuation of long-term benzodiazepine use in insomnia and anxiety disorders. *Int J Environ Res Public Health* 2021 Sep 28;18(19):10222. doi: 10.3390/ijerph181910222.
35. Mak YW, Leung DYP, Loke AY. Effectiveness of an individual acceptance and commitment therapy for smoking cessation, delivered face-to-face and by telephone to adults recruited in primary health care settings: a randomized controlled trial. *BMC Public Health* 2020 Nov 16;20(1):1719. doi: 10.1186/s12889-020-09820-0.
36. Tyng CM, Amin HU, Saad MNM, Malik AS. The Influences of emotion on learning and memory. *Front Psychol* 2017 Aug 24;8:1454. doi: 10.3389/fpsyg.2017.01454.
37. Li Z, Shang W, Wang C, Yang K, Guo J. Characteristics and trends in acceptance and commitment therapy research: A bibliometric analysis. *Front Psychol* 2022 Nov 14;13:980848. doi: 10.3389/fpsyg.2022.980848.
38. Korecki JR, Schwebel FJ, Votaw VR, Witkiewitz K. Mindfulness-based programs for substance use disorders: a systematic review of manualized treatments. *Subst Abuse Treat Prev Policy* 2020 Jul 29;15(1):51. doi: 10.1186/s13011-020-00293-3.
39. Hayes SC, Hofmann SG. "Third-wave" cognitive and behavioral therapies and the emergence of a process-based approach to intervention in psychiatry. *World Psychiatry* 2021 Oct;20(3):363-75.
40. Hayes SC. Acceptance and commitment therapy: towards a unified model of behavior change. *World Psychiatry* 2019 Jun;18(2):226-7.
41. S. Fang S, Ding D. The efficacy of group-based acceptance and commitment therapy on psychological capital and school engagement: A pilot study among Chinese adolescents. *J Context Behav Sci* 2020 Apr;16:134-43.
42. Arnold T, Haubrick KK, Klasko-Foster LB, Rogers BG, Barnett A, Ramirez-Sanchez NA, et al. Acceptance and commitment therapy informed behavioral health interventions delivered by non-mental health professionals: a systematic review. *J Contextual Behav Sci* 2022 Apr;24:185-96.
43. Osaji J, Ojimba C, Ahmed S. The use of acceptance and commitment therapy in substance use disorders: a review of literature. *J Clin Med Res* 2020 Oct;12(10):629-33.
44. Sakamoto R, Ohtake Y, Kataoka Y, Matsuda Y, Hata T, Otonari J, et al. Efficacy of acceptance and commitment therapy for people with type 2 diabetes: Systematic review and meta-analysis. *J Diabetes Investig* 2022 Feb;13(2):262-70.

45. Amsberg S, Wijk I, Livheim F, Toft E, Johansson UB, Anderbro T. Acceptance and commitment therapy (ACT) for adult type 1 diabetes management: study protocol for a randomised controlled trial. *BMJ Open* 2018 Nov 28;8(11):e022234. doi: 10.1136/bmjopen-2018-022234.
46. Maghsoudi Z, Razavi Z, Razavi M, Javadi M. Efficacy of acceptance and commitment therapy for emotional distress in the elderly with type 2 diabetes: a randomized controlled trial. *Diabetes Metab Syndr Obes* 2019 Oct 17;12:2137-43.
47. Shayeghian Z, Hassanabadi H, Aguilar-Vafaie ME, Amiri P, Besharat MA. A randomized controlled trial of acceptance and commitment therapy for type 2 diabetes management: the moderating role of coping styles. *PLoS One* 2016 Dec 1;11(12):e0166599. doi: 10.1371/journal.pone.0166599.
48. Azadi MM, Manshaee G, Golparvar M. Comparing the effectiveness of mobile social network-based mindfulness interventions with acceptance and commitment therapy (ACT) and mindfulness therapy on depression, anxiety, stress among patients with type 2 diabetes. *J Shahrekord Univ Med* 2023 Jul;7(2):775-92.
