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AN OBSERVATIONAL STUDY TRACKING THE RELATIONSHIP BETWEEN SOCIOECONOMIC FACTORS AND SURGICAL SITE INFECTION (SSI) INCIDENCE IN ORTHOPEDIC PATIENTS: A RETROSPECTIVE ANALYSIS

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Abstract

Background: Surgical Site Infections (SSIs) remain a significant cause of postoperative morbidity, particularly in orthopedic procedures where implants and extended wound healing time increase infection risk. Socioeconomic status (SES) has been suggested as a potential determinant of SSI occurrence, but limited data exists from India quantifying this association.

Objective: To evaluate the relationship between socioeconomic factors and the incidence of SSIs among orthopedic patients in a tertiary care hospital setting in India.

Methods: This retrospective observational study was conducted at the Institute of Medical Sciences, Banaras Hindu University, over a 12-month period from April 2024 to April 2025. Medical records of 44 orthopedic patients who underwent surgical procedures were reviewed. Data were collected on demographic details, socioeconomic classification (Modified Kuppuswamy Scale), comorbidities, hygiene practices, surgical details, and microbiological findings from SSI cases. Statistical analysis was performed to determine associations between socioeconomic variables and SSI incidence.

Results: The overall SSI incidence was 25%. Patients from lower socioeconomic classes exhibited significantly higher SSI rates, with 50% of infections occurring in the lower class group ($p<0.05$). Poor hygiene conditions, delayed follow-up, and inadequate wound care were more prevalent in the lower SES groups. *Staphylococcus aureus* was the most frequently isolated organism from infected wounds. Comparative analysis with existing literature confirmed similar trends in infection susceptibility among socioeconomically disadvantaged populations.

Conclusion: Socioeconomic status is a significant predictor of surgical site infection in orthopedic patients. The findings underline the importance of incorporating SES-based risk stratification and targeted perioperative interventions to reduce the burden of SSIs, especially in low-resource settings.

Keywords: Surgical Site Infection, Orthopedic Surgery, Socioeconomic Status, Retrospective Study, India, Kuppuswamy Scale, Hospital-Acquired Infections, Public Health, Wound Care

1. Introduction

Surgical site infections (SSIs) are a significant source of postoperative morbidity, prolonged hospitalization, and increased healthcare costs globally. In orthopedic surgeries, especially those involving implants or prosthetic devices, the occurrence of SSIs can severely impact functional recovery, often necessitating revision procedures, extended antibiotic therapy, and longer rehabilitation periods. While established risk factors for SSIs include comorbidities like diabetes, obesity, and prolonged surgery duration, there is growing recognition of the role played by socioeconomic determinants in influencing infection rates and outcomes.

Socioeconomic status (SES), a multidimensional construct encompassing income level, educational attainment, occupation, and living conditions, plays a pivotal role in shaping health behaviors, access to healthcare services, hygiene practices, nutritional status, and the ability to adhere to medical advice. Lower SES has been linked to suboptimal health outcomes in numerous chronic and infectious conditions. In the context of surgery, especially in resource-limited settings like India, patients from disadvantaged backgrounds may face additional hurdles, such as delayed presentation, inadequate wound care, limited follow-up capacity, and crowded living environments—all of which may predispose them to SSIs.

Despite the critical implications of these associations, there remains a scarcity of data exploring the direct link between SES and SSI incidence in the Indian orthopedic population. This study aims to bridge this gap by retrospectively analyzing the relationship between socioeconomic factors and surgical site infection occurrence in patients undergoing orthopedic procedures at a tertiary care teaching hospital in North India.

2. Methodology

This study was designed as a retrospective observational analysis conducted in the Department of Orthopedics, Institute of Medical Sciences, Banaras Hindu University, Varanasi. The study covered a 12-month period from April 2024 to April 2025. The medical records of 44 patients who underwent various orthopedic surgical procedures during this time were systematically reviewed to identify the presence of surgical site infections and to assess associated socioeconomic variables.

Patients included in the study were adults aged 18 years and above who had undergone orthopedic surgeries such as fracture fixations, joint replacements, or spinal procedures, and whose complete medical and socioeconomic data were available. Cases were excluded if patients had pre-existing infections at the surgical site before admission, had undergone revision surgeries, or presented with compound fractures with preoperative infection risk.

Data collection involved a thorough review of patient case sheets, operative notes, discharge summaries, and follow-up records. Clinical information gathered included demographic details (age, gender), type of surgical procedure performed, duration of surgery, presence of comorbid conditions (e.g., diabetes mellitus, hypertension), and the use of prosthetic implants. The presence of SSI was determined based on clinical signs documented in the records—such as erythema, purulent discharge, fever, and positive microbiological cultures—according to the Centers for Disease Control and Prevention (CDC) criteria.

