Research Article

Effect of Hand Hygiene Practice on Capillary Blood Glucose among the Family Medicine Residents in Jeddah, Saudi Arabia

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Abstract

Background: Good glycemic control significantly reduces the incidence of diabetes-related complications; however, it depends greatly on the frequent and accurate monitoring of blood glucose levels. Hand hygiene may determine the accuracy of capillary blood glucose measurements, which may vary due to differences in hand hygiene practices. This study evaluated the impact of different hand hygiene practices on capillary blood glucose levels in Jeddah, Saudi Arabia. **Methods:** This was an observational cross-sectional study involving the collection of capillary blood samples for the measurement of blood glucose levels of the family medicine residents at King Saud Bin Abdulaziz University in Jeddah, Saudi Arabia. The samples were collected before and after hand washing or after alcohol swab and hand sanitizer use. **Results:** Of the 98 residents, 69.4% were women, with a mean age of 28.7 ± 3.2 years and age range of 22-37 years. No significant difference was observed in the capillary blood glucose levels of the residents who did not wash their hands compared to that of the residents who used hand sanitizer (P=0.785) or alcohol swabs (P=0.487). Similarly, the blood glucose levels of capillary blood samples from washed hands did not differ significantly from those of samples from unwashed (P=0.227) or sanitized hands (0.270). A significant difference was observable in the blood glucose levels between the first and second drops from unwashed hands (P=0.006) and washed hands (P=0.013), as well as between washed hands and hands on which alcohol swabs were used (P=0.040). **Conclusion:** Capillary blood glucose levels obtained after using a hand sanitizer, alcohol swabs, or handwashing did not differ significantly from that of samples obtained from unwashed hands. However, a significant difference between the glucose levels in the samples obtained from the first and second drops from both washed and unwashed hands was observed. This suggests that using the second blood drop provides more accurate results.We recommend that patients perform hand hygiene measures and use the second capillary blood drop to obtain a more accurate assessment of blood glucose level. Additional larger studies are required to confirm these findings.

Keywords: Hand hygiene; Glucose control; Diabetes mellitus; Saudi Arabia

Introduction

Diabetes mellitus is a metabolic disease affecting millions of individuals worldwide [1] and significantly alters patients' quality of life and increases mortality. The incidence of diabetes mellitus is expected to increase drastically in the future. [2] The incidence of diabetes mellitus in Gulf countries, particularly in Saudi Arabia, has increased notably due to changes in the lifestyle and dietary habits of people in the region, specifically the co-existence of other metabolic diseases-primarily obesity. [3]

The incidence of diabetes mellitus in the Middle East is approximately 25%, and it is ranked as the most prevalent chronic disease. [4] Diabetic complications also occur more frequently in Middle Eastern countries, which has been attributed to the increased diabetes-related mortality in these countries compared to global estimates. [5] Diabetes mellitus is often associated with other co-morbidities, particularly cardiovascular and renal disease. Furthermore, it is one of the leading causes of pregnancy complications and stillbirths. [6]

The incidence of complications is correlated with compliance to anti diabetic medications and reasonable blood glucose levels. [7] Nevertheless, some factors may lead to the over or underestimation of blood glucose levels, [8] including measurement timing and its relation to food intake. For example, measuring blood glucose level immediately after a meal would result in an inflated value, and it should therefore be measured at least two hours after a meal. [9]

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Another factor influencing glycemic level is hand hygiene. Although hand hygiene is crucial to prevent infection and improve general well-being, it can also affect the accuracy of blood glucose measurement, primarily the capillary blood glucose level. [10] Hence, hand hygiene practices should be considered when interpreting the results of capillary blood glucose levels. [11,12]

Mekawy conducted an experimental study to assess the impact of hand washing on the blood glucose levels of patients with diabetes in Assiut, Egypt. They reported a significant relationship between the accuracy of capillary blood glucose levels and hand washing, although the outcomes were unaffected; however, peeling oranges with unwashed hands caused a considerable increase in blood glucose levels. Moreover, they observed that several patients had insufficient knowledge of blood glucose self-monitoring, and a strong relationship was observed between the awareness level and area of residence. [13]

Therefore, this study aimed to understand the influence of different hand hygiene practices on capillary blood glucose in a Saudi Arabian cohort.

