



Psychological Interventions for Diabetes Patients During The COVID-19 Pandemic

Ratna Wulandari¹, Heni Dwi Windarwati^{2*})

^{1,2} Universitas Brawijaya

ARTICLE INFO

Article history:

Received 21 January 2023

Accepted 1 April 2023

Published 10 June 2023

Keyword:

Diabetes
COVID-19
Intervention
psychological therapy
stress

ABSTRACT

COVID-19 can trigger increased stress in diabetes people because they are vulnerable to experiencing psychological disorders. The stress experienced by people with diabetes can lead to hyperglycemia which is one of the causes of the poor prognosis of people with diabetes infected with COVID-19. This article aims to develop guidelines for psychological interventions in people with diabetes during the COVID-19 pandemic. We analyzed scientific articles on four databases, namely PubMed, ProQuest, EBSCO, and ScienceDirect. The quality of the articles was assessed using PRISMA based on predefined inclusion and exclusion criteria. The results of the literature review were 1041. Then, 61 articles were reviewed in full text. A total of 24 literatures that met the inclusion and exclusion criteria were analyzed in this article. There are three psychological intervention guidelines for people with diabetes during a pandemic, namely the psychological response of people with diabetes during the pandemic, psychological intervention for people with diabetes during the pandemic, and psychological intervention methods for people with diabetes during the pandemic. People with diabetes are a vulnerable group during the COVID-19 pandemic, so guidelines for psychological intervention in people with diabetes are essential to support and improve the mental health of people with diabetes during the pandemic.

Kata kunci:

Diabetes
covid-19
intervensi
terapi psikologi
stress

*) corresponding author

Dr. Ns. Heni Dwi
Windarwati.,M.Kep.,Sp.Kep.J

Department of Mental Health Nursing,
Faculty of Medicine, Universitas Brawijaya
Jl Veteran, Ketawanggede, Kecamatan
Lowokwaru Kota Malang, Jawa Timur –
Indonesia 64145

Email: henipsik.fk@ub.ac.id

DOI: 10.30604/jika.v8i2.1789
Copyright 2023 @author(s)

ABSTRAK

Penderita diabetes merupakan kelompok rentan untuk mengalami permasalahan psikologis selama masa pandemi Coronavirus disease atau COVID-19. Artikel ini bertujuan untuk menyusun pedoman intervensi psikologis pada penderita diabetes selama masa pandemi COVID-19. Penulis melakukan analisis terhadap pedoman intervensi psikologis diabetes pada masa pandemi dari dua Negara. Penulis kemudian melakukan analisis artikel ilmiah pada empat database yaitu Pubmed, Proquest, EBSCO dan ScienceDirect. Kualitas artikel dinilai menggunakan PRISMA berdasarkan kriteria inklusi dan eksklusi yang telah ditetapkan. Terdapat 2 panduan dari 2 Negara. Hasil pencarian literatur adalah sebesar 1041. Kemudian 63 artikel ditinjau secara fulltext. Sebanyak 26 literatur yang memenuhi kriteria inklusi dan eksklusi dianalisis dalam artikel ini. Terdapat 3 panduan intervensi psikologis pada penderita diabetes pada masa pandemi yaitu respon psikologis penderita diabetes pada masa pandemi, intervensi psikologis penderita diabetes pada masa pandemi dan metode intervensi psikologis penderita diabetes selama masa pandemi. Penderita diabetes merupakan kelompok rentan selama masa pandemi COVID-19, sehingga pedoman intervensi psikologis pada penderita diabetes merupakan hal yang penting untuk mendukung dan meningkatkan kesehatan mental penderita diabetes selama masa pandemi.

This open access article is under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



INTRODUCTION

COVID-19 (coronavirus) pandemic is caused by an infectious disease. This virus belongs to the same virus class as SARS and MERS, which also causes problems in the respiratory system, (Rothan & Byrareddy, 2020) later named SARS-CoV 2 (Yuki, Fujiogi, & Koutsogiannaki, 2020). Transmission of the SARS-COV 2 virus occurs through droplets and airborne (Wilson, Corbett, & Tovey, 2020) so that preventive measures such as minimizing social activities, using masks, and maintaining distance when carrying out activities outside the home are carried out as one way to prevent infection with this virus (Lotfi, Hamblin, & Rezaei, 2020). However, the fear of infection from this disease and the existence of restrictions on social interaction to control the spread of the pandemic impact people's mental health (Khan et al., 2020; Tang et al., 2021). A recent study investigating 1160 general population in Saudi Arabia showed that 28.3% had depressive symptoms, 24% experienced anxiety, and 22.3% experienced moderate to severe stress (Alkhamees, Alrashed, Alzunaydi, Almohimeed, & Aljohani, 2020). In a similar vein in Europe, research done on 1212 Sweden participants indicated that 30% experienced depression, and 24.2% experienced anxiety (McCracken, Badinlou, Buhrman, & Brocki, 2020). While in the Asian region, a meta-analysis study in China with a total number of 27,745 participants out of 12 studies showed that 25% experienced anxiety, and 28% experienced depression (Ren et al., 2020). These data indicate that the COVID-19 pandemic has caused mental health problems such as anxiety and depression.

Diabetes mellitus is included in one of the chronic diseases with the largest number of sufferers in the world, amounting to 463 million people (International Diabetes Federation). The COVID-19 pandemic has placed people with diabetes as a vulnerable group, both physically and psychologically. When viewed from a physical perspective, people with diabetes, especially those with poor glycemic control, are at risk for a worse prognosis when infected with COVID-19 (Y. Li et al., 2020). This is probably because COVID-19 infection has a direct negative effect on β cell function (Apicella et al., 2020). β cells function to produce the hormone insulin responsible for controlling a person's blood sugar levels within normal limits. Thus, disturbances in β cell organs positively affect insulin levels, which would affect blood sugar levels' stability. Previous research showed that damage to β cells could lead to hyperglycemia (Sun, Song, Liu, & Geng, 2019) and acute metabolic complications, namely metabolic ketoacidosis (Apicella et al., 2020) in people with diabetes.

