



Prevalence of Depression among Type-2 Diabetic Patients-A Review

**Faisal Suliman Algaows^{1*}, Sarah Nasser Almisrea²,
Fahad Khalid M. Alshammari³, Barakat, May Yahya A.⁴,
Abdulrahman Abdullah Alamri⁵, Alsharif, Aqeel Mohammed M.⁵,
Alwagdani, Shatha Mesfer A.⁶, Fahad Abdullah Alahmadi⁷,
Abdulmohsin Mohammed Altuwaijri⁸, Alshammari, Nada Naif Z.⁹,
Raghad Ateegallah Alawfi⁸, Maria Mahdi Alqadeeb¹⁰, Duja Naji Zarnogi⁸
and Eman Mohammed Aldraihim¹¹**

¹King Abdulaziz Medical City, National Guard, Iskan PHC, Saudi Arabia.

²Arabian Gulf University, Bahrain, Salmaniya Medical Complex, Saudi Arabia.

³King Abdulaziz University-KSA-Jeddah, Saudi Arabia.

⁴Jazan University, Saudi Arabia.

⁵Imam Muhammad Ibn Saud Islamic University, Saudi Arabia.

⁶Taif university, Saudi Arabia.

⁷Almeqaat General hospital, Saudi Arabia.

⁸King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia.

⁹Northern Borders University, Saudi Arabia.

¹⁰Imam Abdulrahman bin Faisal university, Saudi Arabia.

¹¹Al,aarefa University, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i40A32220

Editor(s):

(1) S. Prabhu, Sri Venkateswara College of Engineering, India,

Reviewers:

(1) Biplob Kumar Dey, University of Chittagong, Bangladesh.

(2) Manjunadh Muraleedharan Pillai, Newcastle University, United Kingdom.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/72278>

Review Article

Received 01 June 2021

Accepted 03 August 2021

Published 04 August 2021

ABSTRACT

The global prevalence of DM is steadily increasing. Depression in patients with diabetes is more prevalent than in the general population. There is good evidence. The bidirectional link can be between diabetes and depression. The chronic nature of the illness and its various consequences can lead to depressive diabetes patients, while increased counter-regulatory hormones can cause the development of diabetic syndromes. Social and environmental variables which influence self-care burden patients and their families substantially. It can lead to depression. Depressed people with diabetes also may experience poor health, inadequate income, stigma and a lack of social support. The aim of the present study is to summarize previously estimated prevalence of depression in patients diagnosed with T2DM, and to identify sociodemographic, clinical and psychological factors associated with the occurrence of depression in diabetic patients in Saudi Arabia and worldwide.

Keywords: T2DM; diabetes; depression; Saudi Arabia; KSA.

1. INTRODUCTION

Diabetes mellitus (DM) is becoming more common across the world. According to the International Diabetes Federation, diabetes mellitus affects around 6.6 percent of the world's population. According to the World Health Organization, 300 million people will have diabetes by 2025 [1], and 7.8 percent will have diabetes by 2030; more than 70 percent of these individuals will live in developing nations [2]. When compared to other parts of the world, the Arab world (North Africa, the Middle East, and the Gulf region) will have the second greatest growth in the percentage of persons with diabetes in 2030 [3].

It is widely established that the prevalence of depression in diabetic patients is greater than in the general population. Diabetes and depression might have a mutually beneficial relationship. Diabetes patients are more likely to develop depression due to the chronic nature of the disease and its multiple consequences, and diabetes can develop in depression due to an increase in counter-regulatory hormones [4]. Depression and diabetes have long been linked; Willis noted in the late 17th century that those who had suffered "significant life stress, grief, or protracted sorrow" are more liable to experience diabetes. Similar clinical findings have been recorded in various countries, and a series of epidemiological studies have shown that depression is more likely to develop in persons with diabetes, regardless of whether the individuals are aware of their diabetes [5].

Chronic stress caused by depression causes hypercortisolemia, which can lead to centripetal obesity and metabolic syndrome. Depression is associated with increased levels of

glucocorticoids, catecholamines, and growth hormone, as well as changes in glucose transport function and the secretion of inflammatory cytokines, all of which may lead to insulin resistance and, ultimately, be causal factors in the development of diabetes and its complications. The second theory is that depression in individuals with type 1 and type 2 diabetes is caused by persistent psychosocial stresses associated with having a chronic medical disease, as well as the psychosocial demands imposed by diabetes [6].