49. Lindholm-Olinder A, Fischler J, Fries J, Alfonsson S, Elvingsson V, Eriksson JW, Leksell J. A randomised wait-list controlled clinical trial of the effects of acceptance and commitment therapy in patients with type 1 diabetes: a study protocol. *BMC Nurs* 2015 Nov 19;14:61. doi: 10.1186/s12912-015-0101-y.
50. Villatte JL, Vilardaga R, Villatte M, Plumb Vilardaga JC, Atkins DC, Hayes SC. Acceptance and commitment therapy modules: differential impact on treatment processes and outcomes. *Behav Res Ther* 2016 Feb;77:52-61.
51. Conybeare D, Behar E, Solomon A, Newman MG, Borkovec TD. The PTSD Checklist-Civilian Version: reliability, validity, and factor structure in a nonclinical sample. *J Clin Psychol* 2012 Jun;68(6):699-713.
52. Salas-Groves E, Childress A, Albracht-Schulte K, Alcorn M, Galyean S. Effectiveness of home-based exercise and nutrition programs for senior adults on muscle outcomes: a scoping review. *Clin Interv Aging* 2023 Jul 11;18:1067-91.
53. Holt RIG, DeVries JH, Hess-Fischl A, Hirsch IB, Kirkman MS, Klupa T, et al. The management of type 1 diabetes in adults. a consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care* 2021 Nov;44(11):2589-625.
54. Li Z, Zhang Z, Ren Y, Wang Y, Fang J, Yue H, et al. Aging and age-related diseases: from mechanisms to therapeutic strategies. *Biogerontology* 2021 Apr;22(2):165-87.
55. Davis HE, McCorkell L, Vogel JM, Topol EJ. Long COVID: major findings, mechanisms and recommendations. *Nat Rev Microbiol* 2023 Mar;21(3):133-46.
56. Franssen T, Stijnen M, Hamers F, Schneider F. Age differences in demographic, social and health-related factors associated with loneliness across the adult life span (19-65 years): a cross-sectional study in the Netherlands. *BMC Public Health* 2020 Aug 6;20(1):1118. doi: 10.1186/s12889-020-09208-0.
57. Zamani-Alavijeh F, Araban M, Koohestani HR, Karimy M. The effectiveness of stress management training on blood glucose control in patients with type 2 diabetes. *Diabetol Metab Syndr* 2018 May 8;10:39. doi: 10.1186/s13098-018-0342-5.
58. Merabet N, Lucassen PJ, Crielaard L, Stronks K, Quax R, Sloot PMA, et al. How exposure to chronic stress contributes to the development of type 2 diabetes: A complexity science approach. *Front Neuroendocrinol* 2022 Apr;65:100972. doi: 10.1016/j.yfrne.2021.100972.
59. Kautzky-Willer A, Harreiter J, Pacini G. Sex and gender differences in risk, pathophysiology and complications of type 2 diabetes mellitus. *Endocr Rev* 2016 Jun;37(3):278-316.
60. Ciarambino T, Crispino P, Leto G, Mastrolorenzo E, Para O, Giordano M. Influence of Gender in Diabetes Mellitus and Its Complication. *Int J Mol Sci* 2022 Aug 9;23(16):8850. doi: 10.3390/ijms23168850.
61. Babicka-Wirkus A, Wirkus L, Stasiak K, Kozłowski P. University students' strategies of coping with stress during the coronavirus pandemic: Data from Poland. *PLoS One* 2021 Jul 26;16(7):e0255041. doi: 10.1371/journal.pone.0255041.
62. Rudland JR, Golding C, Wilkinson TJ. The stress paradox: how stress can be good for learning. *Med Educ* 2020 Jan;54(1):40-5.