Meanwhile, when viewed from a psychological side, people with diabetes are included in the vulnerable group to have mental health problems during the pandemic. Patients with diabetes mellitus are estimated to have a risk of experiencing depression around two to three times higher than individuals without diabetes (Bădescu et al., 2016). The results of a systematic review study show that the global estimate of people with diabetes who have depression is 28% (Khaleedi, Haghghatdoost, Feizi, & Aminorroaya, 2019). This study also explains that Europe's estimated prevalence of depression is 24%, Africa 27%, Australia 29%, Asia 32%, and America 28%. These data suggest that psychological problems such as depression are common in people living with diabetes.

Stress in people with diabetes can affect blood sugar levels, both physiologically and psychologically, and behaviour (Hilliard et al., 2016). When viewed from a

physiological and psychological perspective, stress can trigger the adrenal glands to release cortisol (Qin et al., 2016). Continuously high cortisol levels can reduce levels of insulin secretion (Kamba et al., 2016; Kuo, McQueen, Chen, & Wang, 2015). In comparison, insulin is needed by the body to control blood sugar levels. Apart from cortisol, stress can also trigger catecholamine release (Johnson, Barnard, Kulp, & Mehta, 2019). Catecholamines play a role in regulating glucose in the blood, (Ritter, Li, & Wang, 2019) where it plays a role in increasing glucose levels from both glycogenolysis and gluconeogenesis (Andreis & Singer, 2016). All these processes can undoubtedly lead to hyperglycemia in people with diabetes. Hyperglycemia can lead to various complications in people with diabetes, (Katsuda et al., 2015) such as retinopathy (Wang et al., 2018) and neuropathy (Czajka & Malik, 2016).

Besides having a physiological effect, stress experienced by diabetes mellitus sufferers can also negatively affect disease management. The stress experienced by people with diabetes is associated with decreased adherence to dietary patterns (Park, Quinn, Park, & Martyn-Nemeth, 2018), physical activity, regular blood sugar check (Jannoo, Wah, Lazim, & Hassali, 2017), and reduced level of adherence to medication (N. Kumar et al., 2017). Inadequate diabetes management can certainly harm glycemic control in people with diabetes. This shows that stress can lead to hyperglycemia in people with diabetes, either directly or indirectly.

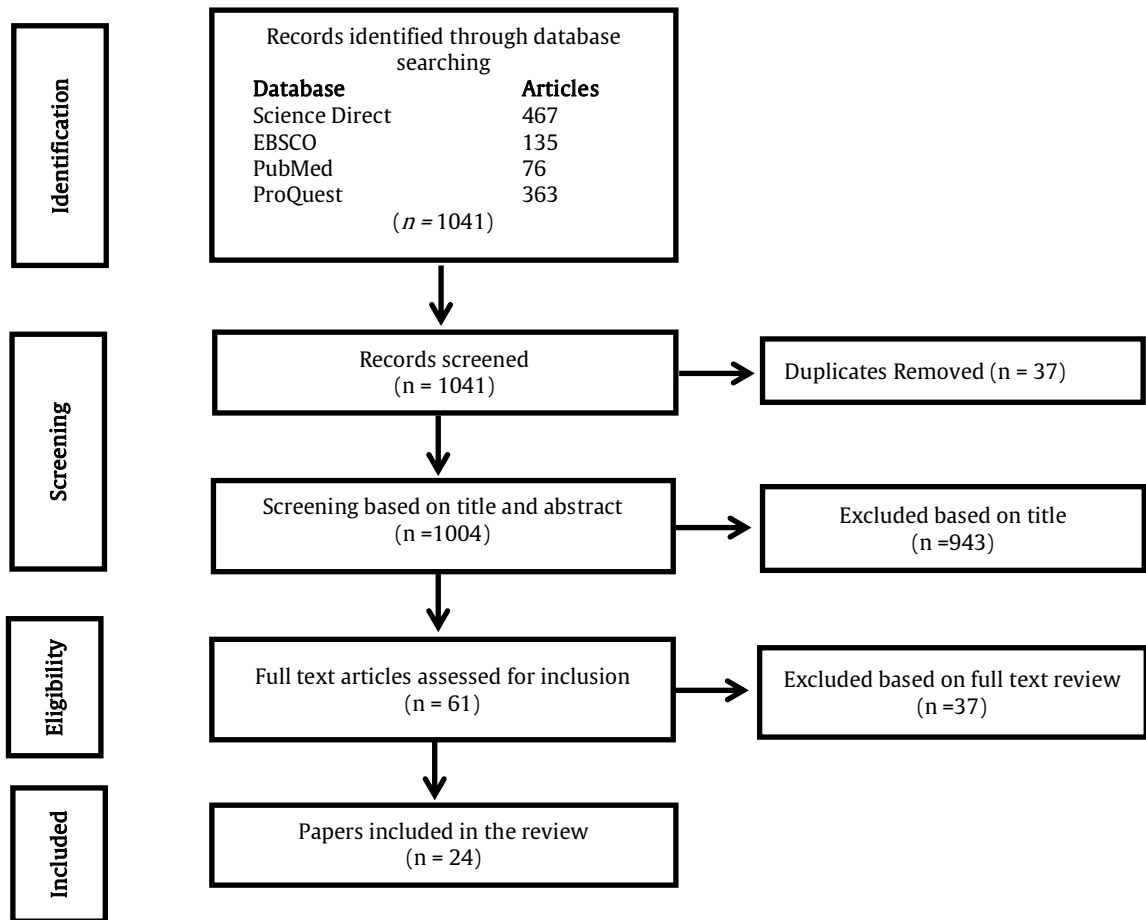
Anchored by these facts, stress, diabetes, and COVID-19 have a relationship with one another. COVID-19 can trigger increased stress in diabetes people because people with diabetes are vulnerable to experiencing psychological disorders. The stress experienced by people with diabetes can lead to hyperglycemia. Hyperglycemia in people with diabetes is one of the causes of the poor prognosis of people with diabetes infected with COVID-19 (Fadini et al., 2020; Singh & Singh, 2020). Therefore, people with diabetes mellitus need psychological support services to improve their mental health, especially during the COVID-19 pandemic. Thus, this paper aims to provide practical guidance regarding psychological interventions for people with diabetes during the COVID-19 pandemic.

