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Association between blood glucose level with glycemic load, physical activity and compliance to medication among diabetes mellitus (DM) patients in Buleleng District General Hospital, Bali Province

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Abstract

Background and purpose: The prevalence of diabetes mellitus (DM) in Indonesia is increasing, including in Buleleng District, Bali Province. Studies regarding determinants of blood glucose control in DM patients show varied findings. This study aims to examine association between blood glucose level with physical activity, compliance to medication and glycemic load among DM patients.

Methods: A cross-sectional survey was conducted in Buleleng District General Hospital from March to April 2017. A total of 73 patients were consecutively recruited to participate in our study. Data were collected through interview, observation and measurement. Data collected included sociodemographic characteristics, fasting blood glucose level, 1-hour and 2-hour postprandial blood glucose levels, carbohydrate intake, body mass index, glycemic index, glycemic load, physical activity, genetic or family history, and compliance to medication. A bivariate analysis was performed to examine association between independent variables and blood glucose levels. Multivariate analysis was also conducted to calculate adjusted odd ratio using a binary logistic regression.

Results: Our study found that blood glucose levels of most respondents were relatively well managed–63% for fasting, 61.6% for 1-hour postprandial, and 63% for 2-hours postprandial. Multivariate analysis revealed that fasting blood glucose level were associated with regular physical activities (AOR=74.09; 95%CI: 7.52-729.69) and compliance to medication (AOR=11.90; 95%CI: 2.24-63.29). Furthermore, 1-hour postprandial blood glucose level were associated with breakfast glycemic load (AOR=0.63; 95%CI: 0.47-0.85) and compliance to medication (AOR=27.29; 95%CI: 2.29-323.95), while 2-hour postprandial blood glucose level were associated with breakfast glycemic load (AOR=0.69; 95%CI: 0.54-0.89) and compliance to medication (AOR=19.81; 95%CI: 2.31-170.14).

Conclusions: Factors associated with fasting blood glucose level were regular physical activities and adherence to medication, while 1-hour and 2-hours postprandial blood glucose levels were both influenced by breakfast glycemic load and compliance to medication.

Keywords: glycemic load, physical activity, compliance to medication, diabetes mellitus

Introduction

The prevalence of diabetes mellitus (DM) is increasing at both regional and global levels.1 International Diabetes Federation reported that as many as 415 million adult population in 2015 lived with DM and it was predicted to reach 642 million patients in 2040.2 The total DM patients in Indonesia was increased from 9.1 million people in 20143 to 10 million patients in 2015,2 and it was predicted to reach 21.3 million patients by 2030.4 In Buleleng District, a survey revealed that the proportion of reported family members who have been
diagnosed with DM by health providers was increased from 0.9% in 2007 to 1.7% in 2013. The total number of DM out-patients in District General Hospital of Buleleng was 11,260 in 2016, whereas in mid-2017 (up to May), the total DM out-patients has reached 4,728.

A high level of blood sugar leads to several complications between five to ten years after the diagnosis, which include: blindness, kidney failure, gangrene, and other cardiovascular diseases. The management of DM is essential because DM is a lifetime disease. Prevention measures to delay such complications are critical for patients, for example blood sugar control using fasting and post-prandial blood glucose levels as indicators.

Several studies in hospital settings in Indonesia have documented that blood sugar control practices among DM patients were poor. A study at Internal Medicine Polyclinic at Dr. Kariadi Hospital, Semarang City in 2008 found that as many as 76.1% of DM patients presented with a high fasting blood glucose level and 78.3% DM patients presented with a high 2-hour postprandial blood glucose level. A study in Sanglah General Hospital Denpasar in 2012 reported that a poorly managed blood glucose level was found among 65.1% of DM in-patients. In addition, a study at Diabetes Polyclinic at Dr Soetomo Hospital revealed that as many as 66% of DM patients were found to have poorly managed blood sugar levels.

