ASSOCIATION BETWEEN POST-CESARIAN SURGICAL SITE INFECTION AND MATERNAL AGE

ABSTRACT

Objective: to analyze the association between post-cesarean surgical site infection and maternal age. Method: quantitative retrospective study performed with 692 medical records of post-cesarean women admitted to a hospital in the West of Santa Catarina, Brazil, from 2015 to 2017. Data were analyzed using prevalence analyzes, Pearson's chi-square or Fisher's exact test, Mann Whitney test, and relative risk assessment. Results: the overall infection rate in puerperal women was 4.6%. However, in women aged over 35 years, the rate was 5.3%. When testing associations between average age and surgical site infection indicators, a significant difference was identified in the variables pain or increased sensitivity in the surgical incision, and hyperemia and/or redness in the surgical incision. Conclusion: a statistically significant difference was identified in the mean age concerning the presence of infection indicators, and women who developed SSI had a higher mean age. In addition, it was observed that women with advanced age (> 35 years) had higher prevalence of infection based on global surgical site infection rates than those belonging to other age groups.

Descriptors: Maternal age; Postpartum period; Puerperal infection; Cesarean section; Surgical wound infection; Nursing.

RESUMO

Objetivo: analisar a associação entre infecção de sítio cirúrgico pós-cesariana e idade materna. Método: estudo quantitativo, retrospectivo, realizado com 692 prontuários de puérperas pós-cesárea atendidas em hospital do Extremo Oeste de Santa Catarina, Brasil, no período de 2015 a 2017. Os dados foram analisados por meio de análises de prevalência, qui-quadrado de Pearson ou exato de fisher, teste de Mann Whitney e avaliação do risco relativo. Resultados: a taxa global de infecção nas puérperas foi de 4,6%, contudo, nas mulheres com mais de 35 anos de idade, a taxa foi de 5,3%. Ao comparar a média de idade das puérperas em relação à presença de indicadores de infecção de sítio cirúrgico, identificou-se diferença significativa nas variáveis dor ou aumento de sensibilidade na incisão cirúrgica e hiperemia e/ou vermelhidão na incisão cirúrgica. Conclusão: identificou-se diferença estatística significativa nas médias de idade, na presença de indicadores de infecção, sendo que mulheres que desenvolveram a ISC apresentaram média de idade maiores,
além disso, observou-se que mulheres em idade avançada (>35 anos) apresentaram prevalências maiores em relação às taxas de infección de sitio quirúrgico global em relação as demais faixas etárias.

**Descritores:** Idade materna; Período pós-parto; Infección puerperal; Cesária; Infección da herida quirúrgica; Enfermería.

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**RESUMEN**

**Objetivo:** analizar la asociación entre la infección del sitio quirúrgico poscesárea y la edad materna. **Método:** estudio cuantitativo, retrospectivo, realizado con 692 historias clínicas de madres poscesáreas atendidas en un hospital del Lejano Oeste de Santa Catarina, Brasil, en el período de 2015 a 2017. Los datos fueron analizados mediante análisis de prevalencia, chi -cuadrado de la prueba de Mann Whitney exacta de Pearson o Fisher y la evaluación del riesgo relativo. **Resultados:** la tasa global de infección en las puérperas fue del 4,6%, sin embargo, en las mujeres mayores de 35 años la tasa fue del 5,3%. Al comparar la edad promedio de las madres en relación con la presencia de indicadores de infección del sitio quirúrgico, se identificó diferencia significativa en las variables dolor o aumento de sensibilidad en la incisión quirúrgica e hiperemia y / o enrojecimiento en la incisión quirúrgica. **Conclusión:** se identificó una diferencia estadísticamente significativa en la edad media, en presencia de indicadores de infección, y las mujeres que desarrollaron ISQ tenían una edad promedio más alta, además, se observó que las mujeres de edad avanzada (> 35 años) presentaron mayores prevalencias en relación con las tasas de infección del sitio quirúrgico global en relación con los otros grupos de edad.

