

Original Research Article

A COMPARATIVE STUDY ON PREOPERATIVE BATHING WITH 4% CHLORHEXIDINE BODYWASH VERSUS 1% CHLORHEXIDINE SOAP TO PREVENT SURGICAL SITE INFECTION IN WOMEN UNDERGOING ELECTIVE CAESAREAN SECTION

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ABSTRACT

Background: Surgical site infection (SSI) is among the most frequent healthcare-associated infections and remains a significant cause of maternal morbidity following caesarean section. Chlorhexidine gluconate (CHG) is widely used for preoperative skin antisepsis because of its broad-spectrum activity and residual antimicrobial effect, but whether increasing its concentration translates into additional protection against SSI remains uncertain.

Materials and Methods: A prospective comparative interventional study was conducted over 18 months (June 2024–January 2026) in the Department of Obstetrics and Gynaecology, PES Institute of Medical Sciences and Research (PESIMSR), Kuppam. A total of 170 primigravida and multigravida women aged 18–40 years undergoing elective caesarean section were allocated on an odd–even basis to preoperative bathing with 4% chlorhexidine bodywash (n=85) or 1% chlorhexidine soap (n=85), with two baths advised before surgery. Patients were monitored for clinical signs of SSI for 7 days postoperatively, and outcomes were analysed using SPSS version 23.0.

Results: The two groups were comparable at baseline for age, weight, parity, previous LSCS, prior SSI history, and maternal comorbidities (all $p>0.05$). SSI occurred in 30 women (35.3%) in the 1% chlorhexidine soap group compared with 18 women (21.2%) in the 4% chlorhexidine bodywash group. Individual postoperative inflammatory signs — redness, tenderness, induration, discharge, and fever — did not differ significantly between the groups (all $p>0.05$). Management of SSI was predominantly conservative in both groups ($p=0.70$), and day of suture removal ($p=0.80$) and total length of hospital stay ($p=0.86$) were also comparable.

Conclusion: Increasing chlorhexidine concentration from 1% to 4% was not associated with a statistically significant improvement across most measured postoperative parameters. 1% chlorhexidine soap may therefore be considered a reasonable, cost-saving alternative to 4% chlorhexidine bodywash for preoperative bathing before elective caesarean section in resource-limited settings.

Keywords: Chlorhexidine gluconate; surgical site infection; caesarean section; preoperative bathing; antiseptic bathing.

INTRODUCTION

Surgical site infection is one of the most frequent healthcare-associated infections globally and is associated with increased morbidity, prolonged hospital stay, and additional healthcare costs. Caesarean section, although a life-saving operation, carries a higher risk of SSI owing to bacterial contamination from the genital tract and pregnancy-related physiological changes.¹

Preoperative bathing with an antiseptic agent such as chlorhexidine gluconate is widely recommended to reduce microbial load on the skin before incision, owing to its broad-spectrum activity and its ability to bind to the stratum corneum, providing a residual effect that suppresses microbial regrowth.^{2,3}

Despite widespread use, evidence for the effectiveness of chlorhexidine bathing remains inconsistent. The Cochrane review by Webster and Osborne found no clear benefit of chlorhexidine gluconate over placebo, soap, or no wash in reducing SSI,² and a 2020 Swedish health technology assessment similarly concluded that the certainty of evidence was low to very low.³ The World Health Organization evidence review reported that the majority of randomized trials found no significant difference between chlorhexidine soap and plain soap, with an overall quality of evidence judged moderate to very low.⁴

In contrast, some newer studies have suggested a possible benefit of higher-concentration regimens: Prayugo et al. reported no SSI with a single preoperative 4% chlorhexidine bath compared with 8.3% in controls,⁵ while Ali et al. and Andrade and Poveda found comparable efficacy across different chlorhexidine formulations and concentrations.^{6,7} Pharmacodynamic data indicate that repeated bathing regimens can achieve higher residual skin concentrations of chlorhexidine,⁸ and institutional guidelines such as those of UCSF recommend 4% chlorhexidine soap or 2% chlorhexidine wipes for preoperative bathing, while acknowledging that evidence for superiority over plain soap remains insufficient.⁹

Given the rising rate of caesarean delivery and the associated burden of SSI, particularly in resource-limited settings, procedure-specific evidence on the comparative effectiveness of different chlorhexidine concentrations in obstetric populations is needed. This study was therefore undertaken to compare the effectiveness of preoperative bathing with 4% chlorhexidine bodywash versus 1% chlorhexidine soap in preventing SSI among women undergoing elective caesarean section.

Aims and Objectives

To compare the effectiveness of preoperative bathing with 4% chlorhexidine bodywash versus 1% chlorhexidine soap in preventing surgical site infection in women undergoing elective caesarean section.

