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Differences in the Results of Determining Glucose Levels using the Poct Device on Specimens Taken when the Finger is Dry and on Fingers that are Still Wet with 70% Alcohol Cotton

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Abstract

Blood glucose is a sugar found in the blood that is formed from Carbohydrates in food that are absorbed in large quantities into the blood and converted in the heart. In blood sampling alcohol is used to clean and disinfect the skin area before injection. This helps reduce the risk of infection by killing germs on the skin's surface. This study aims to determine the differences in the results of glucose level determination using the POCT device on specimens taken when the finger is dry and when the finger is still wet with 70% alcohol cotton. This study uses a laboratory experimental research design. The population of this study were students of Stikes Pantita Husada Bulukumba and the sample of this study was 53 capillary blood samples. The results of this study indicate that there is a significant difference in glucose levels in specimens taken when the fingers were dry and those that were still wet with 70% alcohol cotton. The results of the statistical test show that each data is normally distributed which meets the requirements for conducting the Wilcoxon test. The final results show a p-value of 0.000 <0.05, meaning that there is a significant difference in the average or a significant difference in specimens taken when the fingers were dry and those that were still wet. Conclusion: Based on the research conducted, it can be concluded that there is a difference in glucose levels between specimens taken when the fingers were dry and those that were still wet.

Keywords: *glucose levels, wet finger specimens, dried finger specimen*

1. Introduction

Blood glucose is a sugar found in the blood that is formed from dietary carbohydrates and stored in the form of glycogen in the liver and skeletal muscles. Blood glucose levels in the human body are regulated by various factors, including physical activity, glucose-regulating hormones, age, stress, and diet. The glucose regulation system involves the liver, extrahepatic tissue, and hormones such as insulin and glucagon. When blood glucose concentrations increase, insulin is secreted to lower glucose levels to normal levels. Conversely, if glucose levels decrease, glucagon is released to increase blood glucose concentrations (Ugahari & Mewo, 2016). The characteristics of venous blood and capillary blood have significant differences that affect the sampling process. Venous blood vessels, which carry blood to the heart, contain blood rich in carbon dioxide. In contrast, capillary blood vessels consist of a single endothelial layer and a basement membrane, making them smaller with a diameter of about 5-10 micrometers (M. Ibnu, 2019). In measuring glucose

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levels, capillary blood is often used because of its ease of access and small volume requirements.

Blood glucose level measurement can be done using various methods, either using venous blood or capillary blood. The tools that are often used for this measurement are Point of Care Testing (POCT) and photometers. POCT works based on electrochemical detection through the glucose oxidase enzyme coated on the membrane strip. This tool offers various advantages, such as ease of use, fast results, and small blood sample requirements. Due to its compact size, POCT can be used without the need for a special room, making it suitable for patient monitoring both in hospitals and at home (Analis et al., 2018). POCT for glucose was first introduced in 1980 in North America with two main devices, namely the Glucometer from Bayer and the Accu-Check from Roche. The working principle of this tool uses biosensor technology that measures the electrical charge resulting from the chemical reaction between substances in the blood and the reagent strip. The measurement results are converted into comparable blood glucose levels (Laisouw, 2017). This technology allows for rapid monitoring of glucose levels, making it a very helpful tool for diabetes management.

The use of 70% alcohol in disinfection before capillary blood sampling is a standard step to ensure skin cleanliness and reduce the risk of infection. However, if the alcohol residue does not dry completely, it can cause hemolysis of the sample or affect the results of blood glucose measurements. Alcohol can also cause excessive pain in patients and alter the metabolic process of glucose in the body (Laisouw, 2017). Therefore, it is important to ensure that the disinfected area is completely dry before puncture. The increasing prevalence of diabetes mellitus globally further emphasizes the importance of accurate monitoring tools. According to WHO (2021), there are more than 422 million people with diabetes worldwide, and this number continues to increase. One of the main challenges in diabetes management is providing accurate and rapid glucose measurement results, which are the basis for effective medical decision making. POCT is a practical solution for this purpose, but its use still requires correct procedures so that the results obtained are reliable.

The accuracy of POCT results can be influenced by various factors, with the technique used for blood sampling being a critical determinant. Klonoff (2019) emphasized that non-dried alcohol residue left on the skin can mix with capillary blood, leading to sample dilution and artificially reduced glucose concentrations. This finding underscores the necessity for stringent adherence to technical procedures during capillary blood collection, particularly ensuring the skin is dry before the sample is taken. Such attention to detail in procedural techniques is essential to enhance the reliability and precision of POCT results, especially in clinical settings where timely and accurate data is critical.

