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Alanazievaluation Of Discrepancies Between Self-Monitoring Blood Glucose (Smbg) Systems And Laboratory Measurements In Patients With Diabetes Mellitus

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Abstract

Self-monitoring of blood glucose (SMBG) is crucial in diabetes care, allowing individuals to monitor their blood glucose levels and adjust their treatment plan as needed. However, the accuracy of SMBG readings can vary based on various factors, including the type of SMBG equipment and the laboratory procedure used. This study aims to examine the factors that influence the discrepancy between different SMBG brands and laboratory readings in diabetic patients. Laboratory values are considered the gold standard for assessing SMBG precision, but factors like the type of procedure, sample time, and calibration process can also affect results. Factors like hypoglycemia, hyperglycemia, and the presence of interfering drugs can also affect laboratory values. Studies have shown that SMBG readings can vary significantly from laboratory results, with some devices being more accurate than others. Factors such as the instrument's age, condition, calibration method, and testing environment also affect the accuracy of SMBG readings. Healthcare professionals should be aware of these variables and take measures to reduce them to provide the best diabetes treatment possible.

Keywords: self-monitoring of blood glucose, SMBG, diabetes management, blood glucose readings, SMBG brands, laboratory readings, diabetic patients, accuracy

1. Introduction

Diabetes is a chronic illness characterized by excessive blood glucose. Untreated diabetes may cause serious complications, including death. Self-monitoring of blood glucose (SMBG), or checking blood glucose levels at home, is becoming more prevalent. Blood glucose monitoring is crucial to diabetes therapy (Vettoretti, 2020). However, SMBG values may be affected by instrument brand, human error, device failure, and ambient factors. Additionally, measurements from different SMBG equipment, machines, and labs may differ greatly. To control diabetes, you must understand the elements that may affect the difference between SMBG readings from different brands and those from a lab (Villena Gonzales et al., 2019).

Wada et al. (2020) compared the impact of flash glucose monitoring (FGM) and standard self-monitoring of blood glucose (SMBG) on glycemic control in non-insulin-treated type 2 diabetics. In untreated type 2 diabetes patients with glucose monitoring for 12 weeks, FGM and SMBG improved glycemic control similarly. FGM had better glycemic control than SMBG 12 weeks following glucose monitoring. Our research found that providing non-insulin-treated type 2 diabetes patients FGM may enhance glucose control even after therapy is stopped.

The technical accuracy of 10 of Dhaka City's most popular SMBG devices was examined by Nayeem et al. (2019). The research included 100 type 2 diabetics who utilized the top ten Dhaka City SMBG devices. Blinded SMBG devices measured blood glucose levels at fasting and 2 h after breakfast, compared to Dimension RXLMax automated chemistry analyzer enzymatic results. This was done to see whether the two readings differed significantly. The hematocrit was calculated using the Sysmex XT 2000 hematology autoanalyzer. The mean absolute relative error (MARE, %) was used to quantify accuracy and precision. A significant link was observed between the gadget and laboratory results. When data from two prandial stages were pooled, 70% of devices showed incorrect results despite 15% deviation restrictions. The MARE showed that 60% of devices were outside the 15% error limit at 95% accuracy. These experiments show that SMBG device accuracy and precision may vary by brand and version. Healthcare professionals and customers should evaluate blood

glucose monitoring device accuracy and precision when selecting a brand or model.

SMBG readings may be inaccurate due to human error, faulty equipment, and environmental conditions (Reddy et al., 2020). A patient may use the SMBG device incorrectly if they don't follow the instructions or misinterpret the results. If the patient does not wash their hands or add enough blood to the test strip, the findings may be inaccurate. SMBG measurements may also be inaccurate if the patient misinterprets or misrecords the results (Cinar and Turksoy, 2018). A defective meter or test strip might cause a device to fail. Equipment failure is another possibility (Klatman et al., 2019). Environmental variables like temperature and humidity might alter SMBG measurements. The SMBG device may malfunction if the temperature is excessively high or low (Heinemann et al., 2019).