METHOD

We analyzed scientific articles on four databases, namely PubMed, ProQuest, EBSCO, and ScienceDirect. The quality of articles was assessed using PRISMA based on predefined inclusion and exclusion criteria. The PRISMA diagram of article selection can be seen in figure 1. The keywords used in the literature search process were "intervention," "stress," "diabetes," and "COVID-19." The inclusion criteria for seeking intervention guidelines and scientific articles are as follows: psychological intervention guidelines for people with diabetes during the COVID-19 pandemic. The intervention guide can be accessed electronically in English. The scientific articles used are correspondence articles, responding letters of editors, short communication, reports, reviews, and original research published in 2015 to 2020. We also included a study that addresses psychological interventions in diabetic patients during the COVID-19 pandemic in English. The number of articles obtained from four databases, namely PubMed, ProQuest, EBSCO, and ScienceDirect was 1041. The number of duplicate articles that were excluded was 37. Then the number of articles that

were excluded based on title and abstract was 943. The number of articles reviewed in full text was 61 and those that fit the inclusion and exclusion criteria were 24. The

following PRISMA diagram details the article selection process:



RESULTS AND DISCUSSION

The results of the systematic review through four databases amounted to 24 articles (See table 1). There are three psychological intervention guidelines for people with diabetes during the pandemic. The first is the psychological response of people with diabetes during the pandemic, namely, stress, worry about COVID-19 infection, worry about diabetes management difficulties and anxiety, and

depression. The second guideline is a psychological intervention for diabetes people during the pandemic, namely stress management, encouraging people with diabetes to maintain social relationships, consultation, cognitive therapy, mindfulness therapy, and education. The third recommendation is the psychological intervention method for people with diabetes during the pandemic using telepsychiatry.

Table 1
 Summary of Selected Studies (n=24)

Results and Recommendations		
Psychological Response of Diabetes Patients during the COVID-19 Pandemic		
No	Author and Year	Psychological Reactions
1	Nachimuthu S, Vijayalakshmi R, Sudha M, Viswanathan V. (2020), Sankar P, Ahmed WN, Mariam Koshy V, Jacob R, Sasidharan S. (2020); Khare J, Jindal S. (2020); Yan AF, Sun X, Zheng J, Mi B, Zuo H, Ruan G, et al. (2020); Joensen L, Panduro Madsen K, Holm L, Nielsen K, Rod M, Petersen AA, et al. (2020)	Worried about COVID-19 infection
2	Agarwal N, Harikar M, Shukla R, Bajpai A (2020); Ghosh A, Arora B, Gupta R, Anoop S, Misra A. (2020); Barchetta I, Agata Cimini F, Bertocchini L, Ceccarelli V, Spaccarotella M, Giorgio Baroni M,	Stress

	et al. (2020); Khare J, Jindal S. (2020); Fisher L, Polonsky W, Asuni A, Jolly Y, Hessler D. (2020)	
3	Sankar P, Ahmed WN, Mariam Koshy V, Jacob R, Sasidharan S. (2020); Alessi J, de Oliveira GB, Franco DW, Brino do Amaral B, Becker AS, Knijnik CP, et al. (2020); Joensen L, Panduro Madsen K, Holm L, Nielsen K, Rod M, Petersen AA, et al. (2020); Fisher L, Polonsky W, Asuni A, Jolly Y, Hessler D. (2020)	Worried about diabetes management difficulties
4	Alessi J, de Oliveira GB, Franco DW, Brino do Amaral B, Becker AS, Knijnik CP, et al. (2020)	Anxiety and depression

**Forms of Psychological Intervention for Diabetes Patients during the COVID-19 Pandemic
 Recommendation 2**

No	Author and Year	Type of Therapy	Findings
1	Kyle Jacques R, Renza S. (2020)	Behavioural therapy	<ol style="list-style-type: none"> 1. Make sure to have all the needed supplies and diabetes medications for at least one month if possible. 2. Stay connected to support networks such as health and environmental professionals like friends. Use social media, virtual gatherings, or the phone. 3. Follow health protocols. Wash your hands frequently, maintain physical distance, wear personal protective equipment such as masks, and avoid large-scale social gatherings 4. Limit reading news that causes anxiety. Rely on trusted sources such as the diabetes organization and WHO
2	Banerjee M, Chakraborty S, Pal R. (2020)	Cognitive, affective and behavioural therapy	<ol style="list-style-type: none"> 1. Patients should feel free to discuss psychological problems with their healthcare professionals via telecommunications. In addition, doctors must also regularly ask about the mental health status of DM patients. 2. People with diabetes doctors/educators can coordinate teleconsultation with psychiatrists to help patients overcome psychological problems amid the ongoing pandemic. 3. People with diabetes can spend quality time with the people closest and dearest. 4. People with diabetes can minimize watching, reading, or listening to news about COVID-19
3	Singhai K, Swami MK, Nebhinani N, Rastogi A, Jude E. (2020)	Cognitive, affective and behavioral therapy	<ol style="list-style-type: none"> 1. Healthcare professionals can discuss individual risks based on clinical variables 2. Health workers need to take a proactive approach and principles of cognitive therapy. 3. Health workers need to emphasize the importance and success rate of preventive protective measures such as physical distancing and sanitation practices 4. Health workers can provide mindfulness interventions 5. Health workers need to educate on the impact of stress on blood sugar levels and immunity 6. Health workers can support the use of problem-solving coping 7. Collaborate with the patient to develop alternative plans for physical activity while maintaining preventive norms 8. Involve family members in alternative plans and help as needed 9. Health workers need to identify the presence or absence of patient interpersonal problems before the pandemic 10. Instruct and support patient using alternative means of communication and interaction. Involving the family in the care process 11. Emphasize the patient to do physical distancing in social situations and not emotional distancing. 12. Monitor patients regularly and ensure regular patient compliance 13. Keep the patient connected to psychiatric services 14. Perform mental health assessments such as signs of anxiety and depression on a regular basis to the patient 15. In patients with poor glycemic control, do an in-depth mental health assessment and carry out integrated care
4	Melaku T, Assefa D, Bayisa B, Legese N. (2020)	Cognitive	<ol style="list-style-type: none"> 1. Interventions to control disease status Promote easy