**Descritores:** Edad materna; Periodo posparto; Infección puerperal; Cesária; Infección de la herida quirúrgica; Enfermería.

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INTRODUCTION

Surgical site infection (SSI) is considered one of the most severe complications in the postoperative period, impacting surgical morbidity and mortality. SSI occur mainly due to extrinsic factor, such as inadequate manipulation of surgical incisions in subcutaneous and deep soft tissues, organs, and cavities.¹

In Brazil, among health care-associated infections (HAIs), SSI occupies the third position, representing 14% to 16% of hospital infections². In countries with high poverty rates, this problem can affect up to one-third of people undergoing surgical procedures.³ It is known that the number of cesarean sections has increased substantially, especially those without a clinical indication. This practice has become a worldwide concern, as it has an important relationship with the increase in post-cesarean infection rates, called puerperal infection.⁴

Puerperal infection is defined by the World Health Organization (WHO) as all maternal infectious process caused by bacteria of the female genital and extragenital tract, which can occur during the rupture of the amniotic membranes on childbirth, or even in the postoperative period. This complication can be characterized by hyperthermia, pelvic pain, delayed uterine involution, transvaginal losses, abnormal appearance, and odor, including infectious processes in the surgical wound.⁶

Internationally, the puerperal infection has an incidence rate that varies from 3% to 20% in the postpartum period. In the national scenario, this rate varies from 1% to 7.2%,⁷ being considered problematic due to the lack of consensus on post-cesarean SSI's acceptable rates. However, even with care during the surgical procedure, intrinsic factors that can enhance SSI development are pointed out, such as prolonged labor, premature delivery, primiparity, time of membrane rupture, twin cesarean sections, in addition to late pregnancy.⁸

This latter factor has gained prominence among the risk factors for worrying obstetric outcomes, including SSIs. The literature shows that the higher the maternal age in pregnancy, the greater the risk of complications in the postpartum period.⁹ Postponement of pregnancy has become a worldwide trend and is indicated as a consequence of reduced birth rates, added to the investment of families in other aspects, such as guaranteeing socioeconomic conditions.⁹¹⁰

In this context, it is essential to recognize the implications of SSI indexes in the postpartum period with the maternal age to enable health professionals to minimize the risks of complications in the puerperal period and promote improvements in maternal care quality. Given the above, this study was guided by the following research question: is surgical site infection in women undergoing cesarean section associated with maternal age?

OBJECTIVE

To analyze the association between post-cesarian surgical site infection and maternal age.
A quantitative retrospective study was carried out in a hospital in the West of Santa Catarina, Brazil, from March to April 2018. Medical and post-discharge follow-up records of women undergoing cesarean delivery between 2015 and 2017 were evaluated. Follow-up records were performed for all post-cesarean postpartum women using specific forms from the Hospital Infection Control Committee (HICC), with information on infection indicators. Follow-up was performed by the institution's HICC professionals, by telephone, after 30 days of delivery.

For data collection, a research form was used, following the variables previously evaluated by the institution, containing sociodemographic characteristics of the woman, surgical parameters (date of delivery, date of hospital discharge, duration of the surgical procedure, membrane condition, and administration of surgical prophylaxis), and SSI indicators in post-discharge follow-up (use of antibiotics in the postpartum period, medical report of infection, presence of purulent secretion in the surgical incision or vaginally, pain or tenderness in the incision site, hyperthermia (> 38°C) within 30 days, edema, hyperthermia and warmth in the incision, and spontaneous suture breakage).

The data were entered into the Epi-info® software version 7.0 and checked for errors and inconsistencies. Statistical analysis was performed using the PASW Statistics® software (Predictive Analytics Software, SPSS Inc., Chicago, USA) version 20.0 for Windows. Descriptive analyzes (mean, standard deviation, minimum, and maximum) were performed for the quantitative variables and the Pearson's chi-square or Fisher's exact test was used for the qualitative variables. The comparisons between age means and SSI indicators were performed using the Mann Whitney test. When evaluated by the Kolmogorov Smirnov test, the age variable did not meet the requirement for normal distribution (p < 0.000).