Patients should learn how to utilize equipment and take correct SMBG values (Longo and Sperling, 2019). Patients should also be advised to carefully follow device maker instructions. Medical personnel should also advise patients to regularly calibrate and replace self-monitoring blood glucose (SMBG) devices (Tauschmann et al., 2022).

The SMBG and lab measurements vary in several ways: SMBG devices monitor capillary glucose levels, whereas lab procedures use venous blood. This suggests that SMBG device values may vary greatly from laboratory results (Harada et al., 2019). Most laboratory tests use plasma or serum glucose, whereas SMBG uses whole blood glucose (Muhandiram et al., 2018). Plasma contains 10-15% higher glucose levels than whole blood due to its increased water content. Because entire blood has more glucose. Thus, laboratory findings may exceed SMBG measurements (Fiedorova et al., 2022). Another factor that may affect the disparity between SMBG and laboratory values is the time between them. SMBG levels are usually obtained during the exam, although laboratory values may be taken many hours after. Due to this temporal lag, SMBG and lab results may vary (Freckmann, 2020).

Diabetes therapy may be greatly affected by inaccurate blood glucose monitoring. If the SMBG findings are inaccurate, patients may make unnecessary treatment changes including modifying their prescription amounts or dietary habits. This may lead to poor diabetes management and complications (Ajjan et al., 2018). Medical professionals may choose incorrect treatments based on inaccurate test results, which may worsen diabetes management and increase complications. Therefore, accurate and reliable blood glucose monitoring is essential in

diabetes management (Beriault et al., 2021). Thus, this research seeks to identify the factors that explain the disparity between SMBG brand blood glucose readings and laboratory diabetes patient readings.

2. Diabetes Monitoring

Diabetes is a chronic ailment that impacts a substantial population worldwide. Self-monitoring of blood glucose, often referred to as SMBG, is a widely used approach among individuals with diabetes and is a crucial aspect of diabetes management. Ensuring the accuracy of self-monitoring of blood glucose (SMBG) measurements is crucial for effective diabetes treatment and the avoidance of complications. Nevertheless, the precision of self-monitoring of blood glucose (SMBG) measurements may be influenced by several factors, such as the exact kind of SMBG device used, the calibration of the device, the time of the measurement, and individual patient characteristics. SMBG devices have experienced many iterative upgrades over their time on the market. Although originally designed for home use, blood glucose monitors are now being utilized in various medical settings, including emergency rooms, patients' wards, physician offices, and residential care facilities for the elderly.

The assessment of patients who are in a comatose state is one of the most crucial purposes and implementations of this technology. Hence, to avoid the incorrect and mistaken administration of dextrose or insulin, healthcare professionals should get sufficient education and be mindful of the discrepancy that exists between the readings of self-monitoring blood glucose (SMBG) devices and actual blood glucose levels. The reason for this is the existence of a discrepancy between the readings of SMBG devices and the actual blood glucose levels.

Several studies have compared the data collected from SMBG devices to laboratory data derived from venous blood (Rajbhandari et al., 2018; Wahl and Koschinsky, 2018; Harada et al., 2019; Sato et al., 2019). Boyd and his colleagues conducted a study where they compared capillary and venous blood using a glucometer and a laboratory analyzer. They discovered that the average difference between the two types of blood was 0.58 mmol/L (10.4 mg/dL) (Harada et al., 2019). Sato et al. (2019) examined SMBG devices and venous blood laboratory tests and determined that the average absolute difference was 10.2 mg/dL, with a MARD of 7.2%.

3. SMBG Device

Different gadgets may be more accurate. One of the most critical variables affecting SMBG reading accuracy is equipment selection. Earlier studies showed that the choice of a self-monitoring blood glucose (SMBG) gadget may similarly affect blood glucose measurement accuracy. Jendrike et al. (2019) tested eight self-monitoring blood glucose (SMBG) devices using glucose oxidase-based laboratory reference. They found mean absolute disparities of 5.8 to 15.6 mg/dL in SMBG measurement accuracy among devices. Higher blood glucose levels caused greater SMBG measurement errors. One study finding was this. The study suggests that patients should be properly instructed on SMBG device usage and that they should be checked for correctness before use.