Freckmann et al. (2020) further corroborated this by demonstrating that residual alcohol on the patient's skin could introduce significant discrepancies in blood glucose readings. These errors, albeit procedural, can lead to misdiagnosis or inappropriate management decisions in diabetic care. For instance, a lower-than-actual glucose reading might delay necessary interventions, potentially worsening patient outcomes. Such findings highlight the broader implications of sampling techniques on clinical decision-making, stressing the importance of standardizing protocols to minimize errors arising from sampling variability.

Evaluating and implementing the most optimal capillary blood sampling techniques is imperative to improve the validity of POCT results. In particular, ensuring that the skin is

adequately dried after disinfection with alcohol should become a standard practice in all healthcare settings utilizing POCT. This simple procedural adjustment can significantly reduce variability and enhance the dependability of results. Beyond procedural refinements, educating healthcare professionals and patients about the impact of sampling errors on glucose measurements can foster better practices and ultimately improve diabetes care outcomes.

Another study by Wiencek et al. (2021) emphasized the importance of drying the skin before blood sampling. This step not only helps to avoid alcohol contamination but also reduces the risk of hemolysis and pain. However, in daily practice, this step is often neglected due to time efficiency, especially in emergency situations. POCT has proven its benefits in diabetes management, but to ensure accurate results, every step of the procedure, including disinfection and drying, must be carried out in accordance with Good Laboratory Practice (GLP) guidelines. Non-compliance with SOPs can lead to significant data variability, as found by Baumstark et al. (2017). This underlines the need for a more in-depth evaluation of all technical factors involved in capillary blood sampling.

This problem not only affects the accuracy of medical data but also has financial consequences. Plebani (2020) noted that errors in glucose level measurements can lead to unnecessary treatment, thereby increasing the burden of health care costs. On the other hand, inaccurate data can also reduce the level of trust in the POCT device itself. Various efforts have been made to reduce the impact of external factors on the accuracy of POCT, including the development of more sophisticated devices. Ginsberg (2021) reported that some modern POCT devices are designed to detect alcohol residues or other contamination, although this technology is not yet widely available. Another more practical solution is to ensure adequate training for health workers in the use of POCT. This study aims to identify differences in glucose level measurement results using POCT on specimens taken from wet fingers compared to dry fingers after using 70% alcohol cotton. The results obtained are expected to provide a scientific basis for optimizing capillary blood sampling procedures. These findings are also expected to contribute to the development of better standard operating procedures to improve the accuracy and quality of care for diabetic patients.

2. Methods

This study aims to analyze the differences in the results of determining glucose levels in specimens taken when the finger is dry compared to the finger that is still wet using 70% alcohol cotton. This study uses a laboratory experiment method. This method was chosen because it is able to evaluate the effect of controlled treatment on the results of blood glucose level measurements. With this method, the study focuses on the effect of sampling techniques on measurement results using the Point of Care Testing (POCT) tool. Laboratory experiments were conducted at the Stikes Panrita Husada Bulukumba Laboratory. This laboratory was chosen because it has adequate facilities and infrastructure to support the analysis process. The facilities available include calibrated POCT tools, sterile laboratory space, and the availability of relevant consumables. Controlled laboratory environmental conditions also ensure the accuracy and reliability of the data obtained.

The population in this study were students of Stikes Panrita Husada Bulukumba with a total of 653 people. This population was chosen because it is easily accessible, has a sufficient diversity of physiological conditions to produce representative data, and can meet

the research inclusion criteria. The research sample consisted of 106 students taken using purposive sampling techniques based on inclusion and exclusion criteria. The samples were divided into two groups, namely 53 specimens taken from dry fingers and 53 specimens from wet fingers after being cleaned with alcohol cotton. The inclusion criteria included students who were willing to be respondents, aged 18-30 years, in normal health without a history of diabetes, and were not taking medications that could affect blood glucose levels. The exclusion criteria included students who had wounds on the fingers that would be used for sampling or were allergic to alcohol. Determination of these criteria was carried out to ensure that the research results truly reflected the effect of sampling techniques on blood glucose measurement results.

The materials and tools used in this study include the Nesco tool as a glucometer, autoclick for pricking, glucose chips, glucose strips, and consumables such as alcohol swabs, dry cotton, gloves (handscoon), and capillary blood from respondents. All tools have been tested for reliability before use, and calibration is carried out routinely to ensure the accuracy of the measurement results. The selection of this tool is based on ease of use and sensitivity that is suitable for laboratory research. The research procedure begins with the preparation of tools and materials. Preparation includes cleaning the work area, sterilizing the tools, and checking the suitability of tools such as glucometers and autoclicks. The glucose chip is inserted into the glucometer, and the examination strip is prepared for each sampling session. Tools and materials are ensured to be in sterile conditions to prevent contamination that can affect the measurement results.