The prevalence rates of general SSI stratified by age were evaluated, represented by the evaluation of the number of SSI cases divided by the total number of postpartum women evaluated multiplied by 100, increasing the value in percentage. The Relative Risk (RR) was calculated between the SSI indicators and the age groups, categorized in a dichotomous way. Data were distributed by the median age value (30 years).

The study was approved by the Research Ethics Committee of the University of the West of Santa Catarina (UNOESC / SC) under Presentation Certificate for Ethical Appreciation no. 66419717.6.0000.5367 and opinion no. 2.040.200.

From 2015 to 2017, 692 post-discharge follow-up records of postpartum women who had cesarean sections were evaluated. The mean maternal age, time of surgery, and hospital stay were, respectively, 30.43 years ±
5.15 (15 - 44 years), 34 minutes ± 10 minutes (20 minutes - two hours and 45 minutes), and 1.59 ± 1.23 days (1 - 30 days) (Table 1).

Table 1. Age range of mothers who had cesarean sections and surgical parameters. Brazil. 2020. n = 692.

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 - 20</td>
<td>16</td>
<td>2.3</td>
</tr>
<tr>
<td>21 - 25</td>
<td>103</td>
<td>14.9</td>
</tr>
<tr>
<td>26 - 30</td>
<td>244</td>
<td>35.3</td>
</tr>
<tr>
<td>31 - 35</td>
<td>216</td>
<td>31.2</td>
</tr>
<tr>
<td>36 - 40</td>
<td>92</td>
<td>13.3</td>
</tr>
<tr>
<td>&gt; 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surgery time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 30 minutes</td>
<td>358</td>
<td>51.7</td>
</tr>
<tr>
<td>31 - 45 minutes</td>
<td>189</td>
<td>27.3</td>
</tr>
<tr>
<td>46 minutes to 1 hour</td>
<td>145</td>
<td>21.0</td>
</tr>
<tr>
<td><strong>Length of Hospitalization (days)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>332</td>
<td>48.0</td>
</tr>
<tr>
<td>2</td>
<td>350</td>
<td>50.6</td>
</tr>
<tr>
<td>3 - 7</td>
<td>9</td>
<td>1.3</td>
</tr>
<tr>
<td>≥ 8</td>
<td>1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Regarding SSI indicators and age groups (Table 2), it was found that mothers who had the highest frequency of indicators were in the age group from 26 to 35 years old. When evaluating the indicators by age groups, it was observed that the age group from 26 to 30 years had a higher prevalence of purulent secretion in the surgical site or vaginal incision. The age group from 31 to 35 years had a predominance of pain or increased sensitivity in the surgical site, and hyperthermia and/or redness in the surgical site.

Table 2. Relationship between puerperal women’s age group and indicators of post-cesarean surgical site infection. Brazil. 2020. n = 692.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 to 20</td>
</tr>
</tbody>
</table>

Presence of purulent secretion in the surgical site and/or vaginal incision
- 1 13 8 4 1

Pain or increased sensitivity in the surgical site
- 1 8 11 4 1

Hyperthermia (> 38ºC)
- - 3 5 1

Edema in the surgical incision
- - 5 4 2 1

Hyperemia and/or redness in the surgical incision
- 1 7 11 5

Warmth in the surgical incision
- - 2 3 1

Spontaneous suture breakage
- 1 2 4 3

Medical report of infection
- - 7 4 5 1

SSI is defined as the presence of at least two infection indicators. Based on this parameter, it was identified that the overall rate of infection in the puerperal women evaluated was 4.6%. However, when assessing the prevalence of infection in women aged over 35, the infection rate increased to 5.3% and decreased to 0.8% in women under 25 years of age.

