RELATIONSHIP BETWEEN HOMOCYSTEINE LEVELS AND RISK OF DEPRESSION IN OFFICE WORKERS WITH VEGAN DIETS IN JAKARTA

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ABSTRACT
Based on the World Health Organization (WHO), more than 280 million or as much as 28% of the world's population experience depression (Organization, 2022). This study used a cross-sectional research design to determine the relationship between homocysteine levels and PHQ-9 scores in office workers with vegan diets in Jakarta. The characteristics of the subjects of this study are men and women in the Jakarta area with an age range of 18-64 years with an average age of 33 years, having overweight nutritional status.

INTRODUCTION
Based on the World Health Organization (WHO), more than 280 million or as much as 28% of the world's population experience depression (Organization, 2022). Depression is a major global public health problem and a leading cause of disability (Liu et al., 2020). According to WHO, depression has been ranked third in the global burden of disease since 2004 and is expected to rank first by 2030 (Ren et al., 2020). The 2018 Basic Health Research (Riskesdas) shows that more than 12 million Indonesians aged more than 15 years have depression (Tias Endarti, Andriani and Setyo Pambudi, 2020).

Depression in Indonesia is influenced by socioeconomic status factors, which include education, income, and employment, so this is related to depression can cause performance disorders, worker absenteeism so that it can reduce workers' work productivity. Globally, the increased risk of depression in adults is not spared from the growing vegan diet trend (Kahleova, Levin and Barnard, 2018). The vegan population in Indonesia currently reaches 160 thousand people or an increase of 2.7 times folding since 2017 (Rizzo and Baroni, 2018). Recently, vegan diets have become popular because they promote health, as well as reduce environmental damage (Hemler and Hu, 2019).

Vitamin B12 deficiency in vegans can increase homocysteine levels, due to the body's inability to convert homocysteine to s-adenosymlethionine which will be
responsible for providing methyl groups to form the neurotransmitters dopamine, serotonin, and norepinephrine. Low neurotransmitters can lead to the development of depressive symptoms, and hyperhomocysteine can lead to depressive conditions, schizophrenia, autism, Parkinson's and bipolar disorder.

Studies examining vegan diets on the incidence of depression are currently showing inconsistent results (Fazelian et al., 2022). A meta-analysis of 13 studies conducted by Iguacel et al, found that vegans and vegetarians can increase the risk of depression 2.14 times than non-vegans and vegetarians. In addition, a systematic review revealed conflicting evidence that this dietary pattern is beneficial for depression for both risk management and symptoms (Li et al., 2017).

In Indonesia, there are a variety of screening tools for depression, known as the patient health questionnaire-9 (PHQ-9) is the first step approach to depression screening (Carroll et al., 2020). Given that existing research still shows inconclusive results between the relationship between depression risk and vegan diets in office workers, it is necessary to conduct research to determine the correlation between the two associated with increased homocysteine levels.

**Problem Statement**

**Identify the Problem**

Based on the background description of the problem above, the research problem can be formulated as follows:

1. The prevalence of depression in Indonesia is increasing.
2. Indonesia's growing vegan population.
3. Vegans are at high risk of vitamin B12 deficiency which will correlate with an increase in homocysteine.
4. Hyperhomocysteemia plays an important role in the incidence of depression.
5. There have been no consistent results between homocysteine association and depression risk.

**Research Questions**

Is there a relationship between homocysteine levels and the risk of depression in office workers with vegan diets in Jakarta?

**Hypothesis**

There is a relationship between homocysteine levels and the risk of depression in office workers with vegan diets in Jakarta.

**Research Objectives**

**General Purpose**

Knowing the relationship between homocysteine levels and the risk of depression in office workers with vegan diets in Jakarta.