Patients and their families bear a significant burden as a result of social and environmental variables impacting self-care. This load has the potential to lead to depression. Diabetes patients who are depressed may also have poor health habits, a low income, stigma, and a lack of social support [7]. The aim of the present study is to summarize previously estimated prevalence of depression in patients diagnosed with T2DM, and to identify sociodemographic, clinical and psychological factors associated with the occurrence of depression in diabetic patients in Saudi Arabia and worldwide.

2. METHODOLOGY

2.1 Epidemiological Studies in Saudi Arabia

El Mahalli, A. A., conducted a research with 260 T2DM patients in the Eastern Province of Saudi Arabia to assess the prevalence and determinants of depression. Almost half of diabetics were sad (49.6%). Patients with poor diabetes management and who were unmarried were at a higher risk of getting depression, and the difference was statistically significant [8].

Alhunayni, Norah Muqbil, and colleagues conducted a cross-sectional study on 397 diabetic patients to assess the prevalence and risk factors for depression among type II diabetes patients visiting the National Guard Diabetic Clinic in Arar city. Depression affected 37% of the population, with 23% experiencing mild depression, 9% experiencing severe depression, and 5% experiencing severe depression. Diabetes patients with low education, low income, and diabetes mellitus for a long time were shown to be at a greater risk of depression. Poor adherence to physical activities, food regimen, family history of DM, and the occurrence of comorbidities were all linked with depression [9].

In Jazan, Alzughbi, Turki, and colleagues performed a research on 300 Saudi patients with type 2 diabetes (T2DM) drawn at random from primary healthcare institutions to examine the incidence of diabetes mellitus (DM)-related distress and depression, as well as their associated variables. Diabetes-related depression was found to be 20% prevalent. Risk factors for developing depression in diabetic patients include female gender, age 45 or more, physical inactivity, DM duration 5 years or more, and smoking. Glycated haemoglobin (A1C) levels were substantially higher in individuals with diabetes-related depression (P 0.001) [10].

Another study done in Jazan Province by Madkhali, Jnadi M., et al. among 500 diabetes patients visiting a diabetic facility as well as four basic healthcare facilities found that depression was prevalent in 20.6 percent of DM patients. The majority of patients (59.4 percent) had no depression, one-fifth had mild depression (20.0 percent), some had moderate depression (11.4 percent), and some had severe depression (9.2 percent). Depression was considerably more common among uneducated patients (31.8%) and patients with low monthly income (22.8%). Diabetes-related hypertension and ischemic heart disease were identified as risk factors for depression in diabetic individuals [11].

In Saudi Arabia, a systematic review and meta-analysis were done to assess the incidence of depression in patients with type 2 diabetes mellitus (T2DM) and to compare the prevalence of depression in different diagnostic methods and areas of Saudi Arabia. A total of 24 studies with a total of 7326 individuals were included, with the overall pooled prevalence of depression among T2DM patients in Saudi Arabia being 38.06

percent. According to subgroup analysis, the Western and Central regions had the greatest rates of depression, with 44.29 percent and 36.81 percent, respectively [12].

A cross-sectional research aiming at investigating the incidence and determinants of depression, anxiety, and stress among T2DM patients revealed that depression was prevalent in 33.8 percent of 450 adult T2DM patients at five public primary care facilities in Saudi Arabia's western area. Age, gender, the existence of comorbidities, the time since T2DM diagnosis, and serum haemoglobin A1c levels were all significant predictors of psychological distress [13].

A cross-sectional research in Qassim to examine the incidence of anxiety and depression and to determine their related risk factors among persons with type 2 diabetes mellitus comprised 300 adults with type 2 diabetes mellitus and found that 34.8 percent of the participants were depressed. Depression was more prevalent in patients who had moderate or poor social support, while it was less frequent in those who had diabetes for even more than 10 years [14].