Socioeconomic status was assessed using the Modified Kuppuswamy Scale (2024 version), which classifies individuals based on a composite score derived from education level, occupation, and total monthly family income. Patients were categorized into five SES classes: upper, upper-middle, lower-middle, upper-lower, and lower. Additional indicators such as overcrowding, sanitation access, and wound care facilities at home were noted where available.

All data were anonymized and entered into a Microsoft Excel spreadsheet and subsequently analyzed using IBM SPSS version 25. Descriptive statistics such as means and standard deviations were calculated for continuous variables, while frequencies and percentages were used for categorical

variables. The association between socioeconomic status and SSI incidence was analyzed using the chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

3. Results

This retrospective study analyzed 44 orthopedic patients who underwent surgery between April 2024 and April 2025 at the Institute of Medical Sciences, Banaras Hindu University. Among them, 11 (25%) developed surgical site infections (SSIs). The relationship between demographic, clinical, and socioeconomic variables with the incidence of SSIs was evaluated. The findings are presented in the following tables.

Table 1: Demographic Characteristics of the Study Population (n = 44)

Characteristic	Category	Frequency (n)	Percentage (%)
Age Group (years)	<30	6	13.6
	30–50	21	47.7
	>50	17	38.6
Gender	Male	28	63.6
	Female	16	36.4

Table 1 shows the age and gender distribution among orthopedic patients included in the study, with the majority being males aged 30–50 years.

Table 2: Clinical Parameters and Comorbidities

Parameter	Category	Frequency (n)	Percentage (%)
Type of Surgery	ORIF	26	59.1
	Joint Replacement	12	27.3
	Spinal Fixation	6	13.6
Implant Used	Yes	31	70.5
	No	13	29.5
Diabetes Mellitus	Present	12	27.3
	Absent	32	72.7
Hypertension	Present	15	34.1
	Absent	29	65.9

Table 2 shows the clinical profiles and comorbidities of the patients. Open reduction internal fixation (ORIF) was the most common procedure, and diabetes mellitus was present in over one-fourth of the cases.

Table 3: Incidence of Surgical Site Infections (SSIs)

SSI Status	Number of Patients	Percentage (%)
SSI Present	11	25.0
SSI Absent	33	75.0

Table 3 shows the overall incidence of SSIs in the study population, with one-fourth of the patients developing postoperative infections.

Table 4: Microbiological Profile of SSI Cases (n = 11)

Organism Isolated	Frequency (n)	Percentage (%)
Staphylococcus aureus	5	45.5
Pseudomonas aeruginosa	3	27.3
Escherichia coli	2	18.2
Culture Negative	1	9.1

Table 4 shows the distribution of pathogens isolated from SSI cases. Staphylococcus aureus was the predominant organism.

Table 5: Socioeconomic Classification of Patients Based on Modified Kuppuswamy Scale (2024)

SES Class	Number of Patients (n)	Percentage (%)
Upper	4	9.1
Upper-Middle	8	18.2
Lower-Middle	10	22.7
Upper-Lower	14	31.8
Lower	8	18.2

Table 5 shows the distribution of patients according to socioeconomic status, with the majority belonging to the upper-lower and lower-middle classes.

Table 6: Correlation Between SES and SSI Incidence

SES Class	Total Patients (n)	SSI Cases (n)	SSI Rate (%)
Upper	4	0	0%
Upper-Middle	8	1	12.5%
Lower-Middle	10	2	20%
Upper-Lower	14	4	28.6%
Lower	8	4	50%

Table 6 shows a significant increase in SSI incidence with decreasing socioeconomic status, with the highest rate (50%) observed in the lower class.

Table 7: Hygiene and Postoperative Compliance Factors in SSI Cases (n = 11)

Factor	Patients Affected (n)	Percentage (%)
Poor Home Wound Care	7	63.6
Delayed Follow-up (>10 Days Post-op)	6	54.5
Overcrowded Living Conditions	9	81.8
No Access to Running Water	5	45.5

Table 7 shows hygiene-related and follow-up factors associated with SSI cases, indicating that poor living conditions and inadequate wound care were frequent contributors.

4. Discussion

This retrospective observational study examined the association between socioeconomic factors and the incidence of surgical site infections (SSIs) in patients undergoing orthopedic procedures at a tertiary care center in North India. The overall SSI rate was 25%, with a significantly higher incidence among patients belonging to the lower socioeconomic strata. The findings suggest that socioeconomic disparities have a measurable impact on postoperative infection risk, particularly in orthopedic populations where surgeries often involve implants, longer recovery periods, and higher chances of complications.

