Effect of Biopsychosocial Factors on Glycemic Control in Type 2 Diabetes Mellitus

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ABSTRACT
Objective: To investigate the effect of diabetic patients' biopsychosocial factors on type 2 diabetes mellitus (T2DM) outcomes to contribute to diabetes mellitus management.
Study Design: Cross-sectional descriptive study.
Place and Duration of the Study: Department of Family Medicine, School of Medicine, Firat University, Turkey, from October 2021 to March 2022.
Methodology: A total of 210 type 2 diabetic patients were included. The sociodemographic form, Beck depression inventory (BDI), multidimensional perceived social support scale (MSPSS), general self-efficacy scale (GES), and Diabetes self-care activities scale (DSCA) were used to assess the biopsychosocial factors. Controlled diabetes and uncontrolled diabetes classification was made according to HbA1c level (HbA1c cut-off value: ≤7%).
Results: The median duration of T2DM (p=0.001), total cholesterol level (p=0.004) and fasting plasma glucose (p<0.001) were found to be higher in the uncontrolled diabetes group than in the controlled diabetes group. Spearman correlation test results showed a significant negative relationship between the scores of Beck depression and total cholesterol (r= -0.157, p = 0.023). There is a significant positive correlation between social support and total cholesterol (r=0.343, p<0.001), LDL (r=0.149, p= 0.031), triglyceride (r=0.165, p = 0.017), DSCA general diet score (r=0.367, p<0.001), DSCA physical activities (r=0.221, p = 0.001), DSCA glucose monitoring (r=0.302, p<0.001), DSCA foot care (r=0.311, p<0.001), and DSCA total scores (r=0.401, p<0.001).
Conclusion: The present study showed that high BDI score was associated with low diabetes self-care score and presence of complications. Individuals' self-efficacy and high perception of social support were associated with increased diabetic self-care scores.

Key Words: Social support, Perception, Self care, Diabetes mellitus type 2, Diabetes complications, Depression.

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suggested biopsychosocial evaluation. For example, biological factors such as genetics and medical history, environmental factors, patient’s economic status, access to health services, social values, and social support may affect the patient’s treatment compliance and response, and the patient’s self-care. On the other hand, the complications that have occurred or may develop, the progression of the disease, and the future concerns about the disease create stress factors for the patient and this affects the psychological state. DM affects many physiological systems, and plays a role in mental, emotional, social, and psychosexual problems and complications.

In the current study, it was aimed to evaluate the biopsychosocial factors of patients with T2DM using various tests and to evaluate the effects of these factors on the metabolic control and diabetic outcomes.

**METHODOLOGY**

This cross-sectional descriptive study was carried out with type 2 diabetic patients over the age of 18 years who applied to Firat University Hospital, Turkey, for follow-up and treatment between November 2021 and March 2022. The mean and standard deviation scores of the Beck depression inventory (BDI) were used for the sample size calculation. While the amount of type error (alpha) was 0.05, the power of the test (1-beta) was 0.8, the effect size was 0.46, and the alternative hypothesis (H1) was two-sided, the minimum sample size required to find a significant difference using this test was calculated as 74 for each group and 148 in total. A total of 210 diabetic patients (81 controlled diabetic and 129 uncontrolled diabetic patients) were enrolled. Other types of DM, psychological disease, chronic neurological diseases, and visual and auditory problems that prevented communication were excluded from the study.

The study was approved by Firat University non-interventional research ethics committee (Date: 15.10.2020 no:2020/14-05). Written consent were obtained from all participants in the study.

The participants were divided into two groups as controlled and uncontrolled DM. HbA1c values of the patients were used in T2DM classification. The HbA1c ≤7% was defined as controlled DM and HbA1c >7% was defined as uncontrolled DM.

Sociodemographic characteristics of the participants (age, gender, height, weight, educational status, marital status, income, employment status, number of individuals in the household, years spent with diabetes, concomitant chronic diseases, death of close relatives, partner or friends, substance and alcohol use, and the participant’s T2DM treatment and follow-up characteristics) were obtained by questionnaire.