**Special Purpose**

1. Knowing the characteristics of the subject based on sociodemographics (age, gender, marital status, amount of income, occupation, education), anthropometry in the form of body mass index (BMI), smoking history, alcohol consumption, physical activity, vitamin B12 intake.
2. Knowing homocysteine levels in office workers with vegan diets in Jakarta.
3. Assess the risk of depression among office workers with vegan diets in Jakarta.
4. Knowing the relationship between variables (age, sex, marital status, amount of income, occupation, education, anthropometry in the form of body mass index (BMI), smoking history, alcohol consumption, physical activity, vitamin B12 intake) with PHQ-9 scores
5. Knowing the relationship between homocysteine levels and PHQ-9 in office workers with vegan diets in Jakarta.

Research Benefits
Benefits for Research Subjects
Provide knowledge about homocysteine levels in the subject's body and its relation to health and whether the subject is at risk of depression related to the vegan diet undertaken.

Benefits to Institutions
Can be used as a guide for policymaking in institutions where work, especially in the field of depression prevention, and can be the basis for further research.

Benefits for Researchers
Provide scientific data on the relationship between homocysteine levels and total PHQ-9 scores in office workers with vegan diets in Jakarta and apply knowledge gained during education.

RESEARCH METHODS
Research Design
This study used a cross-sectional research design to determine the relationship between homocysteine levels and PHQ-9 scores in office workers with vegan diets in Jakarta.

Place and Time of Research
The research will be conducted in Jakarta in June-July 2023.

Research Materials
1. Target Population
The target population is all office workers in Jakarta with a vegan diet.

2. Affordable Population
The affordable population is all office workers who follow a vegan diet for at least 2 years. The subject is aged 18-64 years, working in Jakarta.

3. Research Subject
The subjects of the study are part of an affordable population that meets the inclusion criteria and is willing to participate in the research.

Research Subject Criteria
Inclusion Criteria
a) Male or female aged 18-64 years.
b) Undergo a vegan diet for 2 years.
c) Is an office worker.
d) In good health, not taking depression and/or anxiety medications.

Exclusion Criteria
a) Have gastrointestinal diseases (bleeding, impaired absorption, intrinsic factor deficiency).
b) Taking vitamin B12 and/or folic acid supplements.
c) Have a mental disorder.
d) Are pregnant and breastfeeding.

RESULTS AND DISCUSSION

After obtaining approval from the Ethics Committee of the Faculty of Medicine, University of Indonesia with certificate number passing the KET-840/UN2 ethics review. F1/ETIK/PPM.00.02/2023 (Appendix 1), a study using a cross-sectional design conducted to see the relationship between homocysteine levels and the risk of depression in office workers. Data collection will be carried out in July-August 2023. The sampling was conducted at a vegan community location in Jakarta.

Figure 1 Research Subject Selection Flow

After ELISA was carried out on 58 homocysteine samples, 2 samples dropout was obtained because they underwent lysis to produce extreme numbers, so that the number of homocysteine samples analyzed was 56 samples.

Characteristics of the subjects in this study were seen based on sex, age, education level, income, marital status, nutritional status, smoking habits, alcohol consumption, physical activity level, homocysteine levels (Table 4.1). In the age characteristics that have been limited according to the productive age of 18-64 years,
the study subjects had an average age of 33.07±10.31 years with the majority of women.

Table 1 Distribution of Subjects Based on Sociodemographics, Homocysteine Levels, Vitamin B12 Intake, and Risk of Depression