		and behavioural therapy	access to prescription drugs 2. Interventions to improve patient adherence to the treatment regimen 3. Conduct consultations to support physical and mental health during the pandemic
5	Mukona DM, Zvinavashe M. (2020)	Cognitive and affective therapy	1. Encourage patients to use telecommunications to talk about their psychological problems 2. Health workers need to assess the patient's mental health status 3. Provide social support 4. Health workers need to provide the education needed by patients, especially regarding fake news circulating
6	Ranscombe P. (2020)	Cognitive and affective therapy	1. Diabetes education 2. Yoga and mindfulness therapy

**Intervention Methods for Diabetes Patients during the COVID-19 Pandemic
 Recommendation 3**

No	Author and Year	Therapeutic Method
1	Singhai K, Swami MK, Nebhinani N, Rastogi A, Jude E. (2020); Clary L, Wang C, Byrne ME, Monaghan M. (2020)	Telemedicine
2	Melaku T, Assefa D, Bayisa B, Legese N.(2020); Ranscombe P. (2020)	Telemedicine
3	Mukona DM, Zvinavashe M. (2020)	Telecommunication
4	Clary L, Wang C, Byrne ME, Monaghan M. (2020); Ranscombe P. (2020)	Telehealth

Psychological Impact of Diabetes Patients during the COVID-19 Pandemic

People with diabetes are a vulnerable group to experience psychological problems during the COVID-19 pandemic. The first psychological problem that people with diabetes can experience is stress during the COVID-19 pandemic (Agarwal, Harikar, Shukla, & Bajpai, 2020; Barchetta et al., 2020; Fisher, Polonsky, Asuni, Jolly, & Hessler, 2020; Ghosh, Arora, Gupta, Anoop, & Misra, 2020; Khare & Jindal, 2020). The second psychological problem is fear of COVID-19 infection (Joensen et al., 2020; Khare & Jindal, 2020; Nachimuthu, Vijayalakshmi, Sudha, & Viswanathan, 2020; Sankar, Ahmed, Mariam Koshy, Jacob, & Sasidharan, 2020; Yan et al., 2020). Such concerns can arise from a lot of news about the poor prognosis of people with diabetes if infected with COVID-19. People with diabetes are thought to have a twofold higher risk of having a worse prognosis when infected with COVID-19.(A. Kumar et al., 2020)

The third psychological problem concerns people with diabetes about diabetes management difficulties during a pandemic (Alessi et al., 2020; Fisher et al., 2020; Joensen et al., 2020; Sankar et al., 2020). The main goal of diabetes management is to keep blood sugar levels within normal ranges (Lin et al., 2017). However, maintaining blood sugar levels within the normal range is a challenge for diabetes people because blood sugar levels can be affected by many effects. The current COVID-19 pandemic can add to diabetes management's burden in managing diabetes, which is challenging to do (Kyle Jacques & Renza, 2020). The third psychological problem is anxiety and depression. Research on 120 people with diabetes in Brazil showed that 44.2% of participants experienced anxiety and depression, and even 6.7% had suicidal ideation during the COVID-19 pandemic (Alessi et al., 2020). This indicates that the psychological problem of people with diabetes during a pandemic is seriously important for health workers to take care.

Psychological Intervention of Diabetes Patients During the COVID-19 Pandemic

Psychological intervention for people with diabetes during a pandemic can be carried out in various ways. The first way is through stress management. Health workers need to encourage people with diabetes to focus on things they can control, such as doing the best possible diabetes management, rather than focusing on things beyond their control, such as the spread of the diseases. Such gestures are done to manage the feelings of worry that people with diabetes have. In addition, encouraging people with diabetes to limit reading or watching the news that may cause them feelings of anxiety and asking people with diabetes to only use reliable sources such as the WHO (Kyle Jacques & Renza, 2020) are essential. People with diabetes need mental health support, such as stress management skills. Research has shown that stress management training is associated with decreased HbA1c levels (Wagner et al., 2016). HbA1c is the average blood sugar level in the last two or three months (Sherwani, Khan, Ekhzaimy, Masood, & Sakharkar, 2016). So that the optimal glycemic control in people with diabetes mellitus is when their HbA1c levels are within the normal range (Sherwani et al., 2016). Optimal glycemic control can reduce the risk of microvascular complications in diabetes sufferers (Torkamani et al., 2020). The second intervention is to encourage people with diabetes to stay in social contact with their family and friends to keep doing social through technology (Singhai, Swami, Nebhinani, Rastogi, & Jude, 2020). Such approaches are done to ensure that people with diabetes still have a support system during a pandemic. The third intervention is to conduct a consultation. Health workers need to assess the mental condition of people with diabetes and encourage them to share their feelings and psychological problems (Mukona & Zvinavashe, 2020). The health worker can then conduct consultations to support people's mental health with diabetes (Melaku, Assefa, Bayisa, & Legese, 2020). The fourth intervention is to do cognitive therapy. Health workers can provide cognitive therapy to

people with diabetes who have severe anxiety levels as a result of thinking about the inevitable deaths during the COVID-19 pandemic (Singhai et al., 2020). The fifth intervention is to provide therapy mindfulness (Ranscombe, 2020; Singhai et al., 2020). Mindfulness therapy has been shown to effectively deal with stress during the COVID-19 pandemic in Italy's general population (Conversano et al., 2020). The sixth intervention is to conduct education related to COVID-19 and diabetes management during the COVID-19 pandemic (Mukona & Zvinavashe, 2020; Ranscombe, 2020; Singhai et al., 2020). Education related to COVID-19 is significant so that people with diabetes understand precautions and what they need to do if they have signs and symptoms of COVID-19. Meanwhile, education related to disease management is important so that people with diabetes continue to adhere to the treatment regimen during the pandemic (Banerjee, Chakraborty, & Pal, 2020a).