BDI was used for depression assessment. The scale is a Likert type scale consisting of 21 items in total. Each item gets graded points between 0-3. The total value varies between 0-63. As the score obtained from the scale increases, the depressive mood is considered to increase.

The multidimensional scale of perceived social support (MSPSS) was used to measure perceived social support by individuals. The scale, which consists of 12 questions in a Likert style, is rated between 1-7 points from ‘definitely no’ to ‘definitely yes’. The scale has 3 sub-dimensions (family, friend, and special person) containing 4 questions. A minimum of 4 points and a maximum of 28 points can be obtained from the sub-dimensions. The total score of the scale ranges from 12 to 84. Total and subscales Cronbach’s alpha reliability values of MSPSS were reported as total=0.91, family=0.90, friend=0.91, and special person=0.89, respectively.

The spiritual characteristics of the participants were measured with the General Self-Efficacy Scale. The scale consists of 10 items and it is developed by Jerusalem and Schwarzer. A four-point Likert scale is scored between completely false (1 point) and completely true (4 points). The minimum score of the scale is 10 and the maximum score is 40 points and the alpha consistency co-efficient was reported as 0.83.

The participants' diabetes self-care characteristics were measured with the diabetes self-care activities scale (DSCA). The scale questioned the participants' self-care activities such as diet, exercise, blood glucose testing, foot care, and smoking in the last seven days. The answers were marked as days (between 0 and 7) on a number line, and only the 11th item questioning smoking was stated as 0- I do not smoke, 1- I smoke (amount of cigarettes smoked/number). Each sub-dimension of the scale is scored separately and can be used independently. As the score obtained from both the sub-dimensions and the total score of the scale increases, the self-care is considered to increase.

Study data were analysed with IBM SPSS 22 package program. The distribution of continuous data was analysed using the Shapiro-Wilk test. Descriptive data were as mean ± SD for continuous variables with normal distribution, median (min-max) for continuous data with non-normal distribution, and number (n) and percentage (%) for categorical variables. Pearson chi-square and Fisher Exact tests were used to examine the relationship between categorical data. Student t-test or Mann-Whitney U test was used according to the distribution of data in the comparison of continuous variables in the two independent groups. Spearman correlation analysis was used to analyse the relationship between two continuous variables. The significance level was determined as p<0.05.

**RESULTS**

A total of 210 diabetic patients (81 controlled diabetic and 129 uncontrolled diabetic patients) were enrolled. The median duration of T2DM (p=0.001), total cholesterol level (p=0.004), and fasting plasma glucose (p<0.001) were found to be higher in the uncontrolled diabetes group than in the controlled diabetes group. There is a significant relation between DSCA scale scores and DM outcomes. The general diet score (p<0.001), special diet score (p<0.001), total diet score (p<0.001), exercise score (p=0.003), self-monitoring of blood glucose score (p<0.001),...
foot care score (p=0.001), and the total score (p<0.001) were significantly higher in the uncontrolled diabetes group than controlled diabetes group (Table I).

The median BDI score of the patients with diabetic complications was significantly higher than the patients without diabetic complications (p<0.001). The median general self-efficacy score of the patients without diabetic complications was significantly higher than the patients with diabetic complications (p=0.005). The self-monitoring of blood glucose median scores of the patients without diabetic complications were higher than the patients with diabetic complications (p=0.025, Table II).

Spearman correlation test results showed a significant negative correlation between beck depression scores, total cholesterol, and a positive significant correlation with HbA1c level (r = -0.157, p = 0.023). There was a positive correlation between MSPSS score, total cholesterol, LDL, and triglyceride levels.