<table>
<thead>
<tr>
<th>Variable</th>
<th>n(%)</th>
<th>Mean±SD</th>
<th>Median (min-max)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong>*</td>
<td>33.07±10.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Man</td>
<td>24</td>
<td>42.9</td>
<td></td>
</tr>
<tr>
<td>Woman</td>
<td>32</td>
<td>57.1</td>
<td></td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥UMR</td>
<td>48</td>
<td>85.7</td>
<td></td>
</tr>
<tr>
<td>&lt; UMR</td>
<td>8</td>
<td>14.3</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 12 years of compulsory education</td>
<td>44</td>
<td>78.6</td>
<td></td>
</tr>
<tr>
<td>≤12 years of compulsory education</td>
<td>12</td>
<td>21.4</td>
<td></td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unmarried</td>
<td>27</td>
<td>48.2</td>
<td></td>
</tr>
<tr>
<td>Marry</td>
<td>29</td>
<td>51.8</td>
<td></td>
</tr>
<tr>
<td><strong>Smoking Habits</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not</td>
<td>55</td>
<td>98.2</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td><strong>Alcohol Consumption</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not</td>
<td>14</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>42</td>
<td>75.0</td>
<td></td>
</tr>
<tr>
<td><strong>Nutritional Status</strong>*</td>
<td></td>
<td>23.29±3.57</td>
<td></td>
</tr>
<tr>
<td><strong>Depression Score</strong>*</td>
<td></td>
<td>4.75±3.87</td>
<td></td>
</tr>
<tr>
<td><strong>Homocysteine Levels</strong>*</td>
<td></td>
<td>3.48±0.76</td>
<td></td>
</tr>
<tr>
<td><strong>B12 Intake</strong>*</td>
<td></td>
<td>4.17±0.79</td>
<td></td>
</tr>
<tr>
<td>Physical Activity**</td>
<td></td>
<td>575 (144-1006)</td>
<td></td>
</tr>
</tbody>
</table>

*Mean±SD **n% *** Median(Min-max); UMR: Regional Minimum Wage

Subject characteristics based on socioeconomic status, of the total subjects, only a small percentage of 14.3% have income below the UMR, while for educational characteristics, 78.6% have S1/S2/S3. In the marital status variable, as many as 51.8% of subjects had married status. Subjects' habits were based on alcohol consumption habits of 42 subjects (75%) and for smoking habits only 1 subject (1.8%) smoked. Table 4.4 also shows the nutritional status of the study subjects, it was found that the
average BMI was overweight 23.29±3.57 and from the total total subjects had met the recommended intake of vitamin B12 according to the RDA.

The subjects of the study were screened for depression using the PHQ-9 measuring instrument, obtained an interpretation of the range of results that did not have symptoms of depression to mild depression, with 29 subjects not experiencing depression (score 0-4), 18 subjects classified as symptoms of mild depression (scores 4-9), and 9 subjects experiencing mild depression (scores 10-15). The subjects' physical activity was light activity where there were 17 subjects with GPAQ <600 and 39 subjects with GPAQ ≥ 600. The subjects' overall homocysteine levels fall into the low category with the smallest homocysteine value being 1.24μmol/L to the highest homocysteine yield being 5.388μmol/L from the normal cut-off is < 14μmol/L.

Risk of depression based on the characteristics of the study subjects

Table 1 Bivariate analysis of numerical variables with PHQ-9 Score

<table>
<thead>
<tr>
<th>Variable</th>
<th>r</th>
<th>p-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age*</td>
<td>-0.318</td>
<td>0.017***</td>
<td>-0.536 – (-0.060)</td>
</tr>
<tr>
<td>Homocysteine Levels*</td>
<td>0.112</td>
<td>0.412</td>
<td>-0.156 – 0.364</td>
</tr>
<tr>
<td>Nutritional Status*</td>
<td>0.158</td>
<td>0.246</td>
<td>-0.110 – 0.404</td>
</tr>
<tr>
<td>B12 Intake*</td>
<td>-0.123</td>
<td>0.365</td>
<td>-0.374 – 0.144</td>
</tr>
<tr>
<td>Physical Activity**</td>
<td>-0.041</td>
<td>0.899</td>
<td>-0.301 – 0.224</td>
</tr>
</tbody>
</table>