ALMouaalamy NA examined 155 type 2 diabetes patients in Jeddah, Saudi Arabia, to assess depression and its related factors in type 2 diabetic patients. According to the findings, 48% of the patients were depressed. Depression was more common in individuals under the age of 40 and above the age of 60. The presence of depression was considerably increased by a family history of psychiatric disease and the usage of insulin. Another significant finding was that taking more than three drugs or having more than four follow-ups per year increased the chances of having depression, which was explained by the presence of complications in those patients, which was discovered to be a significant factor in increasing cases of depression among study sample. In addition, uncontrolled type 2 DM patients had higher levels of depression than managed ones [15].

A cross-sectional study was conducted at the Al Imam Mohammed Ibn Saud Islamic University medical centre in Riyadh to determine the prevalence of major depressive symptoms among patients with type II diabetes, compare the prevalence between diabetic and non-diabetic patients, and determine the associated factors. The study included 200 diabetic type II and 241 non-diabetic participants who completed

the questionnaires anonymously. The percentage of diabetics with severe depression was 38.5 percent, compared to 26 percent of non-diabetic individuals, with an odds ratio of 1.7 ($p = 0.007$). The proportion of diabetes females suffering from serious depression was greater (45%) than the proportion of diabetic men suffering from depression (32 percent). Diabetes patients who lived alone were more likely to suffer from depression than those who lived with their spouses [16].

2.2 Epidemiology Worldwide

A cross-sectional research conducted in Bangladesh utilising the PHQ-9 psychometric test revealed that the prevalence of depression symptoms (score 5) was 34%. The prevalence was estimated to be 16.5 percent when a cut-off value (PHQ-9 10) suggestive of moderate to severe depression was employed [17]. A cross-sectional study conducted in Chandigarh, India, discovered that 23% of 300 type 2 diabetes patients fulfilled the criteria for severe depression, 18% met the criteria for moderate depression, and 59% had no clinically significant depression [1]. In Sri Lanka, researchers conducted a cross-sectional population-based study. Ball et al. discovered a 6.1 percent lifetime incidence of depression in the Colombo district population [18]. A research which examined depressive diseases among patients in the Colombo outpatient clinic showed an overall 22.4% prevalence, with women more afflicted than men (25.4% vs 18.7%) and with a strong relationship between pain-related pain complaint [19].

A comprehensive analysis of the connections between depression and type 2 diabetes revealed that the probability of acquiring type 2 diabetes increased by 60 percent [20]. In a systemic assessment of the prevalence of clinical depression in type 2 diabetes, the prevalence was shown to be substantially greater in type 2 diabetes patients (17,6%) compared to non-diabetic individuals (9,8%) [21]. In the U.S., 20% of the type 2 diabetes population were diagnosed as depressed [22], a survey has been done. Likewise, in 33.4 per cent of the Type 2 population, a research among Greek people showed high depressed symptoms [23]. Similar studies are also available in South East Asia. In Bangladesh, 29% of males and 30.5% of women newly diagnosed with type 2 diabetes had depressive symptoms in a populational study [24]. In Pakistan, a rural-area research has

shown a 14.7% prevalence of depression in diabetes patients of type 2 [25]. A cross-sectional trial in Palestine revealed a probable depression in 40% of the individuals tested. All the risk variables involved for depression in diabetes sufferers were female sex, low level of education, having no present work, many additional diseases, low adherence to medicine and obesity (BMI/30 kg/m²) [26]. In a prospective study of 2,759 diabetic patients who were follow-up for 5 years, Katon et al, found that 83% of the patients with major depression – defined as reporting – were also depressed at baseline, with at least one core symptom of depression (for example depressed mood or anhedonia) including the following symptoms in Patient Health Questionnaire-9 (PHQ-9), whereas 42.4% were deprived of baseline [27].

3. RESULTS AND DISCUSSION

Mental and physical diseases are a big concern in global healthcare. Its prevalence continues to increase and will likely continue to increase because of increased life expectancy and a number of other factors. Depression and diabetes comorbidity might be seen as a classic case of physical/mental comorbidity. The frequency of both diseases is increasing and depression is twice as common in diabetes-free adults [28]. Estimates of the prevalence of depression vary widely, mainly in accordance with tools for the assessment of depression (standardised interviews versus self-report questionnaires), depression classification (the main discrimination against a minor depression and/or high depression - depression indication - generally, by using particular cutbacks in self-reporting questionnaires), study design (controlled versus controlled) [29].