Table I: Socio-demographic, depression, general self-effication, social support, diabetes self-care activities characteristics of participants.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Controlled DM (n=81)</th>
<th>Uncontrolled DM (n=129)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>49 (60.5)</td>
<td>72 (55.8)</td>
<td>0.504a</td>
</tr>
<tr>
<td>Male</td>
<td>32 (39.5)</td>
<td>57 (44.2)</td>
<td></td>
</tr>
<tr>
<td>Education status [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>23 (28.4)</td>
<td>36 (27.9)</td>
<td></td>
</tr>
<tr>
<td>Literate</td>
<td>26 (32.1)</td>
<td>29 (22.5)</td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>16 (19.7)</td>
<td>37 (28.6)</td>
<td>0.340a</td>
</tr>
<tr>
<td>High school</td>
<td>8 (9.9)</td>
<td>18 (14.0)</td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>8 (9.9)</td>
<td>9 (7.0)</td>
<td></td>
</tr>
<tr>
<td>Marital status [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>72 (88.9)</td>
<td>108 (83.7)</td>
<td>0.588b</td>
</tr>
<tr>
<td>Single</td>
<td>2 (2.5)</td>
<td>6 (4.7)</td>
<td></td>
</tr>
<tr>
<td>Divorced/Widowed</td>
<td>7 (8.6)</td>
<td>15 (11.6)</td>
<td></td>
</tr>
<tr>
<td>Employment [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housewife</td>
<td>38 (46.9)</td>
<td>62 (48.1)</td>
<td></td>
</tr>
<tr>
<td>Officer</td>
<td>12 (14.8)</td>
<td>15 (11.6)</td>
<td></td>
</tr>
<tr>
<td>Minimum wage worker</td>
<td>4 (4.9)</td>
<td>10 (7.8)</td>
<td></td>
</tr>
<tr>
<td>Tradesman</td>
<td>7 (8.6)</td>
<td>15 (11.6)</td>
<td>0.784a</td>
</tr>
<tr>
<td>Retired</td>
<td>20 (24.8)</td>
<td>27 (20.9)</td>
<td></td>
</tr>
<tr>
<td>Chronic disease [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have</td>
<td>49 (60.5)</td>
<td>85 (65.9)</td>
<td>0.428a</td>
</tr>
<tr>
<td>Have not</td>
<td>32 (39.5)</td>
<td>44 (34.1)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>60.84±11.29</td>
<td>60.26±10.35</td>
<td>0.705c</td>
</tr>
<tr>
<td>Monthly income (TL)</td>
<td>3000.0 (15000.0-15000.0)</td>
<td>3000.0 (1300-20000.0)</td>
<td>0.622d</td>
</tr>
<tr>
<td>Number of individuals in the household</td>
<td>3.0 (1.0-9.0)</td>
<td>3.0 (1.0-8.0)</td>
<td>0.552d</td>
</tr>
<tr>
<td>Duration of DM (years)</td>
<td>5.0 (1.0-20.0)</td>
<td>10.0 (1.0-37.0)</td>
<td>0.001d</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>26.6 (20.3-47.0)</td>
<td>27.4 (17.6-41.6)</td>
<td>0.868d</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>200.0 (89.0-700.0)</td>
<td>212.0 (100.0-522.0)</td>
<td>0.004d</td>
</tr>
<tr>
<td>LDL</td>
<td>120.0 (34.0-200.0)</td>
<td>122.0 (51.0-300.0)</td>
<td>0.092d</td>
</tr>
<tr>
<td>Triglyceride</td>
<td>149.0 (70.0-799.0)</td>
<td>170.0 (40.0-684.0)</td>
<td>0.233d</td>
</tr>
<tr>
<td>Fasting blood glucose</td>
<td>120.0 (81.0-229.0)</td>
<td>180.0 (101.0-380.0)</td>
<td>&lt;0.001d</td>
</tr>
<tr>
<td>HbA1c</td>
<td>6.6 (5.5-7.0)</td>
<td>9.1 (7.2-15.0)</td>
<td>&lt;0.001d</td>
</tr>
</tbody>
</table>