**Pearson correlation**Spearman correlation; ***p<0.05

Table 3 Bivariate analysis of categorical variables with PHQ-9 Score

<table>
<thead>
<tr>
<th>Variable</th>
<th>P-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ UMR</td>
<td>&lt;0.001**</td>
<td>2.99 – 5.09</td>
</tr>
<tr>
<td>&lt; UMR</td>
<td></td>
<td>7.00 – 10.99</td>
</tr>
<tr>
<td>Education*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 12 years of compulsory</td>
<td>&lt;0.001**</td>
<td>-7.63 – -2.29</td>
</tr>
<tr>
<td>education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 12 years of compulsory</td>
<td></td>
<td>-7.103 – -2.81</td>
</tr>
<tr>
<td>education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Man</td>
<td>0.059</td>
<td>0.75 – 4.01</td>
</tr>
<tr>
<td>Woman</td>
<td></td>
<td>0.02 – 3.95</td>
</tr>
<tr>
<td>Smoking Habits*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not</td>
<td>0.173</td>
<td>-13.1 – 2.41</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol Consumption*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not</td>
<td>0.969</td>
<td>2.36 – 2.46</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The correlation analysis on the age variable \( r = -0.318 \) with the risk of depression has a relationship but based on interpretation the correlation coefficient is moderately correlated, while for homocysteine levels \( r = 0.112 \) shows a weak correlation with the risk of depression. The average income of subjects above the UMR (\( p\text{-value}<0.001 \)) and the average education of subjects over 12 years (\( p\text{-value}<0.001 \)) showed a significant relationship with the risk of depression. Marital status also showed a significant relationship \( p<0.05 \).

The association between sex and depression risk showed no significant association and was the same as smoking, vitamin B12 intake, and physical activity \( (p > 0.05) \).

### Table 4 Bivariate analysis of homocysteine variables with vitamin B12 intake

<table>
<thead>
<tr>
<th>Variable</th>
<th>Homocysteine Levels (n = 56)</th>
<th>( r )</th>
<th>( p\text{-value} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12 Intake</td>
<td></td>
<td>-0.325</td>
<td>0.014 *</td>
</tr>
</tbody>
</table>

*Pearson correlation \( *p<0.05 \)

Researchers conducted a correlation analysis on homocysteine levels with vitamin B12 intake, the results of the analysis showed a correlation of \(-0.325\) with a moderate correlation interpretation and a \( p\text{-value} < 0.05 \) means that it shows a significant relationship, it means that there is a moderate correlation with any decrease in vitamin B12 intake that can increase homocysteine levels. It is in line with the results of this study that subjects had low homocysteine and an appropriate intake of B12 RDA.

Based on the results of bivariate analysis, it was found that the variables age, income, education had a \( p\text{-value} < 0.20 \) so that these variables continued to the multivariate stage, and homocysteine levels were also included in the multivariate because they were contained in the objectives of this study.

**Association between homocysteine levels and depression risk**

To see the relationship between homocysteine levels and the risk of depression was done with multivariate linear regression.

### Table 5 Multivariate analysis of variables with depression risk

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>95% CI</th>
<th>( p\text{-value} )</th>
<th>Adj R-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.076</td>
<td>-0.164,-0.013</td>
<td>0.092</td>
<td>0.350</td>
</tr>
</tbody>
</table>
The multivariate analysis did not produce significant results on age, income and homocysteine levels. Only educational variables had significant outcomes, but adjusted R-square assessments showed they represented only 35% of variables at risk for depression.

Characteristics of the Research Subject
The subjects in this study were 57.1% women and 42.9% men, the overall subjects in this study were of productive age with an average age of 33 years. Based on the Cabinet of the State Secretariat of the Republic of Indonesia that currently there are 250 million people, and 60% of the population is of productive age. This number, according to the President, will continue to increase and it is estimated that later in 2040 the number of Indonesia's productive age will reach 195 million.97 Office workers are used as subjects in this study because they are of productive age and easily accessible for research. The office worker in this study was someone who spent between two-thirds and three-quarters of their working hours sitting around doing office work both in the office and outside the office.99 All subjects followed a vegan diet for a variety of reasons, but the main one was religious spirituality.

