

The Relationship Between Blood Glucose Levels and The Healing Process of Cesarean Section Wounds at Besuki Regional General Hospital

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ABSTRACT

Introduction: The wound healing process involves the repair and restoration of damaged tissue function. Ineffective healing of cesarean section (CS) wounds can have fatal consequences and is one of the contributing factors to maternal mortality. High blood glucose levels can impair wound healing by compromising immune function and increasing the risk of infection.

Methods: An associative analytical study design with a cross-sectional approach was used. The population consisted of 70 mothers on day 7 post-C-section, with a sample of 60 participants selected using the Slovin method. Data were collected using a checklist and the Reeda CSale observation form. Data analysis was performed using the Fisher-Freeman-Halton Exact Test.

Results: Nearly all respondents had normal blood sugar levels (54 women, 90%), while 6 women (10%) had high blood sugar levels. The C-section wound healing process was good in 38 respondents (63.3%), fair in 19 respondents (31.7%), and poor in 3 respondents (5.0%). The p-value (0.034) was less than α (0.05), so H_0 was rejected, indicating that there is a relationship between blood glucose levels and the healing process of cesarean section (CS) wounds at the Obstetrics Clinic of Besuki Regional General Hospital.

Conclusion: There is a correlation between blood sugar levels and the healing process of cesarean section (C-section) wounds at the Obstetrics Clinic of Besuki Regional General Hospital. It is recommended that pregnant women undergo blood sugar CSreening during pregnancy as a means of early detection of health issues affecting both the mother and the fetus.

Keywords: *Blood Glucose Levels; Wound Healing; Cesarean Section*

Introduction

According to Boyle's theory (2009), the wound healing process is the process of replacing and restoring the function of damaged tissue. The wound healing process involves the integration of physiological processes. Clean surgical incisions, such as those from a cesarean section, are classified as clean wounds because they involve minimal tissue loss. Surgical wounds undergo primary healing (primary closure). The edges of the skin come together or are close to one another, resulting in a low risk of infection and rapid healing. The wound healing process consists of three phases: inflammation, proliferation, and maturation. The wound healing process in the inflammatory phase lasts until the fifth day after surgery; this phase can be brief if there is no infection (Nuraini, 2015)

The duration of cesarean section (CS) wound healing is associated with the incidence of CS surgical site infections. According to the World Health Organization (WHO), through the World Alliance for Patient Safety, it is reported that out of 27 million surgical patients who experience prolonged wound healing due to infection each CS year, 2–5% are cesarean section patients (Ratih, 2024). Based on data from the 2018 Basic Health Research (Riskesdas), the cesarean section rate was 15.8%, with 5–8% of cesarean section patients experiencing delayed wound healing due to wound infection complications. Health Survey Indonesia (SKI) data from 2023 shows a 19.2% increase in cases, with a 7.1% prevalence of delayed CS wound healing and a 2–4% prevalence of non-healing wounds requiring reoperation. In Indonesia, according to Dian Nurani (2015), data from the Inpatient Ward (Irina) at Prof. Dr. R.D. Kandau General Hospital in Manado in 2013 showed that out of 1,066 mothers who had undergone a cesarean section (CS) and experienced prolonged wound healing due to infection, 29 cases (2.7%). This number increased in 2014: among 186 post-CS mothers recorded from January to February 2014, 9 (4.8%) experienced prolonged wound healing.

In East Java, according to a 2023 report by the East Java Health Office, the cesarean section rate was 21.5%, with a prevalence of delayed cesarean wound healing ranging from 6–9% and non-healing cases accounting for approximately 1.5–3% of cases, with an average healing time of 12–15 days (East Java Health Office, 2023). At Dr. Soetomo General Hospital in Surabaya, 2022 data showed that out of 5,000

cesarean sections, 8% of cases had delayed wound healing. Based on a preliminary study, data from Besuki Regional General Hospital from January to July 2025 showed that a total of 204 women gave birth via cesarean section; 177 had normal cesarean wound healing, while the remaining 27 experienced impaired wound healing (Besuki Regional General Hospital, 2025).