Materials and Methods

Study design

This was an observational cross-sectional study conducted at King Saud Bin Abdulaziz University, a postgraduate deanship building in Jeddah, Saudi Arabia. The family medicine residents who attended academic courses were included in the study. All adult, non-pregnant residents were eligible for inclusion, and pregnant residents were excluded.

Data collection

Capillary blood samples were collected and measured with a glucometer (Accu-Chek Performa Roche); the residents were asked whether they were fasting prior to collection. Six samples were obtained from each participant: two consecutive drops (first and second drops) from unwashed hands, one sample after using alcohol swabs, one sample after hand sanitizer use, and two consecutive drops (first and second drops) after hand washing with soap and water. The average of the readings from the first and second drops after and before hand washing was considered. The alcohol swab contained 70% isopropyl alcohol, whereas the hand sanitizer contained ethanol 70% v/v and glycerin. It also contained vitamin E and propylene glycol as thickeners, along with purified water.

Statistical analysis

The residents' demographic data are expressed in counts and percentages. Blood glucose measurements are expressed as mean (standard deviation). The paired t-test was used to compare glucose values before hand washing with different hand hygiene measures. Statistical significance was set at $p<0.05$. One way analysis of variance was used to compare blood glucose values between residents with different demographic features. All data analyses were performed using IBM SPSS software (Statistical Package for the Social Sciences; IBM Corp, Armonk, NY, USA) version 26 for Microscoft Windows.

Results

Residents' demographics

Ninety-eight medical residents were included in the study. Among them, 69.4% were female, and 58.2% were 26-30 years of age. The mean age was 28.7 ± 3.2 years, and the range was 22-37 years. A random blood glucose measurement was performed for most of the residents (85.7%) [Table 1].

Mean blood glucose levels

The average blood glucose readings of samples from both washed and unwashed hands were considered [Table 2, Figure 1]. The average values were as follows: 107.7 ± 21.2 mg/dL for the second drop from unwashed hands, 106.8 ± 21 mg/dL from unwashed hands, 106.3 ± 21.2 mg/dL after hand sanitizer use, 107.7 ± 22.3 mg/dL after alcohol swab use, 104.7 ± 20.6 mg/dL for the first drop from washed hands, 106.7 ± 20.6 mg/dL for the second drop from washed hands, and 105.7 ± 20.3 mg/dL as the average of the values from washed hands.

Table 1: Demographics of the included residents.

Parameter		Frequency (%)
Age	20–25	14 (14.3%)
	26–30	57 (58.2%)
	31–35	23 (23.5%)
	36–40	4 (4.1%)
	Mean ± SD (min-max)	28.8 ± 3.2 (22–37)
Sex	Female	68 (69.4%)
	Male	30 (30.6%)
Blood glucose measurement	Fasting	14 (14.3%)
	Random	84 (85.7%)

Table 2: The mean blood glucose levels.

Sample	Mean ± SD (min-max), mg/dL
First drop from unwashed hands	105.8 ± 21.5 (56-177)
Second drop from unwashed hands	107.7 ± 21.2 (58-192)
Average of the values from unwashed hands	106.8 ± 21 (57-182.5)
Hand sanitizer use	106.3 ± 21.2 (50-176)
Alcohol swab use	107.7 ± 22.3 (59-196)
First drop from washed hands	104.7 ± 20.6 (60-191)
Second drop from unwashed hands	106.7 ± 20.6 (65-186)
Average of the values from washed hands	105.7 ± 20.3 (62.5-188.5)