MATERIALS AND METHODS

Study design and setting: Prospective comparative interventional study conducted in the Department of Obstetrics and Gynaecology, PES Institute of Medical Sciences and Research (PESIMSR), Kuppam, Andhra Pradesh, over 18 months (June 2024 to January 2026).

Study population and sampling: All primigravida and multigravida women aged 18–40 years undergoing elective caesarean section at PESIMSR were eligible. Women undergoing emergency caesarean section and those with known chlorhexidine allergy were excluded. A total of 170 eligible women were enrolled by simple randomized sampling and allocated on an odd–even basis to an interventional group receiving preoperative bathing with 4% chlorhexidine bodywash (n=85) or a control group receiving 1% chlorhexidine soap (n=85).

Intervention: After written informed consent, participants were given standardized oral and written instructions to take two preoperative baths with the allocated bodywash/soap, 10 hours apart, with the final bath 3–4 hours before surgery; three 15 ml lids of bodywash/soap were used per bath with 5 minutes of scrubbing before rinsing, and application of lotions or emollients after bathing was avoided. Postoperatively, patients used only physician-prescribed wound-site medications, and dressing and wound cleaning were performed once daily.

Outcome assessment: Patients were observed for clinical signs of SSI — redness, discharge, tenderness, induration, inflammation, and wound gaping — during a 7-day postoperative hospital stay. Number of SSIs, mode of treatment, and readmissions were recorded and compared between groups.

Statistical analysis: Data were entered in Microsoft Excel and analysed using SPSS version 23.0. Continuous variables were expressed as mean $\pm$ standard deviation and compared using the t-test; categorical variables were expressed as frequencies and percentages and compared using the chi-square test. A p-value <0.05 was considered statistically significant. Ethical clearance was obtained from the Institutional Human Ethics Committee, PESIMSR, Kuppam prior to commencement of the study.

RESULTS

A total of 170 women were enrolled, 85 in the 1% chlorhexidine soap group and 85 in the 4% chlorhexidine bodywash group. Baseline maternal age (28.60 ± 6.58 vs 28.16 ± 6.95 years; $p=0.68$), weight (79.78 ± 10.25 vs 81.15 ± 9.83 kg; $p=0.68$), parity ($p=0.90$), history of previous LSCS (87.1% vs 89.4% ; $p=0.63$), and prior SSI following earlier LSCS (9.5% vs 3.9% ; $p=0.17$) were comparable between groups. Maternal comorbidities —

gestational diabetes, hypertensive disorders, Hansen's disease, vaginitis, and urinary tract infection — were also evenly distributed (all $p>0.05$); obesity was numerically more frequent in the 1% CHG soap group (29 vs 15 cases),

approaching but not reaching statistical significance ($p=0.06$). The mean interval between the last preoperative bath and surgery was similar between groups (4.85 ± 2.21 vs 5.20 ± 2.50 hours; $p=0.33$).

Table 1: Comparison of baseline characteristics between the study groups

Parameter	1% CHG Soap (n=85)	4% CHG Bodywash (n=85)	p value
Mean age $\pm$ SD (years)	28.60 $\pm$ 6.58	28.16 $\pm$ 6.95	0.68
Mean weight $\pm$ SD (kg)	79.78 $\pm$ 10.25	81.15 $\pm$ 9.83	0.68
Parity distribution	Comparable	Comparable	0.90
Previous LSCS, n (%)	74 (87.1%)	76 (89.4%)	0.63
Previous SSI history, n (%)	7 (9.5%)	3 (3.9%)	0.17
Obesity, n (%)	29 (34.1%)	15 (17.6%)	0.06
Interval, last bath to surgery (hours)	4.85 $\pm$ 2.21	5.20 $\pm$ 2.50	0.33

SSI occurred in 30 women (35.3%) in the 1% chlorhexidine soap group compared with 18 women (21.2%) in the 4% chlorhexidine bodywash group.

Individual postoperative inflammatory signs, assessed independently, did not differ significantly between groups.

Table 2: Association of surgical site infection and postoperative signs between the study groups

Variable	1% CHG Soap (n=85)	4% CHG Bodywash (n=85)	p value
Redness, n (%)	15 (17.6%)	10 (11.8%)	0.28
Tenderness, n (%)	16 (18.8%)	9 (10.6%)	0.13
Induration, n (%)	9 (10.6%)	5 (5.9%)	0.26
Discharge at surgical site, n (%)	8 (9.4%)	7 (8.2%)	0.79
Fever, n (%)	8 (9.4%)	5 (5.9%)	0.39
Wound dehiscence, n (%)	1 (1.2%)	1 (1.2%)	1.00

Among women who developed SSI, management was predominantly conservative in both groups — 29 of 30 (96.7%) in the 1% CHG soap group and 17 of 18 (94.4%) in the 4% CHG bodywash group — with surgical management required in only one case in each group ($p=0.70$). Day of suture removal (predominantly postoperative day 6–7 in both groups; $p=0.80$), any increase in length of stay attributable to SSI ($p=0.49$), and total hospital stay from admission ($p=0.86$) were all comparable between groups.