There are several factors that can affect the healing process of superficial cuts. One of these factors is blood sugar levels. High blood sugar levels can inhibit leukocytes from performing phagocytosis, making the body more susceptible to infection. Therefore, if you sustain a cut, it will be slow to heal. High blood glucose levels cause the wound healing process to take longer due to impaired collagen synthesis, angiogenesis, and phagocytosis. Elevated glucose levels can also interfere with the transport of ascorbic acid into various cells, including fibroblasts and white blood cells. Elevated blood glucose levels can also reduce leukocyte chemotaxis, lead to atherosclerosis particularly in small blood vessels and cause impaired tissue oxygen supply (Khudin, 2014). Blood sugar levels play a significant role in the success of the CS wound healing process. Based on data from a research journal (Siregar, S., 2020), the relationship between blood glucose levels and the cesarean section (CS) wound healing process showed that among 62 mothers with normal blood glucose levels, 9 (14.5%) experienced mild infection, whereas among mothers with high blood glucose levels, 14 experienced mild infection, thereby prolonging the CS wound healing process. The prevalence of high blood sugar levels in post-C-section mothers puts them at a 12.1-fold higher risk of developing an infection at the surgical wound site compared to those with normal blood glucose levels. Therefore, it can be concluded that blood sugar levels are one of the factors influencing the C-section wound healing process.

Wound healing is a critical consideration because an incomplete healing process can endanger the patient, such as by leading to infection. Incomplete healing of a cesarean section (CS) wound can endanger the patient, potentially leading to infection, which in turn can cause sepsis. In severe cases, CS wound infections are a major contributor to maternal mortality.

Pregnant women are strongly encouraged to utilize health services to monitor their health throughout pregnancy, childbirth, and the postpartum period. They can

determine their blood sugar levels through antenatal CSreening. It is hoped that by identifying issues early on, health problems affecting both the mother and the fetus can be detected promptly. Patients are encouraged to maintain their blood sugar levels within the normal range or through appropriate interventions so that, if surgery is required, the cesarean section wound heals properly without infection.

Method

An associative analytical research design with a cross-sectional approach. This associative quantitative study aimed to determine the relationship or association between two or more variables under investigation. A total of 70 post-C-section mothers visited the obstetrics clinic, with a sample size of 60 post-C-section mothers. The sampling technique used was incidental sampling. The sample was selected based on specific criteria, namely mothers 7 days post-C-section who visited the obstetrics clinic at Besuki Regional General Hospital. The Fisher–Freeman–Halton exact test was used. This study was conducted at the obstetrics clinic of Besuki Regional General Hospital. The study period was from December 2025 to February 2026, using research instruments such as a glucometer and the REEDA CSale checklist.

Results

Univariate analysis is an analysis conducted to examine each variable in the research results. Univariate analysis is performed to determine the frequency distribution of each variable characterizing the respondents. The characteristics of the respondents are shown in the following table:

Table 1. Frequency Distribution of Characteristics of Mothers Who Underwent Cesarean Section at the Obstetrics Clinic of Besuki Regional General Hospital in 2026

No	Characteristics	Frequency	(%)
Age			
1	< 20 years old	6	10,0
2	20- 35 years old	46	76,7
3	>35 years old	8	13,3
Total		60	100,0
Body Mass Index (BMI)			
1	Obesity	18	30,0
2	Proportional	42	70,0
Total		60	100,0

No	Characteristics	Frequency	(%)
Nutrition			
1	Adequate	55	91,7
2	Deficiency	5	8,3
Total		60	100,0
Early Mobilization			
1	Yes	53	88,3
2	No	7	11,7
Total		60	100,0
Personal Hygiene			
1	Good	58	96,7
2	Poor	2	3,3
Total		60	100,0
Medical History			
1	Yes	15	25,0
2	No	45	75,0
Total		60	100,0
Blood Glucose Level Pre op			
1	Normal	42	70,0
2	High	18	30,0
Total		60	100,0

Source: Primary Data, 2026

Based on Table 1 above, it can be seen that in terms of age, nearly all respondents were between 20 and 35 years old, totaling 46 people (76.7%).

In terms of nutritional status, the majority of respondents were not obese 42 respondents (70%) and nearly all respondents had good nutritional status or did not restrict their diet, totaling 55 respondents (91.7%). Regarding early mobilization, nearly all respondents engaged in early mobilization within 6 hours after cesarean section (CS), totaling 53 respondents (88.3%). Additionally, nearly all respondents maintained good personal hygiene, totaling 58 people (96.7%).

