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# Comparison of Fasting Blood Glucose Levels Based on Light Exposure on Glucose Strips Using Point Of Care Testing (POCT)

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***Abstract***. *A blood sugar test is an examination procedure performed to determine blood sugar levels in the body. This study entitled "Comparison of Blood Glucose Levels Based on Light Exposure to Glucose Strips Using Point Of Care Testing (POCT)". The research method used is pre-experimental. This study aims to determine the comparison of glucose levels based on exposure to light on glucose strips using POCT. This sample collection was carried out using the Federer formula with a total sample of 16 respondents. The data collection technique in this study was carried out using the Shapiro Wilk normality test and the t-test. Glucose levels examined using glucose strips that were not exposed to sunlight obtained an average value of 87.31 mg/dL. Meanwhile, glucose levels were examined using glucose strips which were exposed to light for 15 minutes and obtained an average value of 108.68 mg/dL. Based on the statistical tests that have been carried out, increased results were obtained on strips that were exposed to sunlight for 15 minutes.*

***Keywords*** *: Glucose levels, Glucose strips, Light exposure*

## 1. INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disease characterized by increased blood glucose levels. This occurs when the pancreas is unable to produce enough insulin or when the body is ineffective in using the insulin that has been produced. The effects of uncontrolled high blood glucose are also called hyperglycemia, this condition can cause serious damage to the heart, blood vessels, eyes, kidneys, and nerves. The causes of diabetes are divided into two, namely, type 1 diabetes which occurs due to autoimmune damage to pancreatic beta cells resulting in insulin deficiency, while type 2 diabetes occurs due to insulin resistance (Hantzidiamantis et al., 2024; WHO, 2023).

The increasing cases of DM make blood glucose testing easy and fast. Along with the development of the era, there is a glucometer tool that is easy to use to measure blood glucose levels quickly and efficiently in the laboratory, namely Point Of Care Testing (POCT). The advantages of using POCT are that it can be done near the patient, does not require sample handling such as centrifugation, and only a small sample is needed so that the test results can be issued quickly. The disadvantages of glucose testing using POCT are inadequate calibration or quality control, the high price of test strips, and there is no place to store test documentation (Choi et al., 2021; Shaw, 2016).

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POCT examination has many factors that must be considered so that the stability and storage of the device and strip are important considerations when it will be used. POCT strips are susceptible to environmental conditions so that the results of the examination will be affected if stored in hot, cold, humid conditions, or exposed to sunlight. Inaccuracy in poor storage conditions, open strip bottles, and expired sticks must be considered when examining using POCT. Exposure to sunlight on POCT strips causes discoloration in the test area which can result in increased levels of examination, one of which is the glucose parameter (Kotwal & Pandit, 2012; Wiencek & Nichols, 2016).

Research conducted by (Wulandari et al., 2020) stated that there was a decrease in blood glucose levels with strips exposed to light for 1 minute and 10 minutes compared to glucose strips that were not exposed to light. Based on the background explanation above, a study was conducted on the effect of light on glucose strips on fasting blood glucose levels using POCT. This study was conducted by comparing glucose strips that were not exposed to sunlight with glucose strips that were exposed to sunlight for 15 minutes. This aims to determine the comparison between fasting blood glucose levels tested using glucose strips that were not exposed to sunlight with glucose strips that were exposed to sunlight for 15 minutes.

## 2. THEORITICAL STUDY

Glucose is one of the carbohydrates used as a source of energy and is available in food, especially simple sugars and starches that are degraded into glucose and absorbed in the intestine into the bloodstream. The maximum concentration of blood glucose is reached within 30 minutes after consumption or depending on the food matrix. Blood glucose is produced in the liver from glycogen or also called glycogenolysis, and another place for glucose production is the kidney through gluconeogenesis (Luhovyy & Kathirvel, 2022).

There are several types of blood glucose level examinations, namely fasting blood glucose, random blood glucose, 2-hour pp glucose, OGTT, and HbA1C. Fasting blood glucose is measured after the patient has fasted for 8-12 hours, with levels of more than 126 mg/dL then this is associated with the possibility of diabetes. Random blood glucose level examinations can be done without fasting or can be done at any time, blood glucose levels of more than 200 mg/dL indicate the possibility of diabetes. 2-hour PP (Post Prandial) glucose is done 2 hours after eating with the aim of determining glucose balance and metabolic response to carbohydrates, with levels of more than 199 mg/dL indicating the possibility of diabetes. Oral Glucose Telorance Test (OGTT) or oral glucose tolerance test is a test to measure the

body's ability to absorb glucose in the blood. HbA1C is an examination to see the average glucose level over the last two to three months (Nakrani et al., 2023).