In persons with diabetes the risk of depression is raised, while in those with depressive illness the risk of diabetes is increased. There are a variety of risk factors identified for diabetes and depression, including low birth weight, negative childhood, lifestyle, and obesity events, and there are solid indications that the risk of depression is greatly increased by diabetes complications [28].

Higher risks of depression with the diabetes age group show that the prevalence of depression increased with rising age in this study. This might possibly be owing to the loss of control over the life of an older child, due to limited funds, feelers of desperateness and isolation, which frequently

create suicide thoughts and emotions such as despair, worry, loneliness and little self-esteem [30].

The educational level was another major component in this study related to depression. This relationship with poorer education among persons who have Type 2 diabetes might be connected to their poor awareness of the severity of illness, medicine compliance and nutrition that leaves them prone to complications. Work status was also largely related to depression with the likelihood that depression was the most prevalent among homemakers. This was predicted given there is no employment in itself, and as the sickness imposes a financial cost [31].

DM depression patients are often more susceptible to poor glycemic control. This vulnerability has still to be understood fully. Depression is believed to be induced by changes in the brain's neurotransmitters. Dopamine, serotonin and norepinephrine are used. This affects mood and conduct. Psychological stress secretes counterregulatory hormones such catecholamines, glucocorticoids, glucagon and growth hormones [32]. The impact of insulin can be exacerbated by enhanced counter-specific hormones and glucose excursion. Increased glucose levels can make control of diabetes more complicated. And poor glycemic management especially in DMs with complications might exacerbate symptoms of depression and decrease antidepressant response [33].

Depression occurs due to increased incidence of diabetic complications, increased disability and life losses. The patterns of the causes of mortality do not differ from the patterns in the community, as in other mental illnesses, without depression [34].

A number of research reported in a 2010 review have evaluated the effectiveness of treating depression in the face of severe somatic disease. Pharmacotherapy alone is an important treatment option, especially in situations that do not readily apply more integrated methods, but its effectiveness in treating depression in conjunction with improved glycemic control does not appear to be equal [35].

Psychopharmacological therapy also has a modest to wide effect on depressed diseases

with fewer glycemic control effects (SRI) by selective serotonin reuptake inhibitor (SSRI) medication. By combining screening for depression with a team approach to health services based on population, even greater outcomes may be obtained through cooperation. It includes patient training, the attendance of allied health care professionals in the primary health system (to track the effects of therapy, side effects, and adherence to treatment and to support the required behavioral adjustments) [36].

4. CONCLUSION

In DM patients, depression is of major concern. Not only is it quite frequent, but it is also extremely persistent and repeated, with considerable unfavorable effects on clinical outcomes and sequelae. Diabetes patients have to do every day extra efforts to match the metabolism of diabetes-free people, which substantially influences the person's life quality. The psychological and mental behavior of a diabetic individual impacts self-care and finally long-term glycemic control, the risk of long-term problems and quality of life.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Raval A, Dhanaraj E, Bhansali A, Grover S, Tiwari P. Prevalence & determinants of depression in type 2 diabetes patients in a tertiary care centre. *Indian Journal of Medical Research*. 2010; 132(8):195–200.
2. International Diabetes Federation. *Diabetes Atlas*. 4th edition; 2009. Available:<http://www.worlddiabetesfoundation.org/composite-35.htm> [Cited 2015 Jan].
3. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract*. 2010;87(1):4–14.