Regarding medical history and preoperative blood glucose levels, the results showed that the majority of respondents had no history of disease (45 respondents, 75.0%), and the majority had preoperative blood glucose levels in the normal range (42 respondents, 70.0%).

Table 2. Distribution of Blood Glucose Test Results 7 Days Post-C-Section at the Obstetrics Clinic of Besuki Regional General Hospital in 2026

No	Blood Glucose Level	Frequency	(%)
1	Normal	54	90,0
2	High	6	10,0
Total		60	100

Source: Primary Data, 2026

Table 2 shows that nearly all respondents had blood sugar levels on day 7 post-CS within the normal range, totaling 54 people (90.0%).

Table 3. Distribution of CS Wound Healing Processes at the Obstetrics Clinic of Besuki Regional General Hospital in 2026

No	The CS Wound Healing Process	Frequency	(%)
1	Good	38	63,3
2	Fair	19	31,7
3	Poor	3	5,0
Total		60	100,0

Source: Primary Data, 2026

Table 3 shows that, regarding the CS wound healing process variable, out of a total of 60 respondents, the majority—38 people (63.3%)—experienced a good CS wound healing process.

Table 4. Frequency Distribution of Post-Cesarean Section Blood Glucose Levels on Day 7 According to Cesarean Section Wound Healing Process at the Obstetrics Clinic of Besuki Regional General Hospital in 2026

No	Blood Glucose Level on Day 7	CS Wound Healing Process					
		Good		Frequency		Poor	
		n	%	n	%	n	%
1	Normal	37	61,7	15	25,0	2	3,3
2	Tinggi	1	1,7	4	6,6	1	1,7
Total		38	63,4	19	31,6	3	5,0

Source: Primary Data, 2026

Table 4 shows the results of a cross-tabulation between blood glucose levels on day 7 post-CS and the CS wound healing process. There were 37 respondents (61.7%) with normal blood glucose levels and good CS wound healing; 15 respondents (25.0%) with normal blood glucose levels and poor CS wound healing; and 2 respondents (3.3%) with normal blood glucose levels and very poor CS wound healing. Meanwhile, 1 respondent (1.7%) had high blood sugar levels and good CS wound healing, 4 respondents (6.6%) had high blood sugar levels and poor CS wound healing, and 1 respondent (1.7%) had high blood sugar levels and very poor CS wound healing.

Table 5. Analysis of Blood Glucose Levels on Day 7 Post-C-Section in Relation to the Healing Process of a Cesarean Section Wound

Test	Value	Asymptotic Significance (2-Sided)	Exact Sig. (2-Sided)	Exact Sig. (1-Sided)	Point Probability
Fisher-freeman-halton-exact test	7,014		,034		

Source: Primary Data, 2026

Based on the results of the Fisher-Freeman-Halton Exact Test, the Exact Sig (2-sided) value for the respondents was $0.034 < 0.05$, indicating that there is a significant association between blood glucose levels and the healing process of cesarean section (CS) wounds at the obstetrics clinic of Besuki Regional General Hospital.

DiCSussion

Based on the data above, the results of the blood glucose level test on day 7 post-C-section showed that nearly all respondents had blood glucose levels in the normal range. This is consistent with the theory that blood glucose levels rise in tandem with pregnancy hormones. Insulin resistance and decreased insulin sensitivity during pregnancy can occur due to increased levels of pregnancy-related hormones, such as estrogen, progesterone, cortisol, and placental lactogen, in the maternal circulation. Elevated cortisol levels during pregnancy are considered the primary trigger for impaired glucose tolerance in normal pregnancies.