Table 3: Comparison of surgical site infection rates with previous studies

Study	Year	Sample size	Intervention	SSI rate (intervention)	SSI rate (control)	Significance
Prayugo et al.	2022	60	4% CHG bath	0% (0/30)	8.3% (5/30)	Significant
Ayliffe et al.	1983	5536	4% CHG vs soap	9%	9%	Not significant
Byrne et al.	1992	3733	CHG vs control	5.6%	5.8%	Not significant
Rotter et al.	1988	2953	CHG vs detergent	3.2%	3.5%	Not significant
Graling & Vasaly	2013	335	2% CHG cloth	1.1%	4.4%	Significant
Present study	2026	170	1% vs 4% CHG	21.2% (4% CHG)	35.3% (1% CHG)	Not significant

DISCUSSION

SSI remains one of the most common postoperative complications following caesarean section and a significant contributor to maternal morbidity worldwide; caesarean delivery increases the risk of postoperative infection 5–20-fold compared with vaginal delivery.¹⁰ Skin flora, particularly *Staphylococcus aureus* and coagulase-negative staphylococci, play an important role in wound contamination during surgery,¹¹ and chlorhexidine gluconate binds to the stratum corneum to provide persistent antimicrobial activity for up to 24–48 hours, forming the pharmacological basis for preoperative bathing.¹² Whether increasing chlorhexidine concentration improves clinical outcomes, however, remains controversial,

prompting the present comparison of 1% chlorhexidine soap with 4% chlorhexidine bodywash.

Baseline demographic and risk-factor comparability strengthened the internal validity of this study. Mean maternal age (~28 years in both groups) was similar to that reported by Tuuli et al. (27.8 years) and Lakhi et al. (28.5 years),^{13,14} and maternal weight, parity, previous LSCS rate, and prior SSI history were all balanced between groups, consistent with obstetric cohorts described in these studies. Wloch et al. and Olsen et al. identified obesity and prior wound infection as independent risk factors for SSI,^{15,16} and although obesity was numerically more frequent in the 1% CHG group in the present study, the difference did not reach significance ($p=0.06$), limiting its potential as a confounder.

The effect of chlorhexidine concentration on SSI outcomes remains debated in the literature. Prayugo

et al. demonstrated a significant reduction in SSI with preoperative 4% chlorhexidine bathing,⁵ whereas earlier large randomized trials by Ayliffe et al., Byrne et al., and Rotter et al. found no significant benefit of chlorhexidine bathing over control regimens.^{17–19} The Cochrane review by Webster and Osborne, encompassing over 10,000 patients, similarly concluded that evidence remains insufficient to confirm the superiority of chlorhexidine over plain soap,² and Franco et al. reported no significant reduction in SSI in a pooled meta-analysis of randomized trials.²⁰ In contrast, Graling and Vasaly found a significant reduction in SSI using 2% chlorhexidine cloths,²¹ and Kohler et al. reported benefit when chlorhexidine bathing was combined with mupirocin, suggesting bundled approaches may outperform chlorhexidine alone.²² The present findings align more closely with the larger randomized trials and meta-analyses: individual postoperative inflammatory signs, SSI management approach, suture removal timing, and length of hospital stay did not differ significantly between the 1% and 4% chlorhexidine groups, suggesting that concentration escalation alone may not translate into a clinically meaningful reduction in most SSI-related parameters. The overall counts of SSI cases (30 in the 1% group versus 18 in the 4% group) were numerically lower with the higher concentration, an observation that merits confirmation with a dedicated between-group significance test on this composite outcome, ideally in a larger, multicentre sample.

Strengths and Limitations:

- Prospective comparative design with balanced baseline characteristics across both study arms.
- Focus on an obstetric population, with assessment of multiple SSI indicators and postoperative outcomes.
- Single-centre study with a limited sample size and short (7-day) postoperative follow-up period.
- No microbiological culture correlation was performed to confirm the clinical diagnosis of SSI.

CONCLUSION

The incidence of surgical site infection and most individual postoperative parameters following elective caesarean section were not significantly different between women using 1% chlorhexidine soap and those using 4% chlorhexidine bodywash. Baseline maternal characteristics and established SSI risk factors were comparable between groups, strengthening the internal validity of these findings, which are broadly consistent with existing literature suggesting that the effectiveness of chlorhexidine bathing is not strongly concentration-dependent within commonly used ranges. SSI prevention remains multifactorial, requiring a comprehensive bundle approach that includes appropriate antibiotic

prophylaxis, glycemic control, strict aseptic technique, optimal tissue handling, and standardized postoperative wound care. On the basis of these findings, 1% chlorhexidine soap may be considered a reasonable, cost-saving alternative to 4% chlorhexidine bodywash for preoperative bathing in elective caesarean section in resource-limited settings.

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