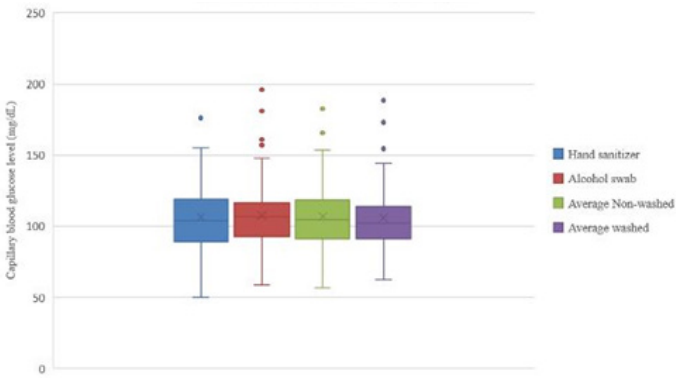

Figure 1: Box plot of the comparison of capillary blood glucose level (mg/dL) among different hand hygiene groups.

Table 3: Differences in blood glucose levels (in mg/dL) in different settings between men and women.

Parameter	Male	Female	P-value*
Average of the values from unwashed hands	108 ± 25	107 ± 20	0.677
Hand sanitizer use	107 ± 23	106 ± 21	0.652
Alcohol swab use	109 ± 24	107 ± 22	0.737
Average of the values from washed hands	108 ± 25	105 ± 19	0.978

*The Mann-Whitney U test was used.

Table 4: Comparison of blood glucose levels (in mg/dL) in different settings between fasting and random blood samples.

Parameter	Fasting	Random	P-value
Average of the values from unwashed hands	96 ± 27	109 ± 20	0.001
Hand sanitizer use	92 ± 27	109 ± 19	0
Alcohol swab use	94 ± 26	110 ± 21	0
Average of the values from washed hands	95 ± 28	108 ± 19	0

*The Mann-Whitney U test was used.

Table 5: Comparison of blood glucose levels (in mg/dL) between unwashed and sanitized or cleaned hands.

Comparison		Z	P-value[a]
First group	Second group		
First drop from unwashed hands	Second drop from unwashed hands	-2.754[b]	0.006
Hand sanitizer use	Average of the values from unwashed hands	-0.272[c]	0.785
Alcohol swab use	Average of the values from unwashed hands	-0.696[b]	0.487
First drop from washed hands	Second drop from washed hands	-2.486[b]	0.013
Average of the values from washed hands	Average of the values from unwashed hands	-1.207[c]	0.227
Alcohol swab use	Hand sanitizer	-0.982[b]	0.326
Hand sanitizer use	Average washed	-1.104[b]	0.27
Alcohol swab use	Average washed	-2.059[b]	0.04

a: The Wilcoxon signed-rank test; b. Based on negative ranks; c: Based on positive ranks

Comparison of blood glucose levels in different settings

One-way analysis of variance was used to compare the mean blood glucose levels between men and women in different settings: Unwashed, after hand sanitizer or alcohol swab use, and hand washing. No significant difference was observed between the blood glucose levels of the male and female residents in each hand hygiene setting [Table 3]. Table 4 shows the comparison of blood glucose levels obtained after fasting and random blood samples.

Comparison of blood glucose levels from different capillary blood samples

The mean blood glucose levels of unwashed and washed or sanitized hands were compared using the Wilcoxon signed-rank test [Table 5].

Discussion

Diabetes mellitus is a primary metabolic disease affecting millions of individuals worldwide. [14] It can cause micro- and macro vascular complications that significantly increase patients' morbidity and reduce their quality of life. [15] Therefore, appropriate glycemic control may significantly reduce the incidence of complications and improve the prognosis of patients with diabetes. Proper hand hygiene may also aid in accurately estimating capillary blood glucose levels, which can guide diabetes control. [16]

This study explored the impact of different hand hygiene practices (no hand washing, hand washing, hand sanitizer use, and alcohol swab use) on the capillary blood glucose levels among the family medicine residents in Jeddah, Saudi Arabia. It demonstrated that different hand hygiene practices resulted in significant differences in blood glucose readings. For example, the use of hand washing and hand sanitizer reduced capillary blood glucose levels significantly. In contrast, alcohol swab use increased capillary blood glucose readings in the samples from unwashed hands.