Studies investigating factors associated with blood sugar management show varies results. A study at Tugorejo District Hospital, Semarang conducted in 2014 found that a physical exercise program can improve blood sugar level of type 2 DM patients. Another study conducted at Arja Winangun District Hospital Cirebon in 2012 revealed that physical activities, regular exercise, and diet compositions are associated with management of blood sugar level among DM patients. A study in Dr. Kariadi Hospital, Semarang City in 2014 also found that total carbohydrate intake and glycemic index can influence fasting and 2-hours postprandial blood glucose levels. Studies conducted at public health centres also show similar findings. A study at Kembiritan Public Health Centre in Banyuwangi District in 2014 reported that compliance to medication and nutritional status might improve glycemic control among type 2 DM patients. In addition, a study conducted at all public health centres in South Denpasar Subdistrict in 2013 revealed that obesity based on waist circumference is a risk factor for developing type 2 DM.

This study aims to examine association between blood sugar level among type-2 DM out-patients with physical activity, compliance to medication and glycemic load.

Methods

A cross-sectional survey was conducted from March to April 2017 in Buleleng District Hospital. A total of 73 patients were selected using a consecutive technique from all DM patients visiting out-patient polyclinic services at Internal Medicine Polyclinic Buleleng District Hospital. Data on carbohydrate intake, glycemic index, and glycemic load were collected using a semi-quantity-food frequency questionnaire (SQ-FFQ) and a direct observation using a food record form. Data on fasting and 2-hours postprandial blood glucose levels were obtained from laboratory result, while the 1-hour postprandial blood glucose level were obtained using a glucometer. Data on physical activity, family history or genetic and compliance to medication were obtained from a structured interview. Specific to compliance data, we used the Morisky Medication Adherence Scale (MMAS-8). Data on body mass index (BMI) were calculated from body weight and height variables. All data collection processes namely interview, observation, and measurement were conducted by the
researcher and two trained enumerators. Informed consent was obtained from all respondents prior to data collection. Bivariate analysis was conducted to test the mean difference and correlation between two variables. Mean difference was tested using Mann Whitney U test while correlation was tested using Kendal Tau_b. Multivariate analysis was conducted using a binary logistic regression to obtain Adjusted Odds Ratio (AOR) at 95% confidence interval level. Our study protocol has been approved by the Human Research Ethics Committees Faculty of Medicine Udayana University and Sanglah General Hospital Denpasar.

Results

Table 1 depicts characteristics of respondent by age, sex, carbohydrate intake, glycemic index, glycemic load and blood sugar levels. The majority of respondents aged between 40 to 49 years (52.1%) with an average of 47.34±7.02 years and female (57.5%). Over the last month, most of respondents consumed adequate amount of carbohydrate (72.6%), with high glycemic index (60.3%), and with low glycemic load (65.8%). During breakfast at the hospital, the majority of respondents consumed adequate amount of carbohydrate (64.4%) with low glycemic index (52.1%). The proportion of glycemic load was divided into three categories: low (30.1%), moderate (37.0%), and high (32.9%). Blood glucose levels of most respondents were relatively well managed – 63% for fasting, 61.6% for 1-hour postprandial, and 63% for 2-hours postprandial blood glucose levels.

Table 2 describes our bivariate analysis using the Mann Whitney U test. Our analysis revealed that fasting blood glucose level were associated with physical activities and compliance to medication (p<0.001), while 1-hour and 2-hours postprandial blood glucose levels were associated with compliance to medication (p<0.001).

Table 3 shows our bivariate analysis using the Kendall Tau_b correlation test to examine association between dependent and independent variables. Our analysis showed that fasting blood glucose level was significantly correlated with carbohydrate consumption in the last month (r=0.197; p=0.015), glycemic index in the last month (r=0.501; p<0.001), and glycemic load in the last month (r=0.529; p<0.001). Furthermore, 1-hour postprandial blood glucose level was associated with carbohydrate intake in the morning or during breakfast (r=0.315; p<0.001), breakfast glycemic index (r=0.556; p<0.001), and breakfast glycemic load (r=0.608; p<0.001), while the 2-hour postprandial blood glucose level was correlated with carbohydrate intake during breakfast (r=0.325; p<0.001), breakfast glycemic index (r=0.580; p<0.001), and breakfast glycemic load (r=0.617; p<0.001).