SCALES

Beck depression inventory       | 9.0 (0.0-27.0)       | 10.0 (0.0-42.0)         | 0.205d  |
General self-efficacy scale     | 31.0 (12.0-40.0)     | 32.0 (14.0-40.0)        | 0.849d  |
Multidimensional of perceived social support scale
Family                          | 23.0 (4.0-28.0)      | 25.0 (4.0-28.0)         | 0.175d  |
Friends                         | 20.0 (6.0-28.0)      | 22.0 (4.0-28.0)         | 0.175   |
A special person                | 20.0 (4.0-28.0)      | 23.0 (4.0-28.0)         | 0.074   |
Total                           | 60.0 (20.0-84.0)     | 67.0 (12.0-84.0)        | 0.075   |
Diabetes self-care activities scale
General diet                    | 5.0 (0.0-14.0)       | 9.0 (0.0-14.0)          | <0.001d |
Specific diet                   | 5.0 (0.0-14.0)       | 9.0 (0.0-14.0)          | <0.001d |
Total diet                      | 10.0 (0.0-28.0)      | 17.0 (0.0-28.0)         | <0.001d |
Physical activities             | 1.0 (0.0-14.0)       | 4.0 (0.0-14.0)          | 0.003d  |
SMBG                            | 2.0 (0.0-14.0)       | 10.0 (0.0-14.0)         | <0.001d |
Foot care                       | 4.0 (0.0-14.0)       | 9.0 (0.0-14.0)          | 0.001d  |
Total                           | 20.0 (2.0-62.0)      | 38.0 (4.0-70.0)         | <0.001d |

*a* Pearson chi-square test; *b* Fisher Exact test; *c* Student t-test; *d* Mann-Whitney U test; TL: Turkish lira; SMBG: self-monitoring blood glucose; BMI: Body mass index.
Table II: Association between scale scores and diabetic complication status.

<table>
<thead>
<tr>
<th>Scales</th>
<th>Diabetic complication</th>
<th>Diabetes complication</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Beck depression inventory</td>
<td>8.5 (0.0-42.0)</td>
<td>13.0 (0.0-41.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>General self-efficacy scale</td>
<td>32.5 (12.0-40.0)</td>
<td>30.0 (14.0-40.0)</td>
<td>0.005</td>
</tr>
<tr>
<td>Multidimensional of perceived social support scale</td>
<td>24.0 (4.0-28.0)</td>
<td>24.5 (6.0-28.0)</td>
<td>0.347</td>
</tr>
<tr>
<td>Family</td>
<td>21.0 (4.0-28.0)</td>
<td>20.0 (4.0-28.0)</td>
<td>0.192</td>
</tr>
<tr>
<td>Friends</td>
<td>21.5 (4.0-28.0)</td>
<td>20.0 (4.0-28.0)</td>
<td>0.068</td>
</tr>
<tr>
<td>Total score</td>
<td>65.0 (12.0-84.0)</td>
<td>61.0 (20.0-84.0)</td>
<td>0.249</td>
</tr>
<tr>
<td>Diabetes self-care activities scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General diet</td>
<td>7.0 (0.0-14.0)</td>
<td>8.0 (0.0-14.0)</td>
<td>0.338</td>
</tr>
<tr>
<td>Specific diet</td>
<td>8.0 (0.0-14.0)</td>
<td>7.0 (0.0-14.0)</td>
<td>0.627</td>
</tr>
<tr>
<td>Total diet score</td>
<td>13.5 (0.0-28.0)</td>
<td>16.0 (0.0-28)</td>
<td>0.751</td>
</tr>
<tr>
<td>Physical activities</td>
<td>2.0 (0.0-14.0)</td>
<td>3.0 (0.0-13.0)</td>
<td>0.997</td>
</tr>
<tr>
<td>SMBG</td>
<td>6.0 (0.0-14.0)</td>
<td>10.0 (0.0-14.0)</td>
<td>0.025</td>
</tr>
<tr>
<td>Foot care</td>
<td>8.0 (0.0-14.0)</td>
<td>6.5 (0.0-14.0)</td>
<td>0.738</td>
</tr>
<tr>
<td>Total score</td>
<td>30.0 (2.0-70.0)</td>
<td>34.5 (4.0-60.0)</td>
<td>0.436</td>
</tr>
</tbody>
</table>

DSCA: Diabetes self-care activities scale.