- DOI: 10.1016/j.diabres.2009.10.007
4. Egede LE. Diabetes, major depression, and functional disability among U.S. adults. *Diabetes Care*. 2004;27(2):421–428. DOI: 10.2337/diacare.27.2.421
 5. Lloyd CE, Tapash R, Nouwen A, Chauhan AM. Epidemiology of depression in diabetes: international and cross-cultural comparisons. *J Affect Disord*. 2012;142(1):S22–S29.
 6. Talbot F, Nouwen A. A review of the relationship between depression and diabetes in adults: Is there a link? *Diabetes Care*. 2000;23:1556–62.
 7. Wit M, Trief PM, Huber JW, Willaing I. State of the art: Understanding and integration of the social context in diabetes care. *Diabetic Medicine*. 2020;37(3):473–482. DOI: 10.1111/dme.14226
 8. El Mahalli AA. Prevalence and Predictors of Depression among Type 2 Diabetes Mellitus Outpatients in Eastern Province, Saudi Arabia. *Int J Health Sci (Qassim)*. 2015;9(2):119-126.
 9. Alhunayni NM, Mohamed AE, Hammad SM. Prevalence of Depression among Type-II Diabetic Patients Attending the Diabetic Clinic at Arar National Guard Primary Health Care Center, Saudi Arabia. *Psychiatry J*. 2020;2020:9174818. Published 2020 Jun 19. DOI: 10.1155/2020/9174818
 10. Alzughbi Turki, et al. Diabetes-Related Distress and Depression in Saudis with Type 2 Diabetes. *Psychology Research and Behavior Management*. 2020;13:453-458.
 11. Jnadi M Madkhali, Ammar A Hakami, Ali H Dallak, Ramzi M Hakami, Abdullah A Yatimi, Mohmmmed E Hamdi, et al. Prevalence and associated factors of depression among patients with diabetes at jazan province, Saudi Arabia: A Cross-Sectional Study, *Psychiatry Journal*. 2019;2019:6. Article ID 6160927. Available:https://doi.org/10.1155/2019/6160927
 12. Alanazi EO, Amer AIAB. Prevalence of depression among type-2 diabetic patients in Saudi Arabia: A systematic review and meta-analysis. *Int. Res. J. Pub. Environ. Health*. 2021;8(2):98-108.
 13. Alzahrani Alhussain, Alghamdi Abdulrahman, Alqarni Turki, Alshareef Reem, Alzahrani, Abdullah. Prevalence and predictors of depression, anxiety, and stress symptoms among patients with type II diabetes attending primary healthcare centers in the western region of Saudi Arabia: A cross-sectional study. *International Journal of Mental Health Systems*. 2019;13. DOI: 10.1186/s13033-019-0307-6
 14. Al-Mohaimeed Abdulrahman A. Prevalence and factors associated with anxiety and depression among type 2 diabetes in Qassim: A descriptive cross-sectional study. *Journal of Taibah University Medical Sciences*. 2017;12(5): 430-436.
 15. ALMouaalamy NA. Prevalence of Depression among Type 2 Diabetic Patients Attending Diabetic Clinic at Primary Health Care Centers in Jeddah, Saudi Arabia. *Arch Med*. 2018;10(5):1. DOI: 10.21767/1989-5216.1000282
 16. Fahad Abdullah Alateeq, Prevalence of major depression among types II diabetes: A cross sectional study in Riyadh, Saudi Arabia, *Majmaah J. Health Sci*. 2020; 8(1):36-44.
 17. Roy T, Lloyd CE, Parvin M, Mohiuddin KGB, Rahman M. Prevalence of co-morbid depression in out-patients with type 2 diabetes mellitus in Bangladesh. *BMC Psychiatry*. 2012;12:Article 123. DOI: 10.1186/1471-244x-12-123
 18. Ball HA, Siribaddana SH, Kovas Y, et al. Epidemiology and symptomatology of depression in Sri Lanka: A corss sectional population based survey in Colombo Distric. *Journal of Affective Disorders*. 2010;123:188–196.
 19. Anandakumar D, Ratnatunga SS, Dayabandara M, Hanwella R, de Silva VA. Depressive disorder in patients attending the outpatient department of a tertiary care hospital in Colombo. *The Ceylon Medical Journal*. 2016;61(3):118–122. DOI: 10.4038/cmj.v61i3.8347
 20. Mezuk B, Eaton WW, Albrecht S, Golden SH. Depression and Type 2 Diabetes Over the Lifespan. *Diabetes care*. 2008;31(12):2383–90. DOI: 10.2337/dc08-0985
 21. Ali S, Stone MA, Peters JL, Davies MJ, Khunti K. The prevalence of co-morbid depression in adults with Type 2 diabetes: a systematic review and meta-analysis. *Diabet Med [Internet]*. 2006;23:1165–73. Available:http://www.ncbi.nlm.nih.gov/pubmed/17054590 10.1111/j.1464-5491.2006.01943.x