Table 4 presents our multivariate analysis which found that fasting blood sugar level were significantly associated with regular physical activities (AOR=74.09; 95%CI: 7.522-729.69) and compliance to medication (AOR=11.9; 95%CI: 2.241-63.29). Furthermore, our analysis also revealed that 1-hour postprandial blood glucose level were significantly associated with compliance to medication (AOR=27.29; 95%CI: 2.298-323.95) and breakfast glycemic load (AOR=0.63; 95%CI: 0.470-0.848), while the 2-hours postprandial blood glucose level were associated with compliance to medication (AOR=19.81; 95%CI: 2.306-170.14) and breakfast glycemic load (AOR=0.69; 95%CI: 0.543-0.888). Other variables which included genetic or family history, carbohydrate intake and glycemic index were not associated with the control of blood glucose level.
Table 1. Distribution of respondents by age, sex, carbohydrate intake, glycemic index, glycemic load and blood glucose level

<table>
<thead>
<tr>
<th>Variables</th>
<th>n=73</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 39</td>
<td>13</td>
<td>17.8</td>
</tr>
<tr>
<td>40-49</td>
<td>38</td>
<td>52.1</td>
</tr>
<tr>
<td>50-59</td>
<td>20</td>
<td>27.4</td>
</tr>
<tr>
<td>≥ 60</td>
<td>2</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>31</td>
<td>42.5</td>
</tr>
<tr>
<td>Female</td>
<td>42</td>
<td>57.5</td>
</tr>
<tr>
<td><strong>Diet patterns over the last month</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Carbohydrate intake</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>20</td>
<td>27.4</td>
</tr>
<tr>
<td>Adequate</td>
<td>53</td>
<td>72.6</td>
</tr>
<tr>
<td><strong>Glycemic index</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>16</td>
<td>21.9</td>
</tr>
<tr>
<td>Moderate</td>
<td>13</td>
<td>17.8</td>
</tr>
<tr>
<td>High</td>
<td>44</td>
<td>60.3</td>
</tr>
<tr>
<td><strong>Glycemic load</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>48</td>
<td>65.8</td>
</tr>
<tr>
<td>Moderate</td>
<td>8</td>
<td>11.0</td>
</tr>
<tr>
<td>High</td>
<td>17</td>
<td>23.2</td>
</tr>
<tr>
<td><strong>Breakfast</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Carbohydrate intake</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>26</td>
<td>35.6</td>
</tr>
<tr>
<td>Adequate</td>
<td>47</td>
<td>64.4</td>
</tr>
<tr>
<td><strong>Glycemic index</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>38</td>
<td>52.1</td>
</tr>
<tr>
<td>Moderate</td>
<td>16</td>
<td>21.9</td>
</tr>
<tr>
<td>High</td>
<td>19</td>
<td>26.0</td>
</tr>
<tr>
<td><strong>Glycemic load</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>22</td>
<td>30.1</td>
</tr>
<tr>
<td>Moderate</td>
<td>27</td>
<td>37.0</td>
</tr>
<tr>
<td>High</td>
<td>24</td>
<td>32.9</td>
</tr>
<tr>
<td><strong>Blood sugar levels</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poorly controlled</td>
<td>27</td>
<td>37.0</td>
</tr>
<tr>
<td>Well managed</td>
<td>46</td>
<td>63.0</td>
</tr>
<tr>
<td><strong>1-hour postprandial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poorly controlled</td>
<td>28</td>
<td>38.4</td>
</tr>
<tr>
<td>Well managed</td>
<td>45</td>
<td>61.6</td>
</tr>
<tr>
<td><strong>2-hours postprandial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poorly controlled</td>
<td>27</td>
<td>37.0</td>
</tr>
<tr>
<td>Well managed</td>
<td>46</td>
<td>63.0</td>
</tr>
</tbody>
</table>
Table 2. The difference between blood sugar levels by physical activity, genetic or family history and compliance to medication

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
<th>Median of blood sugar levels (K1-K3)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fasting</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td>33 (45.2)</td>
<td>107 (101-114)</td>
</tr>
<tr>
<td>Not regular</td>
<td>40 (54.8)</td>
<td>144 (117-154)</td>
</tr>
<tr>
<td>p&lt; 0.001</td>
<td></td>
<td>p=0.088</td>
</tr>
<tr>
<td>Genetic or family history</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>30 (41.1)</td>
<td>126 (110-150)</td>
</tr>
<tr>
<td>No</td>
<td>43 (58.9)</td>
<td>115 (105-135)</td>
</tr>
<tr>
<td>p=0.176</td>
<td></td>
<td>p=0.180</td>
</tr>
<tr>
<td>Compliance to medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>52 (71.2)</td>
<td>110 (104-122)</td>
</tr>
<tr>
<td>Low</td>
<td>21 (28.8)</td>
<td>148 (128-154)</td>
</tr>
<tr>
<td>p&lt; 0.001</td>
<td></td>
<td>p&lt; 0.001</td>
</tr>
</tbody>
</table>