Previous studies have reported the impact of hand hygiene practices on blood glucose readings in different settings. Han et al. [17] conducted a large survey on hand hygiene practices among 920 patients with diabetes. They reported that 72.5% of the patients preferred using soap to wash their hands, and 64.1% preferred using hand sanitizers. However, the quality of hand hygiene practice was higher among individuals without diabetes than in those with diabetes.

In the present study, actual blood glucose readings after different hand hygiene practices were obtained. The capillary blood glucose readings of those who did not wash their hands differed significantly from the readings of those who washed their hands, used hand sanitizers or used alcohol swabs.

Arakawa et al. [18] examined the effect of fruit juice on the fingertips of 12 patients with diabetes who followed different hand hygiene practices before capillary blood glucose measurement. Hand washing also had the smallest effect on blood glucose levels compared to hand sanitizer and alcohol swab use.

The current study demonstrated that handwashing and hand sanitizer use reduced blood glucose levels significantly compared to no handwashing. However, residents who used alcohol swabs had significantly higher glucose levels than those with unwashed hands.

Furthermore, Mohammed et al. [19] examined self-care and hand hygiene practices among 200 patients with diabetes, along with their impact on glycemic monitoring. They reported that that the quality of hand hygiene practices among patients with diabetes was moderate, although it significantly impacted their glycemic control and follow-up. Hence, they recommended educational programs to improve hand hygiene practices among patients with diabetes. Our findings support this recommendation.

The differences between fasting and random blood glucose levels were significantly correlated with different hand hygiene states. Unlike glycated hemoglobin levels, self-monitoring of blood glucose allows patients with diabetes to discriminate between fasting and pre- and post-prandial blood glucose concentrations, allowing them to track the rapid effects of food, exercise, and medications on glycemia management. Data obtained through the self-monitoring of blood glucose can also be used to improve clinical outcomes and instate policies for quality of life improvement. It should form part of a self-management strategy. [20]

Strengths and Limitations

This study measured the capillary blood glucose levels of the medical residents with different hand hygiene practices, using a high-quality digital glucometer. However, this study has some limitations. First, the study included participants from only one city in Saudi Arabia (Jeddah). The single-center design may reduce the external validity of the design and outcomes. The small sample size of the participants also limited the generalizability of the findings. These limitations should be taken into consideration for future research.

Conclusion

In conclusion, the capillary blood glucose levels of the medical residents who used hand sanitizer, alcohol swabs, or washed their hands, did not differ significantly from the levels of those who did not wash their hands. However, there was a significant difference in the glucose levels of the first and second drops obtained from both washed and unwashed hands.

All patients should be instructed to wash their hands with soap and water before capillary blood glucose testing, and instructional initiatives should be instituted to promote patient understanding and blood glucose self-monitoring. Finally, diabetes health care providers and patients should be aware of all circumstances that could cause changes in blood glucose test results. Future studies are required to further investigate the reasons for altered blood glucose test values. Additionally, good hand hygiene practices should be encouraged among all patients, not only to ensure accurate blood glucose readings, but also to reduce the incidence of infections.

Further multicenter studies with more participants from multiple centers should be conducted in different cities in Saudi Arabia to confirm our findings and overcome the limitations of this study.

Ethical Considerations

Approval was obtained from the Institutional Research Ethics Board with the reference number: JED-21-427780-19047. Informed consent was obtained from the residents for data and blood collection. Confidentiality was respected throughout the study.

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