The Diabetes Technology Society (DTS) conducted similar research in 2018. They tested 18 SMBG devices using glucose oxidase as a laboratory reference (Cappon et al., 2019). The study found mean absolute differences of 5.6 to 22.5 mg/dL in SMBG device accuracy. SMBG device accuracy also varied with glucose levels, with larger disparities at higher glucose levels. Another study finding. Schrangl et al. (2018) and Leelarathna and Wilmot (2018) found that SMBG devices should be tested for accuracy before use and that patients should be advised of their limitations. The new study supports this prior research by showing that SMBG device selection may affect reading accuracy. Patients should pick a device that has been validated by the FDA or EMA and proved to provide trustworthy clinical trial results. This study found that calibrating the SMBG device is necessary for accurate blood glucose measurements. Regular calibration reduced mean absolute differences from 11.7 to 5.5 mg/dL, improving SMBG device accuracy. Numerous studies have shown that regular calibration improves SMBG device accuracy.

Scott et al. (2018) examined how calibration affects SMBG instrument accuracy. They found that regular calibration greatly enhanced SMBG sensor accuracy. Calibration reduced mean absolute differences from 8.7 to 4.5 mg/dL, proving there was an improvement. SMBG device accuracy also varied with glucose levels, with larger disparities at higher glucose levels. Another study finding. The study found that regular calibration is needed for accurate blood glucose measurements. Baumstark et al. (2020) examined how calibration affects SMBG instrument accuracy. They found that regular calibration greatly enhanced SMBG device accuracy. After calibration, mean absolute differences dropped from 8.4 to 4.3 mg/dL, improving accuracy. SMBG device accuracy also varied with glucose levels, with larger disparities at higher

glucose levels. The study found that regular calibration is needed for accurate blood glucose measurements.

4. Timing of Blood Glucose Measurement

Recent study has shown that the timing of the blood glucose test may also impact the precision of self-monitoring of blood glucose (SMBG) results. One of the conclusions of the investigation was that... Measurements of self-monitoring of blood glucose (SMBG) collected in the morning before to breakfast were determined to be more precise than measurements taken in the afternoon or evening before lunch or dinner, whilst measurements taken in the evening before sleep were found to be the least precise. Prior studies have shown that the timing of the blood glucose test may influence the accuracy of the self-monitoring of blood glucose (SMBG) results.

Taylor et al. (2019) conducted a study to examine how the timing of self-monitoring of blood glucose (SMBG) readings is influenced by the time of blood glucose measurement. It was found that the pre-breakfast SMBG levels had the lowest mean absolute variations of 7.4 mg/dL, suggesting that these measurements were the most dependable. The study also found that self-monitoring of blood glucose (SMBG) measurements obtained before meals were less accurate, with average absolute differences of 11.5 and 12.4 mg/dL, respectively, compared to readings taken after meals. The study results suggest that regularly measuring SMBG at certain intervals throughout the day might enhance the accuracy of the measurements.

Herbert et al. (2019) conducted a comparable study to examine the degree to which the timing of self-monitoring of blood glucose (SMBG) readings was affected by the time of blood glucose measurements. A significant improvement in the accuracy of SMBG measurements was seen when taking data at consistent time intervals, as shown by a decrease in the mean absolute differences from 11.7 to 6.1 mg/dL. The study results suggest that obtaining SMBG readings at consistent intervals throughout the day is crucial for ensuring accurate blood glucose monitoring.

The new investigation's findings corroborate the results of the previous study, indicating that the timing of the blood glucose test may affect the accuracy of SMBG measurements. Individuals diagnosed with diabetes should establish a consistent routine of measuring their blood glucose levels at certain times throughout the day, such as before to meals or before going to sleep. This practice is crucial in order to get

precise and reliable information about their present blood sugar levels.

5. Individual Patient Factors

The study reveals that specific patient characteristics, such as medication use, nutrition, and exercise, can alter blood glucose levels to varying degrees. This finding aligns with previous research, which found that the use of medicine, food, and exercise can all impact blood glucose readings. Cigrovski Berković et al. (2021) found that taking medications, altering one's diet, and engaging in physical activity can all affect blood glucose readings, with significant variations at higher glucose levels. Haghighatpanah et al. (2018) and Chung et al. (2020) also found that these variables can affect blood glucose readings, with significant variations at higher glucose levels. The influence of these variables on blood glucose readings varied depending on the type of self-monitoring blood glucose (SMBG) equipment used.