Intervention Methods

The vulnerability of people with diabetes during the COVID-19 pandemic keeps them in need of easy access to health services (Boulton, 2020). One form of easy access to health services during a pandemic is telehealth (Clary, Wang, Byrne, & Monaghan, 2020; Ranscombe, 2020). This is because telehealth can enable health workers to provide sustainable care to the community while still preventing all kinds of direct physical contact (Monaghesh & Hajizadeh, 2020). One form of telehealth is telepsychiatry. Telepsychiatry is the term given to the application of telehealth in the specialty of psychiatry, where health professionals provide the administration of psychological care or therapy through technological means (O'Brien & McNicholas, 2020; Windarwati et al., 2020). Telepsychiatry can be used to meet consumer demand for convenient, inexpensive, and easily accessible (Chan, Parish, & Yellowlees, 2015). Support for mental health like this is needed for people with diabetes, especially during the COVID-19 pandemic (Singhai et al., 2020), to develop positive coping patterns and carry out good diabetes management during a pandemic (Banerjee et al., 2020a). Consultations can be carried out synchronously, such as through a phone call or video call, or asynchronously such as via email (Banerjee, Chakraborty, & Pal, 2020b).

The use of telepsychiatry has been shown to be effective in helping to overcome psychological problems. A study of 225 participants in the United States explains that telepsychiatry over the phone for 12 months can improve depression symptoms in people with uncontrolled diabetes (Naik et al., 2019). Another study in the United States of 1406 patients with type 2 diabetes showed that telepsychiatry was associated with a significant reduction in depression and increased satisfaction with diabetes care (Wu et al., 2018). Another study on telepsychiatry in 1530 participants conducted in China for one week showed a reduction in psychological stress due to the COVID-19 pandemic (Li, Liu, Xu, Zhang, & He, 2020). These data indicate that telepsychiatry is a promising way of dealing with psychological problems such as stress, anxiety, and depression.

Telepsychiatry can be used to build positive thinking patterns, stress management, and relaxation techniques in the community in the face of the COVID-19 pandemic (Idris, 2020). The form of mental health support provided by health workers can be in the form of education related to the relationship of stress with blood glucose and immunity. Besides, providing mindfulness therapy as a way to deal with stress due to COVID-19 (Singhai et al., 2020). Encouraging

people with diabetes to continue to have a relationship with the social environment such as friends and family using communication technology such as phone calls and social media should be envisioned so that people with diabetes do not feel lonely (Kyle Jacques & Renza, 2020). This shows that telepsychiatry can be used to provide mental health support for people with diabetes during the COVID-19 pandemic.

LIMITATION OF THE STUDY

This systematic review does not involve studies that do not use English, is not open access and only from four research journal databases.

CONCLUSIONS AND SUGGESTIONS

People with diabetes are a vulnerable group during the COVID-19 pandemic, so guidelines for psychological intervention in people with diabetes are essential to support and improve the mental health of people with diabetes during the pandemic. There are three psychological intervention guidelines for people with diabetes during the pandemic. The first is the psychological response of people with diabetes during a pandemic, namely, stress, worry about COVID-19 infection, and worry about diabetes management difficulties, and anxiety and depression. The second guideline is a psychological intervention for diabetes patients during the pandemic, namely stress management, encouraging people with diabetes to maintain social relationships, consultation, cognitive therapy, mindfulness therapy, and education. The third recommendation is the psychological intervention method for people with diabetes during the pandemic using telepsychiatry. Further research is needed regarding the level of effectiveness and satisfaction levels of people with diabetes with telepsychiatry during the COVID-19 pandemic.

Funding Statement.

The authors did not receive support from any organization for the submitted work.

Conflict of Interest Statement

The authors have no relevant financial or non-financial interests to disclose.

REFERENCES

- Agarwal, N., Harikar, M., Shukla, R., & Bajpai, A. (2020). COVID-19 pandemic: a double trouble for Indian adolescents and young adults living with type 1 diabetes. *International journal of diabetes in developing countries*, 1-7. doi:10.1007/s13410-020-00869-6
- Alessi, J., de Oliveira, G. B., Franco, D. W., Brino do Amaral, B., Becker, A. S., Knijnik, C. P., . . . Telo, G. H. (2020). Mental health in the era of COVID-19: prevalence of psychiatric disorders in a cohort of patients with type 1 and type 2 diabetes during the social distancing. *Diabetology & Metabolic Syndrome*, 12, 76-76. doi:10.1186/s13098-020-00584-6