63. Babapour AR, Gahassab-Mozaffari N, Fathnezhad-Kazemi A. Nurses' job stress and its impact on quality of life and caring behaviors: a cross-sectional study. *BMC Nurs* 2022 Mar 31;21(1):75. doi: 10.1186/s12912-022-00852-y.
64. Adams RV, Blair E. Impact of time management behaviors on undergraduate engineering students' performance. *SAGE Open* 2019 Jan;9(1):2158244018824506. doi: 10.1177/2158244018824506.
65. Lusardi A. Financial literacy and the need for financial education: evidence and implications. *SJES* 2019 Jan;155(1):1. doi: 10.1186/s41937-019-0027-5.
66. Carroll A, Forrest K, Sanders-O'Connor E, Flynn L, Bower JM, Fynes-Clinton S, et al. Teacher stress and burnout in Australia: examining the role of intrapersonal and environmental factors. *Soc Psychol Educ* 2022;25(2-3):441-69.
67. Darling-Hammond L, Flook L, Cook-Harvey C, Barron B, Osher D. Implications for educational practice of the science of learning and development. *Appl Dev Sci* 2020 Apr;24(2):97-140.
68. Mofatteh M. Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health* 2020 Dec 25;8(1):36-65.
69. Freire C, Ferradás MDM, Regueiro B, Rodríguez S, Valle A, Núñez JC. Coping strategies and self-efficacy in university students: a person-centered approach. *Front Psychol* 2020 May 19;11:841. doi: 10.3389/fpsyg.2020.00841.
70. Shi S, Liu R, Yu H, Xiang L, Lu H. Experience of pediatric nurses in parent-child isolation units of COVID-19 Designated hospitals: a qualitative study. *Risk Manag Healthc Policy* 2023 Jul 11;16:1273-85.
71. Huang DR, Goodship A, Webber I, Alaa A, Sasco ER, Hayhoe B, et al. Experience and severity of menopause symptoms and effects on health-seeking behaviours: a cross-sectional online survey of community dwelling adults in the United Kingdom. *BMC Womens Health* 2023 Jul 14;23(1):373. doi: 10.1186/s12905-023-02506-w.
72. Trikkalinou A, Papazafiropoulou AK, Melidonis A. Type 2 diabetes and quality of life. *World J Diabetes* 2017 Apr 15;8(4):120-9.
73. Bavel JJV, Baicker K, Boggio PS, Capraro V, Cichocka A, Cikara M, et al. Using social and behavioural science to support COVID-19 pandemic response. *Nat Hum Behav* 2020 May;4(5):460-71.
74. Yu JS, Xu T, James RA, Lu W, Hoffman JE. Relationship between diabetes, stress, and self-management to inform chronic disease product development: retrospective cross-sectional study. *JMIR Diabetes* 2020 Dec 23;5(4):e20888. doi: 10.2196/20888.
75. Babapour Chafi M, Hultberg A, Bozic Yams N. Post-pandemic office work: perceived challenges and oppor-

- tunities for a sustainable work environment. *Sustainability* 2022;14(1):294. <https://doi.org/10.3390/su14010294>.
76. Kozłowska K, Sawchuk T, Waugh JL, Helgeland H, Baker J, Scher S, Fobian AD. Changing the culture of care for children and adolescents with functional neurological disorder. *Epilepsy Behav Rep* 2021 Sep 23;16:100486. doi: 10.1016/j.ebr.2021.100486.
 77. Bryant C. Psychological interventions for older adults: evidence-based treatments for depression, anxiety, and carer stress. In: Chiu H, Shulman K, eds. *Mental Health and Illness of the Elderly*. Singapore: Springer, 2017. pp. 481-514.
 78. De Leo D. Late-life suicide in an aging world. *Nat Aging* 2022 Jan;2(1):7-12.
 79. Abdi S, Spann A, Borilovic J, de Witte L, Hawley M. Understanding the care and support needs of older people: a scoping review and categorisation using the WHO international classification of functioning, disability and health framework (ICF). *BMC Geriatr* 2019 Jul 22;19(1):195. doi: 10.1186/s12877-019-1189-9.