*Tested using Mann Whitney U

Table 3. Correlation between blood sugar levels with BMI, carbohydrate intake, glycemic index and glycemic load

<table>
<thead>
<tr>
<th>Variables</th>
<th>Blood sugar levels</th>
<th>r</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index (BMI)</td>
<td>Fasting</td>
<td>0.085</td>
<td>0.296</td>
</tr>
<tr>
<td></td>
<td>1-hour postprandial</td>
<td>0.083</td>
<td>0.305</td>
</tr>
<tr>
<td></td>
<td>2-hours postprandial</td>
<td>0.084</td>
<td>0.303</td>
</tr>
<tr>
<td>Carbohydrate intake</td>
<td>Fasting</td>
<td>0.197</td>
<td>0.015</td>
</tr>
<tr>
<td>Over the last month</td>
<td>1-hour postprandial</td>
<td>0.315</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Breakfast</td>
<td>2-hours postprandial</td>
<td>0.325</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Glycemic index</td>
<td>Fasting</td>
<td>0.501</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Over the last month</td>
<td>1-hour postprandial</td>
<td>0.556</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Breakfast</td>
<td>2-hours postprandial</td>
<td>0.580</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Glycemic load</td>
<td>Fasting</td>
<td>0.529</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Over the last month</td>
<td>1-hour postprandial</td>
<td>0.608</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Breakfast</td>
<td>2-hours postprandial</td>
<td>0.617</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Discussion

Our study found that regular physical activities was significantly associated with control of fasting blood sugar, but were not associated with 1-hour and 2-hours postprandial blood glucose levels. It can be explained that blood glucose was transformed into energies through oxidation processes during physical activities.\textsuperscript{21} In addition, physical activities also lead to an increased blood flow resulting in opening up of more capillary bands as well as improving effectiveness of insulin receptors.\textsuperscript{21} Our study revealed that regular physical activities were not associated with 1-hour and 2-hours postprandial blood glucose levels because the effects of diet patterns as well as the compliance factor towards medication are more dominant on the multivariate analysis. A high glycemic load might reduce the control of 1-hour and 2-hours postprandial blood glucose, while compliance to medication may improve
Table 4. Multivariate analysis using a binary logistic regression between blood sugar levels and several independent variables

<table>
<thead>
<tr>
<th>Independent variables¹</th>
<th>Blood sugar levels²</th>
<th>B</th>
<th>Sig.</th>
<th>Exp (B)</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity³</td>
<td>Fasting</td>
<td>4.305</td>
<td>&lt; 0.001</td>
<td>74.09</td>
<td>7.522-729.69</td>
</tr>
<tr>
<td>Compliance to medication⁴</td>
<td></td>
<td>2.477</td>
<td>0.004</td>
<td>11.9</td>
<td>2.241-63.290</td>
</tr>
<tr>
<td>Constant value</td>
<td></td>
<td>-2.408</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakfast glycemic index⁵</td>
<td>1-hour postprandial</td>
<td>-0.460</td>
<td>0.002</td>
<td>0.631</td>
<td>0.470-0.848</td>
</tr>
<tr>
<td>Compliance to medication⁴</td>
<td></td>
<td>3.306</td>
<td>0.009</td>
<td>27.29</td>
<td>2.298-323.95</td>
</tr>
<tr>
<td>Physical activity³</td>
<td></td>
<td>1.905</td>
<td>0.097</td>
<td>6.719</td>
<td>0.707-63.865</td>
</tr>
<tr>
<td>Carbohydrate intake during the breakfast⁵</td>
<td></td>
<td>-0.072</td>
<td>0.046</td>
<td>0.931</td>
<td>0.867-0.999</td>
</tr>
<tr>
<td>Constant value</td>
<td></td>
<td>10.615</td>
<td>0.003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakfast glycemic load⁵</td>
<td>2-hours postprandial</td>
<td>-0.364</td>
<td>0.004</td>
<td>0.695</td>
<td>0.543-0.888</td>
</tr>
<tr>
<td>Compliance to medication⁴</td>
<td></td>
<td>2.986</td>
<td>0.006</td>
<td>19.81</td>
<td>2.306-170.14</td>
</tr>
<tr>
<td>Carbohydrate intake during the breakfast⁵</td>
<td></td>
<td>-0.064</td>
<td>0.061</td>
<td>0.938</td>
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¹Variables that were included in the multivariate analysis: physical activity, genetic or family history, compliance to medication, carbohydrate intake, glycemic index, and glycemic load.