The increase in estrogen and progesterone that occurs during pregnancy are the primary hormones that disrupt β -cell function in early pregnancy and cause insulin resistance in late pregnancy. During pregnancy, human placental lactogen (HPL) begins to be produced by the placenta after 6 weeks of gestation. HPL functions to mobilize lipids and free fatty acids. In the second trimester of pregnancy, HPL levels increase tenfold. HPL stimulates lipolysis, making free fatty acids available as fuel for the mother, while the mother's glucose and amino acids can be supplied to the fetus. Due to this increase in free fatty acids, pregnant women with risk factors may experience impaired insulin sensitivity, leading to episodes of maternal hyperglycemia. After the placenta is delivered, levels of hormones such as human placental lactogen (HPL), progesterone, estrogen, cortisol, and placental growth hormone drop sharply. This

decrease reduces insulin resistance, thereby increasing insulin sensitivity and allowing blood sugar levels to return to normal. Factors that influence blood glucose levels in the body include dietary patterns, medical history, medication use, physical activity, obesity, age, and stress.

The researchers concluded that the normal blood sugar levels were due to the fact that most respondents were in the healthy reproductive age group (20–35 years), were not obese, had preoperative blood sugar levels within the normal range, and had no history of diseases such as diabetes mellitus and others. Theoretically, blood sugar levels are influenced by the balance between glucose intake, glucose production by the liver, and glucose utilization by body tissues, which is mediated by the hormone insulin. In the group with high blood sugar levels, the researchers assumed that there were factors causing elevated blood sugar levels, including high-risk age, obesity, and a history of comorbidities such as diabetes. Blood sugar levels rise with age, particularly in people over 40 years old. This is because glucose intolerance begins to increase at that age. Theoretically, the aging process leads to a decrease in the ability of pancreatic β -cells to produce insulin.

In the elderly, there is a 35% decrease in mitochondrial activity in muCSle cells, leading to a 30% increase in muCSle fat levels and triggering insulin resistance. Researchers suggest that as people age, physical changes and a decline in bodily functions affect the consumption and absorption of nutrients, leading to overweight or obesity, which in turn triggers the onset of degenerative diseases. This is consistent with a study conducted by Arif (2023), which found that age affects blood sugar levels, and is also consistent with research by Retno Triandini et al. (2022), which showed a significant association between BMI and fasting blood glucose levels. In cases of overweight or obesity, an imbalance occurs between energy intake and expenditure; excess energy is stored as fat, and elevated levels of free fatty acids can disrupt glucose homeostasis (Boden, 2011). An increase in plasma free fatty acids is followed by the uptake of free fatty acids by muCSles, which inhibits muCSle glucose uptake and triggers metabolic disorders, including carbohydrate metabolism. This leads to uncontrolled blood sugar levels, thereby increasing the risk of the metabolic disease diabetes mellitus.

The data above show that the majority of mothers on day 7 post-C-section experienced “good” C-section wound healing. According to theory, the wound healing process involves the replacement and restoration of bodily tissue function that has been damaged due to injury or surgery (Dian Nurani, 2015). This process involves a series of cellular and molecular reactions aimed at restoring tissue integrity and function. According to Yusmana et al. (2024), several factors that can influence the cesarean section wound healing process include blood sugar levels, nutrition, early mobilization, proper personal hygiene and wound care, age, and general health status.

Based on the data above, the researchers hypothesize that the good cesarean section wound healing process is due to age, as most post-cesarean section mothers are of healthy reproductive age. At this age, they have skin or a barrier that is well suited to withstand mechanical trauma and infection, as well as healthy immune, cardiovascular, and respiratory systems, all of which aid the wound healing process. Good nutritional status not being obese and having no dietary restrictions, particularly regarding high-protein foods—is also fundamental to the CS wound healing process. In the group with poor or very poor CS wound healing, the researchers hypothesized that post-CS mothers with poor nutrition were due to poor dietary habits, such as food restrictions and a limited variety of foods consumed, particularly side dishes (protein-rich foods). In obese individuals, CS wound healing is relatively slow because fatty tissue is difficult to integrate, making infection more likely and prolonging the healing process. Personal hygiene affects the wound healing process, as germs can enter the wound at any time if personal hygiene is poor. In the group with good cesarean section wound healing, post-cesarean mothers who were mobilized earlier experienced faster wound healing; this is because early mobilization can improve blood circulation, which aids in the healing of injured tissue. This aligns with the research by Armayanti et al. (2024), which found that early mobilization is one of the measures taken to accelerate the post-cesarean wound healing process. Theoretically, wound healing is influenced by good vascularization, as healthy circulation is necessary for cell development or wound repair; if the vascular system functions properly, wound healing occurs more quickly and completely. Researchers assume that the poor wound healing group consists of post-C-section mothers who did not engage in early mobilization due to pain in the