The sampling process begins with adjusting the depth of the autoclick based on the thickness of the respondent's finger. After that, the respondent's index finger or ring finger is cleaned using 70% alcohol cotton. In the wet finger group, sampling is carried out when the alcohol has not completely dried. Meanwhile, in the dry finger group, sampling is carried out after the alcohol residue has completely evaporated. This step is a treatment variable that is the focus of the study. After cleaning, the autoclick is used to prick the respondent's finger until capillary blood comes out. The first blood is removed using dry cotton to ensure that the sample taken is free from tissue fluid or alcohol contamination. The capillary blood is then absorbed using a glucose strip that is already attached to the glucometer. This process is carried out carefully so that the blood that enters the strip is not contaminated by alcohol residue on the skin. After the blood is completely absorbed into the glucose strip, the Nesco device automatically displays the blood glucose level on the screen. These results are recorded and categorized as normal (70-140 mg/dL) or abnormal (≥140 mg/dL) according to the criteria used in the study. Each result is immediately verified to ensure that the data recorded is accurate and consistent.

Researchers also conducted quality control during the sampling process. All procedural steps were carried out in accordance with proper laboratory guidelines (Good Laboratory Practice). This includes the use of disposable gloves, sterilization of equipment before and after use, and systematic documentation of each process. This step is important to minimize bias factors that may arise during the study. The data obtained were analyzed to identify differences in glucose level measurement results between the wet and dry finger groups. The analysis was carried out using relevant statistical tests to determine the significance of the differences between the two groups. Data were categorized and compared based on the mean value, standard deviation, and distribution of glucose level measurement

results. This study has several limitations that need to be considered. One of the main limitations is that the sample only included students from one institution, so the generalization of the results may be limited to a wider population. In addition, the variability of the results can be influenced by individual differences in glucose metabolism, although this has been minimized by strict inclusion criteria. The findings of the study are expected to provide valuable insights into the importance of blood sampling techniques in improving the accuracy of blood glucose measurement results. With this detailed method, the study is expected to provide strong scientific evidence on the impact of alcohol residue on blood glucose level measurement results. The results are expected to be used to improve standard operating procedures in the use of POCT devices, especially in the context of capillary blood sampling.

3. Results and Discussion

From the 106 samples obtained, a normality test was first carried out. This is very important to know whether the data obtained is normally distributed or not in order to know the next test steps.

Table 1. Normality test

Glucose Level Determination Results	Kolmogorov-Smirnov		
	Statistics	Df	Sig
Dried finger specimen	0.169	53	0.001
Wet finger specimen	0.261	53	0,000

Source: Primary Data 2024

From the Normality Test in table 4.3, it can be concluded that the Kolmogorov-Smirnov significance value is greater than 0.05, so the data is declared to be normally distributed.

Table 2. Wilcoxon test results

Glucose Level Determination Results	N	Median (Min-Max)	A	P Value
Dry Finger Specimen	0	100(75-204)	6	0,000
Wet finger specimen	0	94 (68-195)		

Source: Primary Data 2024

From the table above, the results obtained with a p-value = 0.000 where the p value is 0.05 means that from these results there is a meaningful difference in the average or a significant difference between the results of dry finger specimens and wet finger specimens.

The results showed that the significant value of the Kolmogorov-Smirnov test on dry finger specimens was 0.001, and on wet finger specimens was 0.000. Both values are less than 0.05, which indicates that the data is not normally distributed. This abnormality of data distribution is the basis for choosing a non-parametric statistical method, namely the Wilcoxon test, as a tool for analyzing differences between the two groups. Non-parametric approaches such as the Wilcoxon test do not require the assumption of normal distribution, so they are more in line with the characteristics of the data in this study. The selection of this

method aims to ensure the validity of the results, especially in the context of experimental research with controlled variables.

The Wilcoxon test revealed a statistically significant difference in median blood glucose levels between specimens collected from dry and wet fingers. For dry finger specimens, the median blood glucose level was 100 mg/dL, with a range of 75–204 mg/dL, while for wet finger specimens, the median was 94 mg/dL, with a range of 68–195 mg/dL. The median difference of 6 mg/dL was statistically significant, as indicated by the p-value of 0.000, which is below the threshold of 0.05. This finding highlights the critical impact of sampling techniques, particularly whether the finger is dry or wet, on the accuracy of blood glucose measurements using the POCT device. Such variability underscores the need for stringent adherence to standardized procedures to minimize inconsistencies in results.

From a clinical perspective, the difference of 6 mg/dL in blood glucose levels may have significant implications, particularly for patients whose glucose levels are near diagnostic thresholds. For example, in individuals on the borderline for diabetes diagnosis, a lower glucose reading from a wet finger sample could lead to a missed or delayed diagnosis. This, in turn, might result in delayed initiation of necessary interventions, potentially exacerbating the patient's condition. Conversely, in scenarios where glucose levels are monitored for therapeutic adjustments, such as insulin dosing, even minor inaccuracies could lead to suboptimal management decisions, underscoring the clinical importance of precise measurement techniques.