²A well managed category of fasting, 1-hour postprandial, and 2-hours postprandial glucose levels was used as a reference.

³A regular physical exercise was used as a reference.

⁴A high compliance to medication was used as a reference.

⁵The glycemic load and carbohydrate intake during the breakfast were analysed as an interval variable.

the control of 1-hour and 2-hours postprandial blood glucose.

Carbohydrate intake was not associated with fasting and 2-hours postprandial blood glucose levels, however it significantly influenced the 1-hour postprandial glucose level though the 95% confidence interval was close to 1 indicating that it might be clinically insignificant. Other study conducted at Internal Medicine Polyclinic of Prof. Dr. Soerojo Hospital found that carbohydrate intake was not associated with blood sugar levels among DM patients (p=0.717).²² In addition, a study at Dr. Moewardi District Hospital of Surakarta found that carbohydrate intake was not correlated with fasting and 2-hours postprandial blood glucose levels among DM patients (p=0.346).²³

Our study revealed that glycemic load was not associated with the control of fasting blood glucose but was correlated with the control of 1-hour and 2-hours postprandial blood glucose levels. It might be due to the dominant effects of physical activities and compliance to medication on fasting blood sugar level. Our descriptive analysis suggested that there was a significant difference of fasting blood glucose level based on physical activities and compliance to medication. Median value of fasting blood glucose level among patients who perform regular physical activities was significantly lower than those who do not regularly exercise. Similarly, median value of fasting blood sugar level among patients with high compliance was lower than those with poor compliance. In addition, during the fasting period there was no glucose consumption for about 10-12 hours where all blood glucose came from glycogenolysis on the liver.²¹ Our finding is consistent with other study conducted at Batua Raya Public Health Centre and Bara Barayya Public Health Centre in Makasar City which found that there was a significant association between blood glucose level and glycemic load (p=0.004).²⁴ Other study at Dr. Kariadi Hospital in Semarang City also found that there was a positive association...
between glycemic load and 2-hour postprandial blood glucose level \((r=0.775; p<0.001)\).11

Our study identified that compliance to medication was significantly associated with fasting, 1-hour, and 2-hours postprandial blood glucose levels. In addition, our analysis also revealed that there was a significant difference in median blood glucose values based on compliance to medication. Patients with high compliance were found to have a lower median blood sugar (fasting, 1-hour and 2-hour post prandial) values than those with poor compliance. Our finding is consistent with other study conducted in Umbulharjo II Public Health Centre, Yogyakarta which found that there was a significant association between compliance to medication and blood sugar level among DM patients \((OR=8.57; 95\%CI: 2.05-35.92)\).25

Our study found that genetic factor or family history was not associated with fasting, 1-hour, and 2-hours post prandial blood glucose levels. This might be due to the dominant effects of the glycemic load and compliance to medication. Our descriptive analysis suggested that most of our patients consumed a low glycemic load diet (76.7% in the last month, 72.6% during the breakfast at the hospital) and adhered to their medication either oral tablet or insulin injection (71.2%). These findings are consistent with a cross-sectional survey among BMPK employees and Local Secretariat of Depok City in 2014 which found that history of DM in the family was not associated with fasting blood glucose level \((p=0.211)\).26 However, a cross-sectional study conducted at Cengkareng Public Health Centre in West Jakarta found that family history or genetic increased the likelihood to acquire DM \((OR=4.19; 95\%CI: 1.25-14.08)\).27 In our study, all respondent are DM patients therefore family history was no longer a dominant determinant that influences blood sugar levels.