 80. American Diabetes Association. Standards of Medical Care in Diabetes-2022 abridged for primary care providers. *Clin Diabetes* 2022 Jan;40(1):10-38.
 81. Joseph JJ, Deedwania P, Acharya T, Aguilar D, Bhatt DL, Chyun DA, et al; American Heart Association Diabetes Committee of the Council on Lifestyle and Cardiometabolic Health; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Clinical Cardiology; and Council on Hypertension. Comprehensive management of cardiovascular risk factors for adults with type 2 diabetes: a scientific statement from the American Heart Association. *Circulation* 2022 Mar;145(9):e722-e759.
 82. O'Hearn M, Lara-Castor L, Cudhea F, Miller V, Reedy J, Shi P, Zhang J, et al; Global Dietary Database. Incident type 2 diabetes attributable to suboptimal diet in 184 countries. *Nat Med* 2023 Apr;29(4):982-95.
 83. Flagg LA, Sen B, Kilgore M, Locher JL. The influence of gender, age, education and household size on meal preparation and food shopping responsibilities. *Public Health Nutr* 2014 Sep;17(9):2061-70.
 84. van Smoorenburg AN, Herttroijs DFL, Dekkers T, Elissen AMJ, Melles M. Patients' perspective on self-management: type 2 diabetes in daily life. *BMC Health Serv Res* 2019 Aug 28;19(1):605. doi: 10.1186/s12913-019-4384-7.
 85. Powers MA, Bardsley JK, Cypress M, Funnell MM, Harms D, Hess-Fischl A, et al. Diabetes self-management education and support in adults with type 2 diabetes: a consensus report of the American Diabetes Association, the Association of Diabetes Care & Education Specialists, the Academy of Nutrition and Dietetics, the American Academy of Family Physicians, the American Academy of PAs, the American Association of Nurse Practitioners, and the American Pharmacists Association. *Diabetes Care* 2020 Jul;43(7):1636-49.
 86. Chawla SPS, Kaur S, Bharti A, Garg R, Kaur M, Sooin D, et al. Impact of health education on knowledge, attitude, practices and glycemic control in type 2 diabetes mellitus. *J Family Med Prim Care* 2019 Jan;8(1):261-8.
 87. Nyblade L, Stockton MA, Giger K, Bond V, Ekstrand ML, Lean RM, et al. Stigma in health facilities: why it matters and how we can change it. *BMC Med* 2019 Feb 15;17(1):25. doi: 10.1186/s12916-019-1256-2.
 88. Budreiciute A, Damiati S, Sabir DK, Onder K, Schuller-Goetzburg P, Plakys G, et al. Management and prevention strategies for non-communicable diseases (NCDs) and their risk factors. *Front Public Health* 2020 Nov 26;8:574111. doi: 10.3389/fpubh.2020.574111.
 89. Brooks JT, Butler JC. Effectiveness of mask wearing to control community spread of SARS-CoV-2. *JAMA* 2021 Mar 9;325(10):998-9.
 90. Akash MSH, Rehman K, Fiayyaz F, Sabir S, Khurshid M. Diabetes-associated infections: development of antimicrobial resistance and possible treatment strategies. *Arch Microbiol* 2020 Jul;202(5):953-65.
 91. Hilliard ME, Yi-Frazier JP, Hessler D, Butler AM, Anderson BJ, Jaser S. Stress and A1c among people with diabetes across the lifespan. *Curr Diab Rep* 2016 Aug;16(8):67. doi: 10.1007/s11892-016-0761-3.
 92. Basit KA, Mindell J, Fat L. IDF21-0303 Prevalence of cardiovascular risk factors in English young, middle-aged and older adult with and without diabetes. *Diabetes Res Clin Pract* 2020;186:109269. doi: 10.1016/j.diabres.2022.109269.