- Alkhamees, A. A., Alrashed, S. A., Alzunaydi, A. A., Almohimeed, A. S., & Aljohani, M. S. (2020). The psychological impact of COVID-19 pandemic on the general population of Saudi Arabia. *Comprehensive Psychiatry*, *102*, 152192. doi:https://doi.org/10.1016/j.comppsy.2020.152192
- Andreis, D. T., & Singer, M. (2016). Catecholamines for inflammatory shock: a Jekyll-and-Hyde conundrum. *Intensive Care Medicine*, *42*(9), 1387-1397. doi:10.1007/s00134-016-4249-z
- Apicella, M., Campopiano, M. C., Mantuano, M., Mazoni, L., Coppelli, A., & Del Prato, S. (2020). COVID-19 in people with diabetes: understanding the reasons for worse outcomes. *The Lancet Diabetes & Endocrinology*, *8*(9), 782-792. doi:10.1016/S2213-8587(20)30238-2
- Bădescu, S. V., Tătaru, C., Kobylinska, L., Georgescu, E. L., Zahiu, D. M., Zăgrean, A. M., & Zăgrean, L. (2016). The association between Diabetes mellitus and Depression. *Journal of medicine and life*, *9*(2), 120-125.
- Banerjee, M., Chakraborty, S., & Pal, R. (2020a). Diabetes self-management amid COVID-19 pandemic. *Diabetes & metabolic syndrome*, *14*(4), 351-354. doi:10.1016/j.dsx.2020.04.013
- Banerjee, M., Chakraborty, S., & Pal, R. (2020b). Teleconsultation and Diabetes Care Amid COVID-19 Pandemic in India: Scopes and Challenges. *Journal of Diabetes Science and Technology*, *14*(4), 714-715. doi:10.1177/1932296820929391
- Barchetta, I., Agata Cimini, F., Bertocchini, L., Ceccarelli, V., Spaccarotella, M., Giorgio Baroni, M., & Gisella Cavallo, M. (2020). Effects of work status changes and perceived stress on glycaemic control in individuals with type 1 diabetes during COVID-19 lockdown in Italy. *Diabetes Research and Clinical Practice*, 108513. doi:10.1016/j.diabres.2020.108513
- Boulton, A. (2020). Why diabetes must not be forgotten in the global fight against COVID-19. *Diabetes Research and Clinical Practice*, *165*, 108319. doi:https://doi.org/10.1016/j.diabres.2020.108319
- Chan, S., Parish, M., & Yellowlees, P. (2015). Telepsychiatry Today. *Current Psychiatry Reports*, *17*(11), 89. doi:10.1007/s11920-015-0630-9
- Clary, L., Wang, C., Byrne, M. E., & Monaghan, M. (2020). COVID-19 Pandemic-Related Practices and Policies Affecting the Continuity of Behavioral Health Care Among Children With Diabetes. *Translational behavioral medicine*, *10*(4), 819-826. doi:10.1093/tbm/ibaa072
- Conversano, C., Di Giuseppe, M., Miccoli, M., Ciacchini, R., Gemignani, A., & Orrù, G. (2020). Mindfulness, Age and Gender as Protective Factors Against Psychological Distress During COVID-19 Pandemic. *Frontiers in psychology*, *11*, 1900-1900. doi:10.3389/fpsyg.2020.01900
- Czajka, A., & Malik, A. N. (2016). Hyperglycemia induced damage to mitochondrial respiration in renal mesangial and tubular cells: Implications for diabetic nephropathy. *Redox Biology*, *10*, 100-107. doi:https://doi.org/10.1016/j.redox.2016.09.007
- Fadini, G. P., Morieri, M. L., Boscari, F., Fioretto, P., Maran, A., Busetto, L., . . . Vettor, R. (2020). Newly-diagnosed diabetes and admission hyperglycemia predict COVID-19 severity by aggravating respiratory deterioration. *Diabetes Research and Clinical Practice*, *168*, 108374. doi:https://doi.org/10.1016/j.diabres.2020.108374
- Fisher, L., Polonsky, W., Asuni, A., Jolly, Y., & Hessler, D. (2020). The early impact of the COVID-19 pandemic on adults with type 1 or type 2 diabetes: A national cohort study. *Journal of Diabetes and its Complications*, 107748. doi:https://doi.org/10.1016/j.jdiacomp.2020.107748
- Ghosh, A., Arora, B., Gupta, R., Anoop, S., & Misra, A. (2020). Effects of nationwide lockdown during COVID-19 epidemic on lifestyle and other medical issues of patients with type 2 diabetes in north India. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *14*(5), 917-920. doi:https://doi.org/10.1016/j.dsx.2020.05.044
- Hilliard, M. E., Yi-Frazier, J. P., Hessler, D., Butler, A. M., Anderson, B. J., & Jaser, S. (2016). Stress and A1c Among People with Diabetes Across the Lifespan. *Current diabetes reports*, *16*(8), 67-67. doi:10.1007/s11892-016-0761-3
- Idris, H. (2020). Utilization of Teleconsultation: Mitigation in Handling Mental Disorders in the COVID-19 Era. *International journal of mental health and addiction*, 1-3. doi:10.1007/s11469-020-00323-y
- International Diabetes Federation. *IDF Diabetes Atlas* (9th ed.). Brussels, Belgium: International Diabetes Federation; 2019.
- Jannoo, Z., Wah, Y. B., Lazim, A. M., & Hassali, M. A. (2017). Examining diabetes distress, medication adherence, diabetes self-care activities, diabetes-specific quality of life and health-related quality of life among type 2 diabetes mellitus patients. *Journal of Clinical & Translational Endocrinology*, *9*, 48-54. doi:https://doi.org/10.1016/j.jcte.2017.07.003
- Joensen, L., Panduro Madsen, K., Holm, L., Nielsen, K., Rod, M., Petersen, A. A., . . . Willaing, I. (2020). Diabetes and COVID-19: psychosocial consequences of the COVID-19 pandemic in people with diabetes in Denmark—what characterizes people with high levels of COVID-19-related worries? *Diabetic Medicine*, *37*. doi:10.1111/dme.14319
- Johnson, J. D., Barnard, D. F., Kulp, A. C., & Mehta, D. M. (2019). Neuroendocrine Regulation of Brain Cytokines After Psychological Stress. *Journal of the Endocrine Society*, *3*(7), 1302-1320. doi:10.1210/je.2019-00053
- Kamba, A., Daimon, M., Murakami, H., Otaka, H., Matsuki, K., Sato, E., . . . Nakaji, S. (2016). Association between Higher Serum Cortisol Levels and Decreased Insulin Secretion in a General Population. *PLOS ONE*, *11*(11), e0166077. doi:10.1371/journal.pone.0166077
- Katsuda, Y., Sasase, T., Tadaki, H., Mera, Y., Motohashi, Y., Kemmochi, Y., . . . Ohta, T. (2015). Contribution of hyperglycemia on diabetic complications in obese type 2 diabetic SDT fatty rats: effects of SGLT inhibitor phlorizin. *Experimental animals*, *64*(2), 161-169. doi:10.1538/expanim.14-0084
- Khaledi, M., Haghghatdoost, F., Feizi, A., & Aminorroaya, A. (2019). The prevalence of comorbid depression in patients with type 2 diabetes: an updated systematic review and meta-analysis on huge number of observational studies. *Acta Diabetologica*, *56*(6), 631-650. doi:10.1007/s00592-019-01295-9
- Khan, A. H., Sultana, M. S., Hossain, S., Hasan, M. T., Ahmed, H. U., & Sikder, M. T. (2020). The impact of COVID-19 pandemic on mental health & wellbeing among home-quarantined Bangladeshi students: A cross-sectional pilot study. *Journal of affective disorders*, *277*, 121-128. doi:10.1016/j.jad.2020.07.135
- Khare, J., & Jindal, S. (2020). Observational study on Effect of Lock Down due to COVID 19 on glycemic control in patients with Diabetes: Experience from Central India. *Diabetes & metabolic syndrome*, *14*(6), 1571-1574. doi:10.1016/j.dsx.2020.08.012
- Kumar, A., Arora, A., Sharma, P., Anikhindi, S. A., Bansal, N., Singla, V., . . . Srivastava, A. (2020). Is diabetes mellitus associated with mortality and severity of COVID-19? A meta-