In this study, the marital status of subjects was also measured using the interview method, the prevalence of marital status in all subjects was married (51.8%) and the rest were unmarried for reasons of busy work. Education characteristics, 78.6% of S1/S2/S3 college graduates with a low risk of depression, this is in line with research by Bhina Patria, 2022 that higher education is one way to improve public health conditions, that there is a significant and consistent relationship between formal education attainment and physical and mental health outcomes. Individuals with better education will be healthier and live longer. One reason is that better education will improve health literacy.80

Income below the UMR is a risk factor for depression, Sareen et al. suggest that individuals with lower household income levels face an increased risk of depression compared to those with higher household income levels.81 Based on the results of researcher interviews, office workers with incomes below the Jakarta UMR have different types of work, namely salaries with commission systems, payment as per attendance, and as a freelancer or freelancer.

For smoking status, only 1 subject has a smoking habit, based on the observations of researchers, the low percentage of smokers because the average

<table>
<thead>
<tr>
<th>Income</th>
<th>≥ UMR</th>
<th>&lt; UMR</th>
<th>Reff</th>
<th>1,545</th>
<th>-1.682-4.772</th>
<th>0,341</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>&gt; 12 years of compulsory education</td>
<td>≤ 12 years of compulsory education</td>
<td>4,217</td>
<td>1.410-7.023</td>
<td></td>
<td>0,004*</td>
</tr>
<tr>
<td>Homocysteine Levels</td>
<td>0,107</td>
<td>-1,06-1,274</td>
<td>0,855</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05
subject has higher education, Tamioka, et al explained that the higher the level of 
knowledge will increase health awareness. 100

In the habit of alcohol consumption, because alcohol is a vegetable 
fermentation, namely rice, sugarcane, potatoes, cassava, corn and wine, the 
subjects still consume it, there are even subjects who require consuming alcohol in 1 
day as much as 1-2 sloki (25ml), this is in accordance with the Mediterranean diet 
pattern which states that the antioxidant content in alcoholic fermentation in the 
form of phenolic acid can be an antioxidant for the body, prevents cancer, and 
neurodegenerative diseases. 101

Vitamin B12 intake in subjects has reached RDA, even though the subjects do 
not consume animal foods but vitamin B12 needs are still met, based on the SQ-FFQ 
assessment, tempeh is the main food in fulfilling the subject’s protein. Tempeh is the 
result of fermented unsalted soybeans inoculated with Rhizopus oligosporus mold. 
The process is boiled, soaked and wrapped and then incubated at a temperature of 
300 – 370 °C for 24 – 36 hours. The purpose of incubation is to grow mold on the 
surface of tempeh and penetrate the soybean seeds and unite into tempeh. The 
average level of vitamin B12 in tempeh is around 5μg/100g. Vitamin B12 in tempeh is 
produced by Klebsiella pneumoniae and the bacterium Citrobacter freundii during 
the soaking and fermentation process. Klebsiella pneumoniae and Citrobacter 
freundii are not pathogenic so they are safe for consumption. According to the 
subjects, they have often attended seminars and workshops on making tempeh 
independently, even some subjects have routinely made tempeh at home by adding 
yeast that has been fortified with vitamin B12. All subjects always chose foods that 
had been fortified with vitamin B12 because they already knew that vitamin B12 
deficiency could occur in their diet.88

The nutritional status of the subjects had an average overweight, subjects 
stated that sitting for hours and rarely doing physical activity was the cause of 
overweight, weight gain experienced since the last 2 years after the pandemic, plus 
the number of vegan fast food in Indonesia lately. The subject stated that during the 
pandemic they were afraid of contracting the Coronavirus, so the subjects ate more 
regularly and diligently exercised at home, thus making their weight ideal.

Physical activity is assessed using GPAQ which is one of the instruments used 
to measure physical activity levels developed by WHO. In this study showed less 
results of <600 MET, meaning that it has not met moderate-heavy physical activity 
per week. Although the subjects stated that they preferred to use public 
transportation and walk, the intensity of exercise was reduced compared to the last 
2 years.