 93. Kalra S, Bajaj S, Sharma SK, Priya G, Baruah MP, Sanyal D, et al. A practitioner's toolkit for insulin motivation in adults with type 1 and type 2 diabetes mellitus: evidence-based recommendations from an international expert panel. *Diabetes Ther* 2020 Mar;11(3):585-606.
 94. Almalki MH, Alshahrani F. Options for controlling type 2 diabetes during Ramadan. *Front Endocrinol (Lausanne)* 2016 Apr 18;7:32. doi: 10.3389/fendo.2016.00032.
 95. Ibrahim M, Davies MJ, Ahmad E, Annabi FA, Eckel RH, Ba-Essa EM, et al. Recommendations for management of diabetes during Ramadan: update 2020, applying the principles of the ADA/EASD consensus. *BMJ Open Diabetes Res Care* 2020 May;8(1):e001248. doi: 10.1136/bmjdr-2020-001248.
 96. Sanz-Cánovas J, López-Sampalo A, Cobos-Palacios L, Ricci M, Hernández-Negrín H, Mancebo-Sevilla JJ, et al. Management of type 2 diabetes mellitus in elderly patients with frailty and/or sarcopenia. *Int J Environ Res Public Health* 2022 Jul 16;19(14):8677. doi: 10.3390/ijerph19148677.
 97. Gómez-Velasco DV, Almeda-Valdes P, Martagón AJ, Galán-Ramírez GA, Aguilar-Salinas CA. Empowerment of patients with type 2 diabetes: current perspectives. *Diabetes Metab Syndr Obes* 2019 Aug 6;12:1311-21.
 98. Ruini C, Mortara CC. Writing technique across psychotherapies-from traditional expressive writing to new positive psychology interventions: a narrative review. *J Contemp Psychother* 2022;52(1):23-34.
 99. Søvdal LE, Naslund JA, Kousoulis AA, Saxena S, Qoronfle MW, Grobler C, et al. Prioritizing the mental health and well-being of healthcare workers: an urgent global public health priority. *Front Public Health* 2021 May 7;9:679397. doi: 10.3389/fpubh.2021.679397.
 100. Correia JC, Lachat S, Lagger G, Chappuis F, Golay A, Beran D; COHESION Project. Interventions targeting hypertension and diabetes mellitus at community and primary healthcare level in low- and middle-income countries: a scoping review. *BMC Public Health* 2019 Nov 21;19(1):1542. doi: 10.1186/s12889-019-7842-6.
 101. Egbujie BA, Delobelle PA, Levitt N, Puoane T, Sanders D, van Wyk B. Role of community health workers in type 2 diabetes mellitus self-management: A scoping review. *PLoS One* 2018 Jun 1;13(6):e0198424. doi: 10.1371/journal.pone.0198424.
 102. Hanson K, Brikci N, Erlangga D, Alebachew A, De Allegri M, Balabanova D, et al. The Lancet Global Health Commission on financing primary health care: putting people at the centre. *Lancet Glob Health* 2022 May;10(5):e715-e772.
 103. Reynolds R, Dennis S, Hasan I, Slewa J, Chen W, Tian D, et al. A systematic review of chronic disease management interventions in primary care. *BMC Fam Pract* 2018 Jan 9;19(1):11. doi: 10.1186/s12875-017-0692-3.

104. Werfalli M, Raubenheimer PJ, Engel M, Musekiwa A, Bobrow K, Peer N, et al. The effectiveness of peer and community health worker-led self-management support programs for improving diabetes health-related outcomes in adults in low- and-middle-income countries: a systematic review. *Syst Rev* 2020 Jun 6;9(1):133. doi: 10.1186/s13643-020-01377-8.
105. Evans S, Olive L, Dober M, Knowles S, Fuller-Tyszkiewicz M, O E, et al. Acceptance commitment therapy (ACT) for psychological distress associated with inflammatory bowel disease (IBD): protocol for a feasibility trial of the ACTforIBD programme. *BMJ Open* 2022 Jun 10;12(6):e060272. doi: 10.1136/bmjopen-2021-060272.