When comparing the mean age of the mothers concerning the presence of SSI indicators, a significant difference was found in the variables pain or increased sensitivity in the surgical site (p = 0.028) and hyperemia and/or redness in the surgical site (p = 0.038), showing that older women are the most affected by these indicators (Table 3).

Table 3. Mean maternal ages and its relationship with post-cesarean surgical site infection indicators. Brazil. 2020. n = 692.
Regarding the RR evaluation, it was not possible to identify age as a risk factor for SSI (RR = 0.77; 95% CI = 0.50-1.17; p = 0.234). Nevertheless, the indicators pain or increased sensitivity in the surgical incision (p = 0.093) and hyperemia and/or redness in the surgical incision (p = 0.056) showed a significant trend, since age superior to 30 years old increased the risk for surgical site infection in 36% and 42%, respectively (Table 4).

Table 4. Relative risk between maternal age and post-cesarean surgical site infection indicators. Brazil. 2020. n = 692.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age (≤30 years; &gt;30 years)</th>
<th>RR (95% IC)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of purulent secretion in the surgical site and/or vaginal incision</td>
<td></td>
<td>1.01 (0.67-1.51)</td>
<td>0.949</td>
</tr>
<tr>
<td>Pain or increased sensitivity in the surgical site</td>
<td></td>
<td>1.36 (1.00-1.85)</td>
<td>0.093</td>
</tr>
<tr>
<td>Hyperthermia (&gt; 38ºC)</td>
<td></td>
<td>1.41 (0.88-2.25)</td>
<td>0.321*</td>
</tr>
<tr>
<td>Edema in the surgical incision</td>
<td></td>
<td>1.23 (0.76-2.00)</td>
<td>0.564*</td>
</tr>
<tr>
<td>Hyperemia and/or redness in the surgical incision</td>
<td></td>
<td>1.42 (1.06-1.91)</td>
<td>0.056</td>
</tr>
<tr>
<td>Warmth in the surgical incision</td>
<td></td>
<td>1.41 (0.79-2.49)</td>
<td>0.431*</td>
</tr>
<tr>
<td>Spontaneous suture breakage</td>
<td></td>
<td>1.49 (0.99-2.26)</td>
<td>0.203*</td>
</tr>
</tbody>
</table>

* Mann-Whitney test

DISCUSSION

Surgical site infection is a worldwide problem, as it is one of the factors responsible for high hospital infection levels.11,12 Regarding the infection process, the literature points out that two-thirds of SSIs occur due to incisional contamination linked to contamination during the surgical procedure or poor wound management in the postoperative period. However, another third of infections occur due to individual organic causes, which can alter the surgical wound's healing ability.13
The WHO points out that, among organic causes, advanced age is a factor that increases the risk of developing SSI and influences the surgical wound healing.\textsuperscript{3,14} This occurs once the wound repair undergoes certain phases: inflammatory, proliferative (which includes reepithelialization, matrix synthesis, and neovascularization), and maturation; the older a patient is, the less flexible the epithelial tissue becomes. With aging, a progressive decrease in collagen production is observed. Since collagen is responsible for skin sustaining and tensile strength of healing, the healing process may not occur effectively during the proliferative phase in patients with advanced age.\textsuperscript{15}

The increase in cesarean delivery rates has contributed to an increase in puerperal infection rates. In cesarean deliveries, the number of complications increases during the trans and postoperative period. The chance of the puerperal woman presenting postoperative infection is up to 4.35 times greater than in vaginal delivery.\textsuperscript{16,17}

Despite this, a properly conducted cesarean section with medical indication is considered a safe surgical anesthetic procedure. However, Brazil has a high rate of maternal mortality coupled with a high rate of cesarean sections, bringing about the balance between choosing the best conduct for each woman and reducing unnecessary surgical indications, which implies a review of clinical protocols.\textsuperscript{4}