- analysis. *Diabetes & metabolic syndrome*, 14(4), 535-545. doi:10.1016/j.dsx.2020.04.044
- Kumar, N., Unnikrishnan, B., Thapar, R., Mithra, P., Kulkarni, V., Holla, R., . . . Aithal, S. (2017). Distress and Its Effect on Adherence to Antidiabetic Medications Among Type 2 Diabetes Patients in Coastal South India. *Journal of natural science, biology, and medicine*, 8(2), 216-220. doi:10.4103/0976-9668.210008
- Kuo, T., McQueen, A., Chen, T.-C., & Wang, J.-C. (2015). Regulation of Glucose Homeostasis by Glucocorticoids. *Advances in experimental medicine and biology*, 872, 99-126. doi:10.1007/978-1-4939-2895-8_5
- Kyle Jacques, R., & Renza, S. (2020). The COVID19 Pandemic – Perspectives from People Living with Diabetes. *Diabetes Research and Clinical Practice*, 108343. doi:https://doi.org/10.1016/j.diabres.2020.108343
- Li, L., Liu, G., Xu, W., Zhang, Y., & He, M. (2020). Effects of Internet Hospital Consultations on Psychological Burdens and Disease Knowledge During the Early Outbreak of COVID-19 in China: Cross-Sectional Survey Study. *J Med Internet Res*, 22(8), e19551. doi:10.2196/19551
- Li, Y., Han, X., Alwalid, O., Cui, Y., Cao, Y., Liu, J., . . . Shi, H. (2020). Baseline characteristics and risk factors for short-term outcomes in 132 COVID-19 patients with diabetes in Wuhan China: A retrospective study. *Diabetes Research and Clinical Practice*, 166, 108299. doi:https://doi.org/10.1016/j.diabres.2020.108299
- Lin, K., Park, C., Li, M., Wang, X., Li, X., Li, W., & Quinn, L. (2017). Effects of depression, diabetes distress, diabetes self-efficacy, and diabetes self-management on glycemic control among Chinese population with type 2 diabetes mellitus. *Diabetes Research and Clinical Practice*, 131, 179-186. doi:10.1016/j.diabres.2017.03.013
- Lotfi, M., Hamblin, M. R., & Rezaei, N. (2020). COVID-19: Transmission, prevention, and potential therapeutic opportunities. *Clinica chimica acta; international journal of clinical chemistry*, 508, 254-266. doi:10.1016/j.cca.2020.05.044
- McCracken, L. M., Badinlou, F., Buhman, M., & Brocki, K. C. (2020). Psychological impact of COVID-19 in the Swedish population: Depression, anxiety, and insomnia and their associations to risk and vulnerability factors. *European Psychiatry*, 63(1), e81. doi:10.1192/j.eurpsy.2020.81
- Melaku, T., Assefa, D., Bayisa, B., & Legese, N. (2020). Research and intervention priorities for mental health of people living with chronic disease(s) in the midst of the COVID-19 pandemic in low resource settings: A commentary. *Annals of Medicine and Surgery*, 57, 268-269. doi:https://doi.org/10.1016/j.amsu.2020.07.051
- Monaghesh, E., & Hajizadeh, A. (2020). The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence. *BMC public health*, 20(1), 1193-1193. doi:10.1186/s12889-020-09301-4
- Mukona, D. M., & Zvinavashe, M. (2020). Self- management of diabetes mellitus during the Covid-19 pandemic: Recommendations for a resource limited setting. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(6), 1575-1578. doi:https://doi.org/10.1016/j.dsx.2020.08.022
- Nachimuthu, S., Vijayalakshmi, R., Sudha, M., & Viswanathan, V. (2020). Coping with diabetes during the COVID – 19 lockdown in India: Results of an online pilot survey. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(4), 579-582. doi:https://doi.org/10.1016/j.dsx.2020.04.053
- Naik, A. D., Hundt, N. E., Vaughan, E. M., Petersen, N. J., Zeno, D., Kunik, M. E., & Cully, J. A. (2019). Effect of Telephone-Delivered Collaborative Goal Setting and Behavioral Activation vs Enhanced Usual Care for Depression Among Adults With Uncontrolled Diabetes: A Randomized Clinical Trial. *JAMA Netw Open*, 2(8), e198634. doi:10.1001/jamanetworkopen.2019.8634
- O'Brien, M., & McNicholas, F. (2020). The use of telepsychiatry during COVID-19 and beyond. *Ir J Psychol Med*, 37(4), 250-255. doi:10.1017/ipm.2020.54
- Park, M., Quinn, L., Park, C., & Martyn-Nemeth, P. (2018). Pathways of the relationships among eating behavior, stress, and coping in adults with type 2 diabetes: A cross-sectional study. *Appetite*, 131, 84-93. doi:https://doi.org/10.1016/j.appet.2018.09.008
- Qin, D.-D., Rizak, J., Feng, X.-L., Yang, S.-C., Lü, L.-B., Pan, L., . . . Hu, X.-T. (2016). Prolonged secretion of cortisol as a possible mechanism underlying stress and depressive behaviour. *Scientific reports*, 6, 30187-30187. doi:10.1038/srep30187
- Ranscombe, P. (2020). How diabetes management is adapting amid the COVID-19 pandemic. *The Lancet Diabetes & Endocrinology*, 8(7), 571. doi:https://doi.org/10.1016/S2213-8587(20)30181-9
- Ren, X., Huang, W., Pan, H., Huang, T., Wang, X., & Ma, Y. (2020). Mental Health During the Covid-19 Outbreak in China: a Meta-Analysis. *Psychiatric Quarterly*. doi:10.1007/s1126-020-09796-5
- Ritter, S., Li, A.-J., & Wang, Q. (2019). Hindbrain glucoregulatory mechanisms: Critical role of catecholamine neurons in the ventrolateral medulla. *Physiology & Behavior*, 208, 112568. doi:https://doi.org/10.1016/j.physbeh.2019.112568
- Rothan, H. A., & Byrareddy, S. N. (2020). The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *Journal of Autoimmunity*, 109, 102433. doi:https://doi.org/10.1016/j.jaut.2020.102433
- Sankar, P., Ahmed, W. N., Mariam Koshy, V., Jacob, R., & Sasidharan, S. (2020). Effects of COVID-19 lockdown on type 2 diabetes, lifestyle and psychosocial health: A hospital-based cross-sectional survey from South India. *Diabetes & metabolic syndrome*, 14(6), 1815-1819. doi:10.1016/j.dsx.2020.09.005
- Sherwani, S. I., Khan, H. A., Ekhzaimy, A., Masood, A., & Sakharkar, M. K. (2016). Significance of HbA1c Test in Diagnosis and Prognosis of Diabetic Patients. *Biomarker insights*, 11, 95-104. doi:10.4137/BMI.S38440
- Singh, A. K., & Singh, R. (2020). At-admission hyperglycemia is consistently associated with poor prognosis and early intervention can improve outcomes in patients with COVID-19. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(6), 1641-1644. doi:https://doi.org/10.1016/j.dsx.2020.08.034
- Singhai, K., Swami, M. K., Nebhinani, N., Rastogi, A., & Jude, E. (2020). Psychological adaptive difficulties and their management during COVID-19 pandemic in people with diabetes mellitus. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, 14(6), 1603-1605. doi:https://doi.org/10.1016/j.dsx.2020.08.025
- Sun, Y.-f., Song, Y., Liu, C.-s., & Geng, J.-l. (2019). Correlation between the glucose level and the development of acute pancreatitis. *Saudi Journal of Biological Sciences*, 26(2), 427-430. doi:https://doi.org/10.1016/j.sjbs.2018.11.012
- Tang, F., Liang, J., Zhang, H., Kelifa, M. M., He, Q., & Wang, P. (2021). COVID-19 related depression and anxiety among