106. Yang X, Li Z, Sun J. Effects of cognitive behavioral therapy-based intervention on improving glycaemic, psychological, and physiological outcomes in adult patients with diabetes mellitus: a meta-analysis of randomized controlled trials. *Front Psychiatry* 2020 Jul 28;11:711. doi: 10.3389/fpsy.2020.00711.
107. Velázquez-Jurado H, Flores-Torres A, Pérez-Peralta L, Salinas-Rivera E, Valle-Nava MD, Arcila-Martinez D, et al; CAIPaDi Study Group. Cognitive behavioral treatment to improve psychological adjustment in people recently diagnosed with type 2 diabetes: Psychological treatment in type 2 diabetes. *Health Psychol Behav Med* 2023 Feb 19;11(1):2179058. doi: 10.1080/21642850.2023.2179058.
108. Cardel MI, Ross KM, Butryn M, Donahoo WT, Eastman A, Dillard JR, et al. Acceptance-based therapy: the potential to augment behavioral interventions in the treatment of type 2 diabetes. *Nutr Diabetes* 2020 Jan 21;10(1):3. doi: 10.1038/s41387-020-0106-9.
109. Visagie E, Deacon E, Kok R. Exploring the role of CBT in the self-management of type 2 diabetes: A rapid review. *Health SA* 2023 May 29;28:2254. doi: 10.4102/hsag.v28i0.2254.
110. Carpenter R, DiChiacchio T, Barker K. Interventions for self-management of type 2 diabetes: An integrative review. *Int J Nurs Sci* 2018 Dec 14;6(1):70-91.
111. Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, et al. Management of hyperglycemia in type 2 diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care* 2022 Nov 1;45(11):2753-86.
112. Abedi H, Matinnia N, Yazdi-Ravandi S. Investigating the effectiveness of cognitive behavioral group therapy on psycho-social and emotional adaptability and cognitive flexibility in people with multiple sclerosis in Hamedan, Iran. *Neurol Sci* 2023 Jul 17. doi: 10.1007/s10072-023-06953-z.
113. Prudenzi A, Graham CD, Flaxman PE, Wilding S, Day F, O'Connor DB. A workplace Acceptance and Commitment Therapy (ACT) intervention for improving healthcare staff psychological distress: A randomised controlled trial. *PLoS One* 2022 Apr 20;17(4):e0266357. doi: 10.1371/journal.pone.0266357.
114. Keulen J, Matthijssen D, Schraven J, Deković M, Bodden D. The effectiveness and cost-effectiveness of Acceptance and Commitment Therapy as a transdiagnostic intervention for transitional-age youth: study protocol of a randomized controlled trial. *BMC Psychiatry* 2023 Jan 19;23(1):51. doi: 10.1186/s12888-023-04535-z.
115. Hahr AJ, Molitch ME. Management of diabetes mellitus in patients with chronic kidney disease. *Clin Diabetes Endocrinol* 2015 Jun 4;1:2. doi: 10.1186/s40842-015-0001-9.
116. US Preventive Services Task Force; Davidson KW, Barry MJ, Mangione CM, Cabana M, Caughey AB, Davis EM, et al. Screening for prediabetes and type 2 diabetes: US preventive services task force recommendation statement. *JAMA* 2021 Aug 24;326(8):736-43.
117. Sapra S, P. Bhandari P. Diabetes. In StatPearls, Treasure Island (FL): StatPearls Publishing, 2023. [Accessed: 18-Jul-2023]. [Online]. Available at: <http://www.ncbi.nlm.nih.gov/books/NBK551501/>.
118. Ramkisson S, Pillay BJ, Sibanda W. Social support and coping in adults with type 2 diabetes. *Afr J Prim Health Care Fam Med* 2017 Jul 31;9(1):e1-e8.