22. Li C, Ford ES, Zhao G, Ahluwalia IB, Pearson WS, Mokdad AH. Prevalence and correlates of undiagnosed depression among U.S. adults with diabetes: The Behavioral Risk Factor Surveillance System, 2006. *Diabetes Research and Clinical Practice*. 2009;83(2):268–79. DOI: 10.1016/j.diabres.2008.11.006
23. Sotiropoulos A, Papazafiropoulou A, Apostolou O, Kokolaki A, Gikas A, Pappas S. Prevalence of depressive symptoms among non insulin treated Greek type 2 diabetic subjects. *BMC research notes* [Internet]. 2008;1:101. Available: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2590605&tool=pmcentrez&rendertype=abstract> 10.1186/1756-0500-1-101
24. Asghar S, Hussain A, Ali SMK, Khan AKA, Magnusson A. Prevalence of depression and diabetes: A population-based study from rural Bangladesh. *Diabetic Medicine*. 2007;24(8):872–7. DOI: 10.1111/j.1464-5491.2007.02136.x
25. Zahid N, Asghar S, Claussen B, Hussain A. Depression and diabetes in a rural community in Pakistan. *Diabetes Research and Clinical Practice*. 2008;79(1):124–7. DOI: 10.1016/j.diabres.2007.07.006
26. Sweileh WM, Abu-Hadeed HM, Al-Jabi SW, Zyoud SH. Prevalence of depression among people with type 2 diabetes mellitus: A cross sectional study in Palestine. *BMC Public Health*. 2014;14:163. Published 2014 Feb 13. DOI: 10.1186/1471-2458-14-163
27. Katon W, Fan MU, Unützer J, Taylor J, Pincus H, Schoenbaum M. Depression and diabetes: a potentially lethal combination. *J Gen Intern Med*. 2008;23:1571–1578.
28. Egede LE. Diabetes, major depression and functional disability among U.S. adults. *Diabetes Care*. 2004;27(2):421–428.
29. Sartorius N. Depression and diabetes. *Dialogues Clin Neurosci*. 2018;20(1):47–52. DOI: 10.31887/DCNS.2018.20.1/nsartorius
30. Katon W, Russo J, Lin EH, Heckbert SR, Karter AJ, Williams LH, et al. Diabetes and poor diseases control: is comorbid depression associated with poor medication adherence or lack of treatment intensification. *Psychosom Med*. 2009;23:588–594.
31. Engum A, Mykletun A, Midthjell K, Holen A, Dahl AA. Depression and Diabetes. A large population-based study of sociodemographic, lifestyle and clinical factors associated with depression in type 1 and type 2 diabetes. *Diabetes Care*. 2005;28:1904–1909.
32. Park M., Katon WJ., Wolf FM. Depression and risk of mortality in individuals with diabetes: a meta-analysis and systematic review. *Gen Hosp Psychiatry*. 2013;35(3):217–225.
33. Vancampfort D, Mitchell AJ, De Hert M, et al. Type 2 diabetes in patients with major depressive disorder: A meta-analysis of prevalence estimates and predictors. *Depress Anxiety*. 2015;32(10):763–773.
34. de Groot M, Anderson RM, Freedland KE, Clouse RE, Lustman PJ. Association of depression and diabetes complication: A meta-analysis. *Psychosom Med*. 2001;63(4):619–630.
35. Lloyd CE, et al. Neglect of depressive disorders in people with type 2 diabetes. Results from a collaborative study carried out in 14 countries. *Diabetic Medicine*. In Press.
36. Simon GE, Katon WJ, Lin EH, Rutter C, Manning WG, Von Korff M, et al. Cost-effectiveness of systematic depression treatment among people with diabetes mellitus. *Arch Gen Psychiatry*. 2007;64:65–72.

© 2021 Algaows et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle4.com/review-history/72278>