Our study also found that BMI was not associated with fasting, 1-hour, and 2-hours post prandial blood glucose levels. Our finding is consistent with a cross-sectional study conducted in Nigeria which found that there was no significant association between BMI and random blood glucose level \((r=0.00; p=0.30)\).28 However, our study is different from cross-sectional studies conducted in India and Estonia which discovered that there was a significant correlation between BMI and blood glucose level among DM patients.29,30

Furthermore, our study showed that glycemic index was not correlated with fasting, 1-hour, and 2-hour post prandial blood glucose levels. This might be due to the dominant effects of other independent variables in the multivariate model which included physical activities, compliance to medication, and glycemic load. Our finding is consistent with a nested cohort study conducted in Europe Region which found that food with high glycemic index were not associated with increased risk of acquiring DM.31 Another study at Sanglah General Hospital Denpasar also revealed that there was no significant association between glycemic index and the control of blood glucose among DM patients.12

One of main limitation of our study is that we utilize glycemic index data from other countries due to limited data available on glycemic index for Indonesian food. In addition, our study also uses data on diet patterns over the last month by using SQ-FFQ which very much depends on the memory and recall ability of the respondents.

Our study indicates that there is a growing need for education program for DM patients related to management of blood glucose level covering issues on consumption of low glycemic index food, regular physical activities, and promoting adherence towards medication.

**Conclusion**

Breakfast glycemic load was associated with an increased of 1-hour and 2-hours postprandial
blood glucose levels, however it did not affect the fasting blood glucose level. Regular physical activities were associated with the fasting blood glucose level. The compliance to medication was associated with 1-hour and 2-hours postprandial as well as fasting blood glucose levels.

Acknowledgement

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Instruction for authors

1. Manuscript must be written in English or Bahasa Indonesia of maximum of 3000 words (not includes abstract) and consists of 3-4 key arguments, and 3-4 tables and or graphs. It must be written in Microsoft Word with the maximum file capacity of 5 MB. Manuscript must be electronically submitted. Editors can change the format of the manuscripts but not the content.

2. Title must be concise and ensure it reflects the subject matter. Title page should be no longer than 18 words.

3. Authors’ name and affiliation must be placed under the title. Corresponding author’s email address must be stated to allow further discussion and interaction with the audience.

4. Abstract should be no longer than 300 words and must reflect the subject matter which includes: background and purpose, methods, results, and conclusion. It should also be accompanied by 3-5 key words.

5. Introduction must concisely address the existing gaps in the literature and state precisely study objectives.

6. Methods must clearly outline the study design, population, sample, source of data, data collection techniques, research instruments, and data analysis.

7. Results present findings of the study without opinion of the authors. Findings should be concise and can be presented using tables, graphs, and narratives. Table must be single space and must be numbered based on its occurrence in the text. The maximum of four tables and/or graphs are allowed which must contain a short self explanatory title. The title of table is placed above the table with left alignment, single space. The title of graph is placed under the graph with centre alignment, single space.

8. Discussion explains precisely findings of the study supported by sound theoretical and evidence from previous studies. Specific to qualitative studies, findings can be presented along with the discussion.

9. Conclusion should answer the research questions and can include a brief recommendation.

10. Acknowledgements should be addressed to related stakeholders who had supported the study, including respondents.

11. Reference lists
   It contains all references cited in the text. Referencing format must follow the Vancouver style (superscript without bracket), and should refer to the most up-to-date available evidence. Author's last name followed by the initials of their first and middle name should be consistently used. When the authors are up to six, all authors should be written, but when those are more than six, the first six authors should be written followed by et al. The title of article must be written in sentence case. If the journal acronym is used, it should confirm to Medicus Index. Examples of referencing styles of different sources can be seen in the appendix.

12. Authors should pay attention on their writing structure, including sentence structure, accuracy of the text, table or graph. All accepted manuscripts will be provided back to the authors if the format has not complied with the instruction guidelines.

13. Authors must state their full name, qualifications, corresponding address, and affiliations. They should also complete the agreement form of right transfer for publication purposes only.

14. All manuscripts are subject to peer review processes and reviewed by editors. Further revision is requested prior to publication, or rejected for publication. Editors will provide the final decision and notify the authors whether the manuscript is accepted for publication.

15. Accepted manuscript written in Bahasa Indonesia will be translated by the PHPMA production editor, with the cost of IDR 3,000,000.