- quarantined respondents. *Psychol Health*, 36(2), 164-178. doi:10.1080/08870446.2020.1782410
- Torkamani, N., Churilov, L., Robbins, R., Jerums, G., Beik, V., Radcliffe, N., . . . Ekinci, E. I. (2020). Diabetes and higher HbA1c levels are independently associated with adverse renal outcomes in inpatients following multiple hospital admissions. *Journal of Diabetes and its Complications*, 34(1), 107465. doi:https://doi.org/10.1016/j.jdiacomp.2019.107465
- Wagner, J. A., Bermudez-Millan, A., Damio, G., Segura-Perez, S., Chhabra, J., Vergara, C., . . . Perez-Escamilla, R. (2016). A randomized, controlled trial of a stress management intervention for Latinos with type 2 diabetes delivered by community health workers: Outcomes for psychological wellbeing, glycemic control, and cortisol. *Diabetes Research and Clinical Practice*, 120, 162-170. doi:https://doi.org/10.1016/j.diabres.2016.07.022
- Wang, L., Zhou, X., Yin, Y., Mai, Y., Wang, D., & Zhang, X. (2018). Hyperglycemia Induces Neutrophil Extracellular Traps Formation Through an NADPH Oxidase-Dependent Pathway in Diabetic Retinopathy. *Front Immunol*, 9, 3076. doi:10.3389/fimmu.2018.03076
- Wilson, N., Corbett, S., & Tovey, E. (2020). Airborne transmission of covid-19. *Bmj*, 370, m3206. doi:10.1136/bmj.m3206
- Windarwati, H. D., Oktaviana, W., Mukarromah, I., Ati, N. A. L., Rizzal, A. F., & Sulaksono, A. D. (2020). In the middle of the COVID-19 outbreak: Early practical guidelines for psychosocial aspects of COVID-19 in East Java, Indonesia. *Psychiatry Research*, 293, 113395. doi:https://doi.org/10.1016/j.psychres.2020.113395
- Wu, S., Ell, K., Jin, H., Vidyanti, I., Chou, C.-P., Lee, P.-J., . . . Myers, C. (2018). Comparative Effectiveness of a Technology-Facilitated Depression Care Management Model in Safety-Net Primary Care Patients With Type 2 Diabetes: 6-Month Outcomes of a Large Clinical Trial. *Journal of medical Internet research*, 20(4), 1-1. doi:10.2196/jmir.7692
- Yan, A. F., Sun, X., Zheng, J., Mi, B., Zuo, H., Ruan, G., . . . Shi, Z. (2020). Perceived risk, behavior changes and Health-related outcomes during COVID-19 pandemic: Findings among adults with and without diabetes in China. *Diabetes Research and Clinical Practice*, 167, 108350. doi:https://doi.org/10.1016/j.diabres.2020.108350
- Yuki, K., Fujiogi, M., & Koutsogiannaki, S. (2020). COVID-19 pathophysiology: A review. *Clinical Immunology*, 215, 108427. doi:https://doi.org/10.1016/j.clim.2020.108427