The methods used in the Laboratory for blood glucose level examination are POCT and enzymatic methods. Blood glucose examination with the POCT method uses a glucometer, which is only used for monitoring and not for diagnosis because there are various limitations in its use. The sample used in this POCT method is a capillary blood sample. There are three enzymatic methods used for blood glucose testing, namely hexokinase, oxidase, and dehydrogenase, this enzymatic examination uses a photometer (Baharuddin et al., 2018; Matthes et al., 2023). Glucometer is a tool used to measure blood glucose with the use of chemical sensors and glucose oxidase enzymes as active ingredients. The presence of POCT can simplify and accelerate laboratory examinations. The POCT instrument is designed to be portable so that it is easy to carry anywhere and easy to operate, Biosensor technology electrical charges produced by chemical interactions between certain substances in the blood and chemicals on the strip will be measured and converted into numbers that correspond to the amount of electrical charge, the numbers shown on the device are considered equivalent to the levels of substances measured in the blood (Kemenkes RI, 2010; Kiechle, 2021).

The reagents in the glucose parameter strip are the enzymes glucose oxidase and glucose dehydrogenase. The glucometer measures color changes with reflectance photometry. If the blood drop does not cover the entire area of the strip that is listed, the glucometer will give a false low result, in addition, temperature and environment will also affect the glucose test results. Exposure to sunlight on the strip can cause color changes in the test area, resulting in an increase in false blood glucose levels, while high humidity and temperature can reduce the stability of the strip (Kotwal & Pandit, 2012).

## 3. RESEARCH METHOD

The type of research conducted is pre-experimental because to see the comparison of blood glucose levels using strips that are not exposed to sunlight with strips exposed to sunlight for 15 minutes using a POCT device as an examination. The independent variables in this study are glucose strips that are not exposed to sunlight and strips exposed to sunlight for 15 minutes and the dependent variable is fasting blood glucose levels. The population in this study were third-year students of the D-III Health Analyst study program, STIKes Karsa Husada Garut. The calculation of the research sample to be taken used the Federer formula and obtained 16 samples. The instruments in this study were autoclick, blood lancet, glucose strip, alcohol

swab, and POCT while the materials contained in this study were capillary blood at the fingertips.

**Exposure of Glucose Strips to Sunlight**

Prepared 2 boxes of glucose strips that were new and not expired. One box of blood glucose strips that had been opened was then exposed to sunlight for 15 minutes, while one box of glucose strips was prepared for those that were not exposed to sunlight.

**Capillary Blood Specimen Collection**

Prepare the tool to take capillary blood samples. Patient identity must be confirmed before sampling. The finger selected for the research sample needs can come from the patient's middle finger or ring finger. Disinfect the finger to be sampled using an alcohol swab and wait until dry. Insert the test strip into the tool and prick the tip of the finger using the blood lancet that is already in the autoclick, wipe off the first drop of blood using a tissue or dry cotton. The capillary blood used for examination is the blood that comes out after being wiped with a tissue or dry cotton

**Blood Glucose Level Examination using POCT Device**

The blood that has come out after being wiped with tissue or dry cotton is immediately attached to the glucose strip that has been attached to the POCT device. The device will count down for approximately 5 seconds until the results appear on the POCT screen. The used blood lancet is immediately thrown into the safety box, while the glucose strip can be thrown directly into infectious waste which is characterized by a large yellow plastic bag.

## 4. RESEARCH RESULTS AND DISCUSSION

**Research Results**

This study was conducted at the STIKes Karsa Husada Garut Clinical Laboratory in July 2023 with a sample of 16 people. The results of the study are presented in the form of tables and graphs.

**Table 1** Fasting Blood Glucose Level Examination Based on Sunlight Exposure on POCT Method Glucose Strips

| Variables | N | Kadar Glukosa Darah Puasa (mg/dL) | | | Average ifference (mg/dL) |
|---|---|---|---|---|---|
| | | Mean | Minimum | Maximum | |
| Strips that are not exposed to sunlight | 16 | 87,31 | 67 | 102 | 21,37 |
| Strips exposed to sunlight for 15 minutes | 16 | 108,68 | 83 | 140 | |

Based on table 1, the data obtained are the average value, minimum value, maximum value, and average difference. There is a difference in the average results between the strip exposed to sunlight for 15 minutes and the strip not exposed to sunlight. This final result can be seen from the overall average and the average difference. Fasting blood glucose levels that are not exposed to sunlight have an average value of 87.31 mg/dL, the highest value is 102 mg/dL, and the lowest value is 67 mg/dL. Meanwhile, fasting blood glucose levels examined using glucose strips exposed to sunlight for 15 minutes have an average value of 108.68 mg/dL, the highest value is 140 mg/dL, and the lowest value is 83 mg/dL. Based on the average values of both, a difference of 21.37 mg/dL was obtained.

The normality test aims to determine whether the data is normally distributed or not, while the Shapiro Wilk test is carried out to determine the distribution of random data in a small sample.