16. Manuscript must be submitted electronically to the following email: jurnalmikm@gmail.com
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Every cited reference must appear in the reference lists and vice versa. The citation in the text should be numbered, for example: 1 or 2. If the citation is more than two references, only the first and the last number are written separated by ‘dash’, for example 1-3 or 3-8. The citation must be superscript and must be placed after the text, for example: Nutritional assessments can be done by several methods which are anthropometric\(^1\), dietetic\(^2\), and biochemistry tests.\(^3\)

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Appendix 2. Guidance for statistical reporting

This guidance is provided to assist authors preparing for their statistical report for publication. This guidance is not to replace the existing statistical guidelines required in a quantitative study. Each component is elaborated below.

Abstract:
Total sample and source of data must be clearly stated. Any conclusion made from statistical tests must be accompanied by descriptive statistic reports for example mean, median, mode, standard deviation, interquartile, variation coefficient percentage, 95% confidence interval, regression formula, and so forth.

Methods:
For an experimental study, sampling technique and randomisation procedure must be clearly provided. If applicable, analytical precision should also be stated. Statistical hypothesis must be clearly stated. Power of the study should be provided in relation to sample size calculation (it is recommended to use at least 80%). For a case control design, selection procedures for cases and controls must be explained in great depth. When applicable, matching procedure should also be clearly stated. For a diagnostic study or a clinical trial, it is recommended to refer to other reporting structures for example STARD, CONCORT, or STROBE.

Results:
Any insignificant precision should be avoided, especially when presenting data using table. A rounded data is easier to read and often decimal numbers are not essential. It is recommended for percentage data to report only one decimal digit (for example 27.9%). If the sample size is relatively small, it is strongly recommended to avoid decimal numbers. Data distribution must be reported in terms of mean, standard deviation, or coefficient variation percentage and must be reported as ‘mean (SD)’ instead of ‘mean ± SD’. If data are not normally distributed (after the Shapiro Wilk Test), median and interquartile range must be used to replace mean and standard deviation. A skewed data could be normalised by applying a logarithm or power transformation. All statistical analysis must use this transformed data which then must be re-transformed for data presentation. All individual values must be presented (if applicable) by deleting all overlapping values. Error bars which reflect standard error for each mean value or interquartile range for each median value can be used to guide data interpretation.

Each statistical test such as chi square test must be reported with the descriptive data, degree of freedom and p-value. Validity of each assumption prior to the test should be examined (for example data should be normally distributed when a t-test is used with the same variance for each data set). When a contingency table is used (2x2 table) for chi square test, continuity correction should be considered and if the expected count is low, the Fisher Exact value should be used. P-values should be clearly provided to show significance of such test. When the statistical test shows a very significant result and p-value from the computer program calculation is 0.0000, p-value should be presented as ‘p<0.0005’. Confidence interval must also be clearly stated, particularly for the insignificant results. As a general principle, statistical analysis should be reported as p ≤ 0.05. If another method is used, this must be clearly justified on the method section of statistical analysis.

Discussion:
A result of statistical test is not the most critical point of discussion. It is recommended that p-value should not be compared for different data set or for a different statistical analysis. Each association must not be interpreted as causal relationship without a sound supporting evidence.
**Statistical issues:**

*Multiple Comparisons*
This can cause misleading interpretation for significance values. Primary hypothesis must be clearly stated. Every association identified from a retrospective method must be interpreted with cautions. If applicable, one statistical test should be performed to all variables, for example ANOVA test. If this test is not significant, multiple comparisons thus can be applied. If ANOVA test is not applicable (or related statistical tests), multiple comparisons can be applied by referring to Bonferroni test.

*Paired Data*
For paired data, the difference for each pair and variability from these differences is more significant than the values of each individual. It is recommended to use graph for example plotted lines to present paired data.

*Standard regression analysis*
To perform this analysis, independent data are required (repeated measurements are not an independent data). Independent variables are measured without significant errors and all data must be normally distributed without outliers. These can be easily tested using a scatter plot diagram.

*Method comparison*
It is inappropriate to compare methods using regression and correlation coefficient. It is recommended to use the Altman and Bland Difference Plot. If regression and standard scatter plot are considered useful, it can be presented along with the Altman-Bland Plot. It should always be considered that if two methods are supposed to measure the same matter, it is highly possible that both are correlated, therefore correlation value provides limited information for interpretation. When a more complex statistical analysis is performed for example a multivariate analysis including ROC test or other tests, it is recommended that the authors should consult to statisticians.
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