**Distribution of homocysteine levels in study subjects**

Plasma homocysteine levels were obtained from the assessment of blood 
samples measured at the Laboratory of Biochemistry &; Molecular Biology, Faculty 
of Medicine, University of Indonesia. A total of 58 research subjects were sampled 
from a vein and inserted in a vaccuncontainer tube and then carried out a centrifugation 
process to separate blood plasma. There were 2 subjects who dropped out because 
they produced extreme numbers due to blood lysis, so only 56 samples were
analyzed in this study. From the results of the analysis, a median of 3.48μmol/L was obtained with the smallest yield value of 1.240 μmol/L and the largest 5.388 μmol/L.

Homocysteine levels in all vegan subjects were within normal to low limits (<14 μmol/L), these results are not in line with existing theories about vegans who lack vitamin B12 so that they can increase homocysteine levels. Currently, vegans already know that vegan diets are at risk of vitamin B12 deficiency, for that because they have good literacy, they consume vitamin B12 fortified foods, this is stated in an experimental study by Susianto, 2020, providing vitamin B12 fortified oatmeal powder made by the Bogor Nutrition Research and Development Center. Each subject consumed 100 grams of vitamin fortification material daily for three months from March 20, 2010 to June 19, 2010, resulting in a decrease in the median homocysteine value from baseline before intervention began by 20.1 μmol/L to 15.1 μmol/L at the end of the intervention.87

In addition, research in the United States also states that yeast (nutritional yeast) has been enriched with vitamin B12, about 2 tablespoons of yeast has contained vitamin B12 half of the RDA for adults.88 All subjects in this study had normal-low homocysteine levels in line with research by M. Krajcovicova, average homocysteine levels in vegetarians 13.18 vs. 10.19 μmol in omnivores, Indeed, it appears that vegetarian homocysteine levels are higher but the average is still within normal limits of <14 μmol/L.89

Since 2016, Gianluca Rizzo through his research has recommended that if the consumption of animal foods is very low or absent, then his vitamin B12 needs can be met through supplements or fortified foods.86 The Academy of Nutrition and Dietetics also recommends the same.91 Vitamin B12 deficiency is currently less of a scourge for vegans because of the presence of vitamin B12-fortified foods.

This study also examined the intake of vitamin B12 which has been known to be directly related to homocysteine levels in the body. Because consumption of animal products is so low in vegans, vitamin B12 intake is at risk of decreasing and can increase homocysteine levels in the body.92 Good literacy in subjects led them to know that reliable sources of B12 for vegans are foods fortified with B12 (including some plant-based milks, some soy products, and some breakfast cereals) and B12 supplements.

The absorption of vitamin B12 in the body begins from foods containing B12, the process begins in the mouth when food mixes with saliva. The liberated vitamin B12 then binds to haptocorrin, a cobalamin-binding protein, then in the stomach vitamin B12 binds to hydrochloric acid and proteases, then in the duodenum, digestive enzymes free vitamin B12 from haptocorrin, and this liberated vitamin B12 combines with intrinsic factor, a binding protein for transport which is then secreted by gastric parietal cells. The complex is absorbed in the distal ileum through receptor-mediated endocytosis and then distributed to organs (Fan et al., 2016).

The body can store 1-5 mg of vitamin B12 in the liver and can store up to 1-5 years (Butola et al., 2020). In 1 day the B12 needed by the body is about 1-2 μg, so that if the subject regularly consumes tempeh and foods that have been fortified with vitamin B12 it can meet daily needs and stored in the body long enough. In this study,
normal vitamin B12 results can be attributed to adequate stores in the body due to a diet that has been fortified with vitamin B12 (Azzini, Raguzzini and Polito, 2021).

**Distribution of risk of depression in subjects**

Risk of depression was assessed using PHQ-9 (Costantini et al., 2021). These tools have been validated and used as depression risk screening in health facilities in Indonesia (Tran et al., 2019). In the risk spread, PHQ-9 has an average of 4.75 with the lowest value being 0 and the highest being 13. Based on the results of the highest depression score in this study, there were 2 subjects with each score was 13. Based on the ages of the two, namely 23 years and 25 years according to IFLS research, the age of 18-25 years has a high risk of depression with PR = 1.69, 95% CI 1.59-1.8182.