Table III: Spearman correlation analysis between biochemical parameters and diabetes self-care inventory and other scale scores.

<table>
<thead>
<tr>
<th>Biochemical parameters and DSCA scores</th>
<th>BDI</th>
<th>GSE</th>
<th>MSPSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol</td>
<td>r:-0.157</td>
<td>r:0.097</td>
<td>r:0.343</td>
</tr>
<tr>
<td>LDL</td>
<td>p=0.023</td>
<td>p=0.160</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>r:-0.015</td>
<td>r:-0.034</td>
<td>r:0.149</td>
</tr>
<tr>
<td>Fasting blood glucose</td>
<td>p=0.826</td>
<td>p=0.622</td>
<td>p=0.031</td>
</tr>
<tr>
<td>HbA1c</td>
<td>p=0.015</td>
<td>p=0.034</td>
<td>p=0.146</td>
</tr>
<tr>
<td>DSCA general diet</td>
<td>r:-0.260</td>
<td>r:0.340</td>
<td>r:0.367</td>
</tr>
<tr>
<td>DSCA special diet</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>DSCA total diet</td>
<td>r:-0.315</td>
<td>r:0.345</td>
<td>r:0.386</td>
</tr>
<tr>
<td>DSCA physical activities</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>DSCA SMBG</td>
<td>r:-0.320</td>
<td>r:0.351</td>
<td>r:0.401</td>
</tr>
<tr>
<td>DSCA foot care</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>DSCA total</td>
<td>r:-0.320</td>
<td>r:0.351</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

BDI: Beck depression inventory, GSE: General self-efficacy scale, MSPSS: Multidimensional of perceived social support scale, DSCA: Diabetes self-care activities scale.

There is a negative correlation between Beck depression scores and DSCA general diet (r:-0.260, p<0.001), DSCA special diet (r:-0.325, p<0.001), DSCA total diet (r:-0.315, p<0.001), DSCA physical activities (r:-0.320, p<0.001), DSCA foot care (r:-0.325, p<0.001), and DSCA total scores (r:-0.320, p<0.001). A positive correlation was found between DSCA self-monitoring of blood glucose score and MSPSS (r: 0.302, p<0.001, Table III).

DISCUSSION

The current study focused on the effect of biopsychosocial factors on diabetic patients' self-care activities and diabetes outcomes. In the current study, there was no significant difference in terms of depression scores between the controlled and uncontrolled diabetes groups. When the participants were classified according to their diabetic complication status, it was determined that the depression scores of the patients with diabetic complications were higher. A positive correlation was found between the depression scores of diabetic patients and their HbA1c levels. It has been shown that concomitant depression in diabetic individuals is associated with decreased glycemic control and drug and diet non-compliance. It has also been reported that depression increases the risk of developing diabetes and paves the way for complications by disrupting diabetes regulation. In the current study, although depression scores did not differ between the controlled and uncontrolled diabetes groups, the depression scores of the participants with diabetic
complications were found to be higher and consistent with the literature. In addition, in the present study, a negative significant correlation was found between the depression score and the diabetic self-care activities scores of the participants. It has been shown that an increased depression score negatively affects diabetic self-care. Previous literature data have reported that the depressive state accompanying diabetes will cause drug and diet non-compliance and adversely affect glycemic control. In the current study, it has been shown that increased depressive state negatively affects the self-care of individuals such as diet, physical activity, and foot care. Previous literature and the current study have shown that depressive state will complicate diabetes control. Findings emphasised that psychological factors should be taken into account in the follow-up and treatment of diabetic individuals and the importance of a holistic approach in addition to pharmacological treatment.