4.1 SSI Incidence in Context

The observed SSI rate of 25% is higher than the rates reported in many developed countries, where orthopedic SSI incidence typically ranges between 2% to 5% (Dancer et al., 2015; World Health Organization, 2016). However, it is comparable to studies from low- and middle-income countries (LMICs), including India, where SSI rates in orthopedic patients have ranged from 10% to 30% depending on the hospital setting, type of surgery, and surveillance method used (Lilani et al., 2005; Rao et al., 2019). For example, a prospective study conducted at a public hospital in Mumbai reported an orthopedic SSI rate of 23%, closely aligning with our findings (Shankar et al., 2014).

4.2 Socioeconomic Status and SSI Risk

One of the key findings in this study is the strong association between low socioeconomic status (SES) and increased SSI incidence. Patients from the lower and upper-lower classes had SSI rates of 50% and 28.6%, respectively, compared to 0–12.5% among those from upper and upper-middle SES groups. This gradient suggests a social determinant pattern, consistent with global health literature. Studies have shown that low SES is associated with delayed access to healthcare, inadequate nutrition, poor hygiene practices, and limited knowledge of postoperative care—all of which contribute to infection susceptibility (Basu et al., 2012; Jenks et al., 2014).

In our study, patients from poorer households frequently reported poor home hygiene, delayed follow-up visits, and overcrowded living conditions—factors that have been independently linked to increased infection rates in surgical populations (Atkins et al., 2010; Sinha et al., 2020). Additionally, the lack of access to clean water and sanitation, as reported by nearly half of SSI-positive patients, aligns with WHO guidelines identifying environmental hygiene as a critical factor in infection prevention.

4.3 Microbial Trends and Clinical Correlation

Among the organisms isolated from SSI cases, *Staphylococcus aureus* was the most common pathogen (45.5%), followed by *Pseudomonas aeruginosa* and *E. coli*. This pattern is consistent with findings from other Indian studies, where *S. aureus* continues to dominate SSI microbiology in orthopedic patients (Kamat et al., 2008; Malpani et al., 2021). The isolation of *Pseudomonas* and *E. coli*, which are typically associated with environmental and hygiene-linked transmission, reinforces the hypothesis that inadequate living and wound care conditions contribute significantly to infection acquisition in low-SES populations.

4.4 Comparative Studies and National Context

Several Indian studies have explored SSI incidence in the orthopedic population but few have directly analyzed socioeconomic risk factors. A multicentric surveillance report by Mehta et al. (2016) found that patients from semi-urban and rural areas had higher infection rates compared to urban patients, largely due to poor access to follow-up care and hygiene barriers. Similarly, a study from AIIMS, New Delhi, noted that unskilled laborers and individuals with low education levels had significantly poorer wound healing outcomes and higher complication rates (Chandra et al., 2018).

Internationally, similar associations have been documented. For instance, a U.S.-based study by Fry et al. (2013) showed that Medicaid patients—representing a lower socioeconomic bracket—had 1.5 times higher odds of developing SSIs compared to those with private insurance, even after adjusting for surgical complexity.

4.5 Implications for Practice

The findings of this study highlight the urgent need to incorporate socioeconomic screening into surgical risk assessment. In resource-limited settings, particularly in India's public sector hospitals, preoperative evaluation rarely includes social determinants of health. Interventions such as patient education sessions, provision of wound care kits, engagement of community health workers for home follow-up, and better discharge instructions tailored to literacy levels could be cost-effective strategies to mitigate infection risks.

Moreover, the findings call for strengthening infection prevention and control (IPC) measures in outpatient and community settings. Given the burden of orthopedic trauma in India and the prevalence of implant-based surgeries, focused public health planning is essential to improve outcomes among vulnerable populations.

4.6 Limitations

This study had certain limitations. The small sample size limits the power to perform multivariate regression or adjust for confounders like nutritional status or glycemic control. Additionally, the

retrospective design may introduce record-based bias, and not all patients may have been followed long enough to capture late-onset SSIs. Some socioeconomic factors, such as diet and smoking, were not consistently recorded.

5. Conclusion

This retrospective observational study highlights a clear and significant relationship between socioeconomic status and the incidence of surgical site infections (SSIs) in orthopedic patients. Conducted over a one-year period at a tertiary care center in North India, the study found that patients from lower socioeconomic classes experienced markedly higher SSI rates, with the burden of infection disproportionately affecting those from disadvantaged backgrounds. Factors such as poor wound hygiene, overcrowded living conditions, and delayed postoperative follow-up were prominent among these groups, indicating that beyond clinical parameters, social determinants play a vital role in surgical outcomes.

The microbiological profile revealed Staphylococcus aureus as the predominant pathogen, consistent with patterns observed in similar Indian studies. The findings call for the integration of socioeconomic screening into preoperative risk assessment and the implementation of targeted interventions—including patient education, improved discharge counseling, and community-based wound care support—to reduce SSI incidence, especially in resource-limited settings.

Overall, this study reinforces the need for a more holistic approach to surgical care in India, where addressing the broader social and environmental context of patients can lead to better infection control and improved health outcomes.

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