119. Galaviz KI, Narayan KMV, Lobelo F, Weber MB. Lifestyle and the prevention of type 2 diabetes: a status report. *Am J Lifestyle Med* 2015 Nov 24;12(1):4-20.
120. Strain WD, Cos X, Hirst M, Vencio S, Mohan V, Vokó Z, et al. Time to do more: addressing clinical inertia in the management of type 2 diabetes mellitus. *Diabetes Res Clin Pract* 2014 Sep;105(3):302-12.
121. Alòs F, Colomer MÀ, Martín-Cantera C, Solís-Muñoz M, Bort-Roig J, Saigi I, et al. Effectiveness of a health-care-based mobile intervention on sedentary patterns, physical activity, mental well-being and clinical and productivity outcomes in office employees with type 2 diabetes: study protocol for a randomized controlled trial. *BMC Public Health* 2022 Jun 29;22(1):1269. doi: 10.1186/s12889-022-13676-x.
122. Pleus S, Freckmann G, Schauer S, Heinemann L, Ziegler R, Ji L, et al. Self-monitoring of blood glucose as an integral part in the management of people with type 2 diabetes mellitus. *Diabetes Ther* 2022 May;13(5):829-46.
123. Clark CN, Eby EL, Lensing CJ, Fultz E, Hart B, Lingcaro L, et al. Characterizing diabetes empowerment and motivation for changing health behaviors among people with type 2 diabetes: a cross-sectional survey. *Diabetes Ther* 2023 May;14(5):869-82.
124. Schmidt SK, Hemmestad L, MacDonald CS, Langberg H, Valentiner LS. Motivation and barriers to maintaining lifestyle changes in patients with type 2 diabetes after an intensive lifestyle intervention (The U-TURN Trial): a longitudinal qualitative study. *Int J Environ Res Public Health* 2020 Oct 13;17(20):7454. doi: 10.3390/ijerph17207454.
125. Woldamanuel Y, Rossen J, Andermo S, Bergman P, Åberg L, Hagströmer M, Johansson UB. Perspectives on promoting physical activity using ehealth in primary care by health care professionals and individuals with prediabetes and type 2 diabetes: qualitative study. *JMIR Diabetes* 2023 Jan 20;8:e39474. doi: 10.2196/39474.
126. Binesh M, Shafaroodi N, Mirmohammadhani M, Aghili R, Motaharinezhad F, Khanipour M, et al. A randomized controlled trial for evaluating an occupational therapy self management intervention in adults with type 2 diabetes. *Sci Rep* 2023 Jun 22;13(1):10128. doi: 10.1038/s41598-023-37231-9.
127. Duncan AD, Peters BS, Rivas C, Goff LM. Reducing risk of Type 2 diabetes in HIV: a mixed-methods investigation of the STOP-Diabetes diet and physical activity intervention. *Diabet Med* 2020 Oct;37(10):1705-14.
128. Coningsby I, Ainsworth B, Dack C. A qualitative study exploring the barriers to attending structured education programmes among adults with type 2 diabetes. *BMC Health Serv Res* 2022 Apr 30;22(1):584. doi: 10.1186/s12913-022-07980-w.
129. Ribu L, Rønnevig M, Corbin J. People with type 2 diabetes struggling for self-management: A part study from the randomized controlled trial in RENEWING HEALTH. *Nurs Open* 2019 May 23;6(3):1088-96.

130. Lin CL, Huang LC, Chang YT, Chen RY, Yang SH. Effectiveness of health coaching in diabetes control and lifestyle improvement: a randomized-controlled trial. *Nutrients* 2021 Oct 29;13(11):3878. doi: 10.3390/nu13113878.
131. Barr JA, Tsai LP. Health coaching provided by registered nurses described: a systematic review and narrative synthesis. *BMC Nurs* 2021 May 10;20(1):74. doi: 10.1186/s12912-021-00594-3.