In this study, researchers also interviewed 58 subjects about their jobs, most stating that they worked >40 hours per week, in accordance with the theory that excessive working hours in office workers have a 1.94-fold increased risk of depression (OR = 1.94; 95% CI, 1.34–2.82).40 This is also made clear by a South Korean study by Yeogyeong Yoon, et al. that the risk of depressive symptoms was significantly higher in people who worked more than 68 hours/week (PR: 1.14, CI: 1.07–1.21).90

**The Relationship Between Homocysteine and the Risk of Depression in Subjects**

In this study, a linear regression statistical test was conducted to see the relationship between homocysteine levels and the risk of depression in vegans, although the bivariate test did not show significant results p-value 0.412.

In some studies that link homocysteine with depression risk with vegan subjects, such as in Saraswathy study, 2019 there is an association between hyperhomocysteine and depression risk, OR 4.09 (95% CI 0.93-17.99) but this study was conducted in the population of Bhil, India which is poor, so the depressive condition is also caused by the socioeconomic subject, so this is a limitation of the study.66

Megan Frances Lee's 2021 study, the relationship between homocysteine, depression risk and a vegan diet has a vague relationship (Garcia-Garcia et al., 2023). A cross-sectional study of 219 adults aged 18–44 years (M=31.22, SD=7.40) explored the association between the estimated overall quality of plant-based diets and depression in vegans (n=165) and vegetarians (n=54). Overall the quality of plant-based diets was associated with depressive symptoms in vegans and vegetarians OR (1, 215) p<0.001 while for those without depression, it was stated that better food quality with high antioxidant levels in vegans and vegetarians actually protected against depressive symptoms OR (1, 125) p = 0.012.94

Other studies explain that there are other pathways that can reduce the risk of depression, namely the hypothalamic-pituitary axis (HPA Axis), oxidative stress reactions, inflammatory processes, gut microbiota, and epigenetics where these pathways can reduce the risk of depression from eating healthy foods. This has been proven in Wolfgang Marx’s research in 2020, which states that consumption of a Mediterranean diet (75% plant-based food composition) can increase antioxidant levels so as to prevent depressive events.95
Published by the World Journal Psychiatry regarding dietary recommendations for depression prevention is to carry out a Mediterranean diet pattern, namely increasing the consumption of fruits, vegetables, nuts, cereals, whole grains, nuts and seeds, consumption of foods rich in omega-3 polyunsaturated fatty acids and limit intake of processed foods, 'Fast food', and sweet treats.

In addition to antioxidants, in the study of Gianluca Rizzo, et al. the conversion of homocysteine to methionine is available in 3 pathways, the transulfuration pathway and folic acid dependent and folic acid independent. In the independent folic acid pathway, there is choline as a betaine precursor that can convert homocysteine into methionine so that hyperhomocysteine does not occur. Whole plant foods have a higher choline content than most animal products, so if plant-based foods are met, vegans can lower the risk of depression due to increased homocysteine96

Based on previous research that depression is not only caused by increased homocysteine but can be caused by multifactorial, including low antioxidant intake, gastric intrinsic factor disorders, poor food quality that causes dysbiosis.

**Research limitations**

This study has limitations in not assessing whether the subjects consumed vitamin B12 fortified foods or not and adding yeast to the subjects' diets so that it may be biased in this study. These efforts are made to prevent health problems due to increased homocysteine levels, so that these efforts are expected not to give a bad image to religious teachings.

**CONCLUSION**

The characteristics of the subjects of this study are men and women in the Jakarta area with an age range of 18-64 years with an average age of 33 years, having overweight nutritional status. B12 intake in all subjects was sufficient according to RDA, income >UMR, and education >12 years. Average physical activity was less, the subjects' average smoking status was non-smoking. The average plasma homocysteine level in the study subjects was 3.48 μg / l meaning low. The average PHQ-9 result of the subjects was 4.75 with an interpretation of no depression to moderate depression. There was no association between homocysteine levels and the risk of depression in office workers on vegan diets in Jakarta

**BIBLIOGRAPHY**


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