Among the factors that increase the risk of SSI related to cesarean section are age extremes, which involve women under 17 and over 35 years old.\textsuperscript{18} Pregnancy at an advanced age (over 35 years) contributes to the occurrence of complications such as those related to the risk of postpartum infection.\textsuperscript{19,20}

The increase in infection rates in cesarean sections in women of advanced age occurs for several reasons. First, there is a decrease in collagen production, resulting from the aging process and the body system’s maturity. Second, due to immunoendocrine changes typical of pregnancy including immunosupression in view of the decrease in IgG levels close to delivery, which leaves women susceptible to infections. However, it is understood that pregnancy alone is a risk factor for infection and, added to the cesarean section and advanced maternal age, the risk for SSI increases.\textsuperscript{20}

In this study, the rate of global surgical site infection was 4.6%. However, internationally, puerperal infection rates can vary and reach 20%. In developed countries, the number of infections tends to be lower compared to developing countries. In Brazil, the SSI rate is considered low given the potential for contamination. Studies indicate different rates of post-cesarean SSI in the country\textsuperscript{21,22}, which can be determined by the health system's precariousness in certain regions.

In this study, it was not possible to identify that the SSI rate increased with age. In this perspective, studies indicate that although advanced age is considered a risk factor for complications in pregnancy and that even though puerperal infection rates are higher in women in this age group, the findings are still inconclusive.\textsuperscript{19,23}
It should be noted that this study was carried out according to the information contained in SSI follow-up records, which may be a limitation due to the possibility of information bias. Besides, it is pointed out that this study was carried out with limited pre-existing variables used for evaluation of SSI by the hospital, which can interfere in an accurate assessment of SSI in the postoperative period of cesarean section. In this sense, it is emphasized that the hospital did not describe the classification of the infections according to the compromised structures (superficial, deep, and organ-cavity), and in the postpartum women who presented clinical symptoms of SSI laboratory tests were not requested to confirm infection according to the criteria established by the Center for Disease Control (CDC).\(^24\)

**CONCLUSION**

When analyzing the association between post-cesarean SSI and maternal age, a statistically significant difference was found between age and presence of infection indicators. Women who developed SSI had a higher mean age. Likewise, when assessing the prevalence rates, it was observed that advanced aged women (> 35 years) had a higher prevalence of SSI than those belonging to other age groups. However, it was not possible to significantly determine that age is a risk factor for SSI.

The study also showed significant relationships between SSI indicators and average age, highlighting the tendency that women over 30 years old had a high risk of pain or increased sensitivity and hyperemia and/or redness in the surgical incision.

This study's findings reinforce the concern that cesarean section is a surgery with the potential for contamination and for SSI in the puerperium. Second, although not confirmed as a direct risk factor for SSI, the increase in late pregnancies increases the risk of puerperal complications. Thus, the importance of high-quality care by health professionals and the need to develop protocols and guidelines for puerperal care are highlighted.

The need to establish health education strategies is highlighted integrating the hospital environment and primary health care to promote women's health guidelines covering reproductive planning, prenatal, and puerperal care. Such measures can minimize the chances of complications and SSI in the puerperium when addressing the uniqueness of each woman's context, the types of delivery, postpartum care, and the prevention guidelines for HAIs.

Still, it is necessary to qualify the surveillance service and follow-up of post-cesarean mothers to contemplate a more detailed assessment of the surgical wound and other SSI factors, since these data allow health services to identify, qualify, and improve practices. Finally, prospective, cohort, or case-control observational studies are needed to elucidate whether maternal age is a determining factor for the
development of SSI, considering that most studies about the theme are retrospective and based on descriptive evaluations with a low power of inference.

**CONTRIBUTIONS**

All authors also contributed in the conception, analysis and interpretation of the research, in the writing and critical review with intellectual contribution, and, in the approval of the final version.

**CONFLICT OF INTERESTS**

Nothing to declare.

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