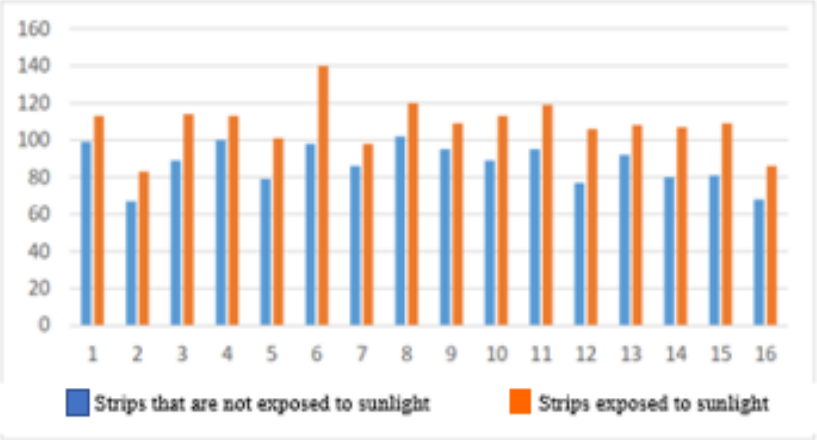


**Figure 1** Chart of examination of fasting blood glucose levels based on exposure to sunlight

Figure 1 is the difference in fasting blood glucose values per person based on glucose strips exposed to sunlight and not exposed to sunlight. The calculation results that have been obtained, then carried out a normality test using Shapiro Wilk and continued with the Paired Sample Test statistical test to compare the average of two paired groups.

The normality test was carried out using Shapiro Wilk because the data used were less than 50 samples, the results of the normality test in this study obtained p (0.309 and 0.251) so this is greater than 0.05, meaning that the data is normally distributed and continued with the Paired sample T-test statistical test. After conducting the dependent sample t-test, the p-result was (0.00) and this was less than 0.005, so it was said that there was a significant

difference between the average fasting blood glucose levels examined using glucose strips exposed to sunlight for 15 minutes and glucose strips not exposed to sunlight.

**Discussion**

In the research that has been conducted, namely the examination of fasting blood glucose levels in 16 samples (respondents). This study was conducted using a POCT tool by means of a glucose strip that had been exposed to sunlight for 15 minutes and a strip that was not exposed to sunlight in order to determine the comparison of these treatments.

Based on research (Wiencek & Nichols, 2016) POCT strips are susceptible to environmental conditions, heat, cold, humidity, and sunlight, which can affect POCT performance. Inaccuracies in the use of POCT strips, such as poor storage conditions, open strip bottles, and expiration should be considered when checking glucose levels.

Extremes of hot or cold temperatures can affect the accuracy of glucose strips. These temperature extremes vary by strip brand, but typically exposure to temperatures <90°F or 32°C (95°F) for more than 30 minutes can be a concern. Glucose test strips were subjected to cold (-21°C) and heat (40°C) treatments for 72 hours. The results were compared to those of untreated strips. The results of the heated glucose test strips increased. The results of the chilled test strips decreased (Louie et al., 2009).

The study of glucose levels examined using strips that were not exposed to sunlight with strips exposed to sunlight for 15 minutes using POCT experienced an increase. Exposure of the strip to light causes a color change in the test area which results in an increase in false glucose levels, glucose containing strips containing two enzymes, glucose oxidase (GO) and glucose dehydrogenase (GDH) or hexokinase. Glucose oxidase meters require oxygen and water for their reactions and are therefore susceptible to extreme hydration or oxygenation. Ambient temperature has been shown to affect glucose readings in back-reflection measurements, showing that glucose concentrations using a glucometer are too high at 44°C and too low at 25°C (Kotwal & Pandit, 2012).

## 5. CONCLUSION AND SUGGESTIONS

### Conclusion

The results of the study showed that the examination of blood glucose levels examined using a POCT device with strips that were not exposed to sunlight and those exposed to light for 15 minutes with 16 respondents or samples can be concluded as follows:

a. Fasting blood glucose levels checked using glucose strips that were not exposed to sunlight obtained a mean value of 87.31 mg/dL, the highest value of 102 mg/dL, and the lowest value of 67 mg/dL.
b. Fasting blood glucose levels checked using glucose strips exposed to light for 15 minutes obtained a mean value of 108.68 mg/dL, the highest value of 140 mg/dL, and the lowest value of 83 mg/dL.
c. There is a difference in fasting blood glucose levels examined using glucose strips that are not exposed to sunlight with strips that are exposed to light for 15 minutes using POCT.

### Suggestions

Must pay more attention to the storage conditions of the strip such as humidity, the open strip container must not be forgotten to be closed immediately after use, so it must be placed at room temperature and avoid exposure to sunlight because it will affect glucose levels.

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