The current study showed that there was a significant positive correlation between social support perception scores and self-care scores such as diet, physical activities, blood sugar monitoring, and foot care. Abundant evidence in the literature has reported that social support significantly and independently influences glycemic control in diabetic individuals. However, there are contradictory findings reporting that there is no relationship between social support and HbA1c level and that high social support causes poor glycemic control. Social support develops positive mental and emotional changes in the patient, it can increase the individual's determination, belief, self-confidence and self-care, and contribute to the fight against diseases. The current study showed that the social support had a positive effect on self-care and was found to be compatible with the literature. It was thought that the perception of social support and behavioural changes of diabetic individuals should be examined with prospective studies in order to prove the effect on social support and diabetic output.

The current study showed that there is no significant correlation between the general self-efficacy scale scores in the controlled and uncontrolled diabetes. However, efficacy score is higher in uncomplicated diabetes than in others. In addition, there is positive correlation between self-efficacy scores and self-care scores such as diet, physical activities, and foot care.

Some studies showed that the higher glycemic control is associated with better self-efficacy. In addition, the self-efficacy is positively correlated with self-care in individuals with diabetes. The current study showed that self-efficacy affects diabetes self-care and the individual's disease follow-up and treatment process positively. In addition low self-care was found to be associated with the diabetic complications, and these data support the previous literature.

The current study evaluated the effects of diabetes self-care in the diabetes control group. It was determined that the self-care activities of the uncontrolled group, diet, physical activity, blood sugar and foot care scores were higher than those of the controlled group. The blood glucose score of the group with complications was higher than the group without complications. Studies have been reported in the literature showing that the self-care activities of individuals with adequate glycemic control are better than those with poor control. The finding that better self-care is associated with worse diabetes control in the current study is contrary to the previous literature. The reason for this may be that poor glycemic control has increased the patient's hospital visits, and the awareness of self-care under the control of the physician has increased.

The current study showed that the cholesterol level was higher in uncontrolled diabetics than in controlled diabetics patients. Previous literature reported that the diabetic patients with poor glycemic control have higher cholesterol level. In the current study, social support score was related with higher LDL, triglyceride, and total cholesterol levels. This may be due to the high moral and financial support that individuals receive from their environment and family, and the positive effect on the eating behaviour of the individual.

Strengths of this study include the required sample size which is calculated by power analysis, and the use of standardised tests for psychological, spiritual, and social support perception and diabetes self-care characteristics to determine independent relationships. This study had several limitations. Due to the cross-sectional design of the study, the findings are insufficient to generalise to the whole population. Second, the study was inadequate to evaluate the bidirectionality of the association between diabetic complications and risk factors; more randomised studies with larger samples are required to determine why the biopsychosocial factors found in this study were strongly associated with diabetes outcomes. As a third limitation, especially psychological and diabetes self-care characteristics may vary depending on the process in individuals with complications. There is a need to examine the effects of biopsychosocial factors on the development of diabetic complications with a large population cohort studies.

**CONCLUSION**

A high BDI score was associated with the low diabetes self-care score and diabetic complications. Individuals' self-efficacy and high perception of social support were associated with increased diabetic self-care scores. In addition, the participants' high self-efficacy scale scores were found to be associated with diabetic complications. Reducing the depressive mood of diabetic individuals can positively affect diabetes outcomes and reduce complications. Increasing the self-efficacy of individuals can positively affect the treatment compliance of the patients and the effective control of diabetes.
ETHICAL APPROVAL:
The study was approved by Firat University non-interventional research ethics committee (Date: 15.10.2020 No. 2020/14-05).

PATIENTS’ CONSENT:
Informed written consent were obtained from all the patients for the purpose of this research and its publication.

COMPETING INTEREST:
The authors declared no competing interest.

AUTHORS’ CONTRIBUTION:
EOO: Contributed to the idea, design, interpretation of the data, and drafting of the manuscript.
BY: Funds management, conception and design, did the literature search, and wrote the manuscript.
EO, MOK: Contributed to the design, analysis, and drafting of the manuscript.
All the authors have approved the final version and agreed to be accountable.

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Effect of biopsychosocial factors on glycemic control in type 2 diabetes mellitus