The practical consequences of these findings emphasize the need for standardized specimen collection procedures to ensure accurate blood glucose measurements. Drying the finger thoroughly after disinfection with alcohol should be a routine step in all blood glucose testing protocols, as it is a simple yet effective measure to reduce variability in results. Additionally, educating healthcare providers about the potential implications of improper sampling techniques can improve adherence to best practices, enhancing the reliability of POCT measurements. This not only optimizes patient care but also builds confidence in the accuracy of results used for critical clinical decisions.

This finding is in line with Klonoff's (2019) study, which showed that alcohol residue on the skin can mix capillary blood and cause lower glucose measurement results. Freckmann et al. (2020) also found that residual alcohol moisture on the fingers contributed to variations in glucose measurement results using POCT devices. This study strengthens previous findings by confirming that dry finger conditions provide more stable and accurate measurement results compared to wet finger conditions. In addition, Baumstark et al. (2017) noted that technical errors in sampling, including the use of alcohol cotton that was not followed by drying, could cause bias in glucose measurement results. This bias can affect the reliability of POCT devices, especially in clinical settings that require fast but accurate results. This study adds to the evidence that proper sampling techniques are essential to minimize bias and increase confidence in POCT results.

The implications of these findings are broad, especially in the development of standard operating procedures (SOPs) in clinical laboratories and patient self-monitoring practices. Ensuring that the finger is dry after disinfection with 70% alcohol swabs should be a standard step in capillary blood sampling. This step not only improves the accuracy of the measurement results but also reduces the risk of sample hemolysis and pain for the patient, as noted by Wiencek et al. (2021). Thus, finger drying is a simple but important step in improving the quality of laboratory results. This study also highlights the need to educate healthcare workers and patients about the importance of correct sampling techniques. In patients using POCT devices for self-monitoring, errors such as not drying the finger after disinfection can lead to biased results and interfere with treatment decision-making. Therefore, training programs that emphasize the importance of this step need to be widely implemented in healthcare facilities.

However, this study has limitations that need to be noted. The relatively small sample size (53 specimens for each group) limits the generalizability of the findings to a wider population. In addition, external factors such as ambient temperature, sampling time, and individual variation in glucose metabolism were not fully controlled. Future studies need to involve larger samples and more stringent control of these factors to provide more comprehensive results. The relevance of these findings in a broader context is the confirmation that sampling technique affects blood glucose results, as also reported by other international studies. In a clinical setting, the results of this study can be applied to improve the accuracy of blood glucose measurement results, especially in patients with diabetes or other conditions that require close monitoring of glucose levels. This study can also be a basis for revising SOPs in clinical laboratories and patient self-monitoring practices.

In addition, this study contributes to the broader literature on technical factors that influence measurement results using POCT devices. Previous studies tend to focus on device and material factors, while this study highlights the importance of sampling technique, especially the condition of the finger after disinfection. These findings may encourage further research to explore the influence of other technical factors on blood glucose measurement results. In conclusion, this study confirms that specimen collection technique, especially the dry or wet condition of the finger, has a significant influence on blood glucose measurement results. These results suggest that drying the finger after disinfection with 70% alcohol swab is an important step in ensuring the accuracy of the results. These findings are relevant not only for clinical practice but also for laboratory studies that use blood glucose data as the main variable. Thus, the development of standard operating procedures and education for POCT device users are essential to ensure accurate and reliable results.

Conclusions

This study shows that the technique of taking capillary blood specimens, especially the condition of dry or wet fingers after disinfection with 70% alcohol cotton, has a significant effect on the results of blood glucose level measurements using the POCT device. Based on the results of the Wilcoxon test, there was a difference in the median glucose levels between dry finger specimens (100 mg/dL) and wet fingers (94 mg/dL) with a p value = 0.000, which showed a statistically significant difference. These results indicate that alcohol residues on wet fingers can mix capillary blood, resulting in lower glucose levels compared to specimens from dry fingers. From a clinical perspective, this difference can have an important impact, especially in patients who are on the borderline of normal or abnormal glucose levels, because errors in measurement can affect diagnosis and therapy management. Therefore, the technique of taking specimens by ensuring that the fingers are dry after disinfection is recommended to be applied consistently in clinical settings and patient self-monitoring.

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Conflict of Interest

The authors declare that there is no conflict of interest related to this research. All data, analysis, and results presented in this research are purely based on scientific studies without any influence from third parties. In addition, this research was conducted independently without any commercial affiliation or financial support from companies or institutions that could influence the results or interpretation of the data.

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