132. Almulhim AN, Hartley H, Norman P, Caton SJ, Doğru OC, Goyder E. Behavioural change techniques in health coaching-based interventions for type 2 diabetes: a systematic review and meta-analysis. *BMC Public Health* 2023 Jan 13;23(1):95. doi: 10.1186/s12889-022-14874-3.
133. Al-Rasheedi AA. The role of educational level in glycaemic control among patients with type II Diabetes Mellitus. *Int J Health Sci (Qassim)* 2014 Apr;8(2):177-87.
134. Raghupathi V, Raghupathi W. The influence of education on health: an empirical assessment of OECD countries for the period 1995-2015. *Arch Public Health* 2020 Apr 6;78:20. doi: 10.1186/s13690-020-00402-5.
135. Andermann A; CLEAR Collaboration. Taking action on the social determinants of health in clinical practice: a framework for health professionals. *CMAJ* 2016 Dec 6;188(17-18):E474-E483.
136. Zimmer-Gembeck MJ, Skinner EA. The Development of Coping: implications for psychopathology and resilience. In: *Developmental Psychopathology*. New York: John Wiley & Sons Ltd, 2016. pp. 1–61.
137. Abbas Q, Latif S, Ayaz Habib H, Shahzad S, Sarwar U, Shahzadi M, et al. Cognitive behavior therapy for diabetes distress, depression, health anxiety, quality of life and treatment adherence among patients with type-II diabetes mellitus: a randomized control trial. *BMC Psychiatry* 2023 Feb 3;23(1):86. doi: 10.1186/s12888-023-04546-w.
138. Gloster AT, Walder N, Levin ME, Twohig MP, Karekla M. The empirical status of acceptance and commitment therapy: A review of meta-analyses. *J Context Behav Sci* 2020 Oct;18:181-92.
139. Dindo L, Van Liew JR, Arch JJ. Acceptance and commitment therapy: a transdiagnostic behavioral intervention for mental health and medical conditions. *Neurotherapeutics* 2017 Jul;14(3):546-553.
140. Ferguson T, Olds T, Curtis R, Blake H, Crozier AJ, Dankiw K, et al. Effectiveness of wearable activity trackers to increase physical activity and improve health: a systematic review of systematic reviews and meta-analyses. *Lancet Digit Health* 2022 Aug;4(8):e615-e626.
141. Timpel P, Harst L, Reifegerste D, Weihrauch-Blüher S, Schwarz PEH. What should governments be doing to prevent diabetes throughout the life course? *Diabetologia* 2019 Oct;62(10):1842-53.
142. Deslippe AL, Soanes A, Bouchaud CC, Beckenstein H, Slim M, Plourde H, et al. Barriers and facilitators to diet, physical activity and lifestyle behavior intervention adherence: a qualitative systematic review of the literature. *Int J Behav Nutr Phys Act* 2023 Feb 14;20(1):14. doi: 10.1186/s12966-023-01424-2.
143. Lambrinou E, Hansen TB, Beulens JW. Lifestyle factors, self-management and patient empowerment in diabetes care. *Eur J Prev Cardiol* 2019 Dec;26(2_suppl):55-63.
144. Dack C, Ross J, Stevenson F, Pal K, Gubert E, Michie S, et al. A digital self-management intervention for adults with type 2 diabetes: Combining theory, data and participatory design to develop HeLP-Diabetes. *Internet Interv* 2019 Mar 20;17:100241. doi: 10.1016/j.invent.2019.100241.
145. Bendig E, Schmitt A, Wittenberg A, Kulzer B, Hermanns N, Moshagen M, et al. ACTonDiabetes: study protocol of a pragmatic randomised controlled trial for the evaluation of an acceptance and commitment-based internet-based and mobile-based intervention for adults living with type 1 or type 2 diabetes. *BMJ Open* 2022 Sep 15;12(9):e059336. doi: 10.1136/bmjopen-2021-059336.
146. Harrington D, Henson J. Physical activity and exercise in the management of type 2 diabetes: where to start? *Practical Diabetes* 2021;38(5): 35–40b.