wound when moving. Other factors causing post-C-section mothers to fear movement include fear that the wound will reopen, that the sutures will come loose or break, or that bleeding will occur. In the group with poor wound healing, the study results indicate that several factors can contribute to delayed wound healing, including blood sugar levels. Blood glucose levels in this study were measured during the preoperative examination and 7 days after the cesarean section. Blood glucose levels affect the healing process of cesarean section wounds; one cause of high blood glucose levels is a history of diseases such as diabetes mellitus. In addition, a history of diseases related to immunity also affects the healing process of cesarean section wounds.

High blood glucose levels significantly impair the healing process of surgical wounds. This occurs through several complex mechanisms that disrupt every phase of normal wound healing. High blood glucose levels can impair the ability of leukocytes to perform phagocytosis, making the body more susceptible to infection; therefore, wounds may heal more slowly. High blood glucose levels prolong the wound healing process due to impaired collagen synthesis, angiogenesis, and phagocytosis.

Post-cesarean section (CS) mothers with normal blood sugar levels have a greater chance of experiencing good CS wound healing compared to respondents with high blood sugar levels. Conversely, high blood sugar levels tend to be associated with an increased incidence of poor to very poor CS wound healing. In theory, blood sugar levels play a very important role in the wound healing process. Under normal conditions, the cesarean section (CS) wound healing process proceeds through three main phases: inflammation, proliferation, and maturation. During the inflammatory phase, immune cells such as neutrophils and macrophages play a role in clearing damaged tissue and fighting infection. However, in hyperglycemic conditions, immune cell function is impaired, thereby reducing the body's ability to fight infection. This is consistent with a study (Sarmanda, 2020) showing a relationship between random blood glucose levels and the wound healing process in post-Cesarean section patients at RSU IP Medan. Statistical analysis results indicate a weak association between blood glucose levels and the CS wound healing process. These results suggest that blood glucose levels are associated with the CS wound healing process, but the strength of this association is relatively weak.

The researchers argue that blood glucose levels are not the sole factor determining the speed of the CS wound healing process. Theoretically, high blood sugar levels can inhibit the wound healing process by impairing leukocyte function, reducing the immune response, decreasing collagen synthesis, and inhibiting new tissue formation. Hyperglycemia also increases the risk of infection in surgical wounds, thereby slowing down the healing process. Conversely, normal blood sugar levels can support tissue regeneration and accelerate wound healing, which is consistent with the research by Riana and Amalia, Jeffrey (2021), who found a significant association between blood glucose levels and the postoperative wound healing process. Therefore, although blood sugar levels are not the sole factor determining the speed of CS wound healing as other factors also influence CS wound healing, such as nutrition, age, body mass index, personal hygiene, early mobilization, and the mother's overall health however, blood glucose levels remain one of the key factors that have a significant influence.

Conclusion

Based on the results of a study conducted on mothers 7 days post-C-section at the Obstetrics Clinic of Besuki Regional General Hospital, the following conclusions can be drawn: blood glucose levels measured in mothers 7 days post-C-section at the Obstetrics Clinic of Besuki Regional General Hospital were almost entirely within the normal range (blood glucose < 140 mg/dl), the healing process of cesarean section (CS) incisions in post-CS mothers on day 7 at the Obstetrics Clinic of Besuki Regional General Hospital was generally good, there is a correlation between blood glucose levels on day 7 post-CS and the healing process of CS incisions, as indicated by the Exact Sig (2-sided) result of $0.034 < 0.05$ among the respondents. The analysis results indicate that there is a significant association between blood glucose levels and the healing process of cesarean section (CS) wounds at the obstetrics clinic of Besuki Regional General Hospital, One factor contributing to the healing process of cesarean section (CS) wounds at the obstetrics clinic is blood glucose levels falling within the normal range. In post-CS mothers, there is a drastic decrease in pregnancy hormones, leading to increased insulin sensitivity and consequently bringing blood glucose levels back to normal. Hyperglycemia impairs the healing process of cesarean section (CS)

wounds. Elevated glucose levels can disrupt collagen synthesis, angiogenesis, and phagocytosis.

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