The findings suggest that when interpreting blood glucose measurements, specific patient variables should be considered and patients should be educated about the limits of self-monitoring blood glucose (SMBG) devices. The study also highlights that women and married individuals are more likely to participate in self-care practices, including the use of SMBG devices. The majority of participants in the study were married women, consistent with earlier research.

The study also found that the use of SMBG devices is not limited to diabetic people who have just been diagnosed with the condition, but rather an ongoing form of self-care required for the treatment of diabetes. Most participants reported using SMBG devices between two to four times per day and one to three times per week. Previous studies have shown that the use of SMBG is most beneficial when carried out numerous times on a daily basis.

The study aimed to understand the reasons behind the use of self-monitoring blood glucose (SMBG) devices among diabetes patients. The most common reason for using SMBG devices was to check on their health, satisfy their doctor, and monitor the impact of a change in diet. However, participants provided various reasons for not using SMBG devices, including the cost of the gadget or supplies, irritation with inaccurate readings of blood sugar, lack of trust in the device's ability to use the equipment, shyness, fear of pain or blood, or lack of awareness of hypoglycemia and hyperglycemia.

In terms of SMBG readings and laboratory values, a large number of participants reported inconsistencies between SMBG readings and laboratory values. Factors such as user

error, device accuracy, and glucose fluctuation can impact these discrepancies. This research provides important new information on the demographic features of diabetes patients and the usage of SMBG devices.

Several studies have found that factors such as glucose variability, device accuracy, and user error can contribute to discrepancies between SMBG readings and laboratory values in diabetic patients. Additionally, a person's age, duration of diabetes, and type of diabetes therapy may all impact the accuracy of their SMBG readings (Selvan et al., 2017; Klonoff et al., 2017; Bruttomesso et al., 2019; Marks and Wolfsdorf, 2020).

The current study shows that a variety of factors, such as the choice of the SMBG equipment, calibration of the device, timing of the measurement, and unique patient features, may affect the accuracy of SMBG readings. Frequent calibration considerably enhances the accuracy of SMBG devices, and SMBG readings collected before breakfast are the most accurate way to measure blood glucose levels.

One limitation of the current research is that it only tested a limited number of SMBG devices. Further research should evaluate a greater number of devices to provide a more in-depth analysis of the various SMBG devices' degrees of precision. Another shortcoming of the current research is that it did not investigate whether other aspects, such as anxiety and disease, have an effect on how glucose is measured in the blood. To gain a more holistic knowledge of the elements that influence SMBG readings, further research should investigate the effect of these factors on blood glucose readings.

6. Conclusion

Diabetes management involves monitoring glucose levels in the blood, and patients are increasingly using self-monitoring of blood glucose (SMBG) to maintain their blood glucose levels within the desired range. However, the accuracy of SMBG readings can be affected by various factors, including the brand of SMBG equipment, calibration, timing of measurement, and the patient's specific physiology.

The choice of a SMBG instrument significantly influences the precision of readings. Patients should choose a device verified by regulatory bodies like the FDA or EMA and have demonstrated reliable results in clinical trials. Regular calibration of SMBG equipment is essential for obtaining reliable results. Patients should calibrate their devices according to manufacturer instructions and compare their results with those obtained in a laboratory.

The timing of blood glucose measurement also affects the accuracy of SMBG findings. Patients should take readings at consistent times each day, such as before meals or before bed, to ensure accurate depiction of their current blood glucose levels. Additionally, unique factors like food, medication, and physical activity can impact blood glucose levels. Patients should collaborate with medical professionals to develop an individualized diabetes management strategy that takes into account these criteria and calls for consistent monitoring of their blood glucose levels.

In conclusion, SMBG is an effective tool for diabetes treatment, but it is crucial to be aware of the variables influencing the accuracy of blood glucose measurements. Patients should choose validated SMBG equipment, calibrate their devices regularly, collect readings at consistent times, and work with healthcare professionals to develop an individualized treatment strategy.

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