



Incidence & Severity of NSTI at High Altitude

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INTRODUCTION

Necrotizing soft tissue infections (NSTIs) are rapidly progressive bacterial infections involving the fascia, subcutaneous tissue, and sometimes muscle, associated with high morbidity and mortality and requiring early recognition and urgent surgical intervention. Diagnosis may be challenging due to subtle early findings and unpredictable progression. The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, which incorporates common laboratory markers (CRP, WBC, hemoglobin, sodium, creatinine, and glucose), is widely used to aid in risk stratification, though its performance varies across populations. High-altitude environments such as Colorado may influence NSTI pathophysiology through chronic hypoxia-induced increases in hematocrit, altered blood viscosity, and microvascular and endothelial changes that impact tissue perfusion and oxygenation, potentially modifying infection susceptibility and severity. Given the limited research on altitude-related effects, this study aims to characterize NSTI cases at a high-altitude tertiary care center and evaluate associations between altitude-related physiology, LRINEC scores, and clinical outcomes to inform future multi-center investigations and improve risk stratification.

METHODS

- Retrospective chart reviews were conducted at a single academic hospital located at high altitude in Colorado
- 247 patients met initial inclusion criteria
- Abstraction included demographics (age, sex, race/ethnicity, BMI, insurance status), comorbidities (e.g., hypertension, diabetes, cardiovascular disease, chronic kidney and liver disease, cancer, immunosuppression, smoking, and substance use), and clinical variables such as presenting symptoms, vital signs, imaging, and laboratory values and calculated LRINEC scores.
- Primary outcomes included operative intervention, number of debridements, amputation, hospital and ICU length of stay, and in-hospital mortality, while secondary outcomes included LRINEC scores and wound care requirements.
- Comorbidity prevalence was compared to national datasets, and odds ratios were calculated to assess associations with NSTI presentation and outcomes.

RESULTS

Table 1. Measuring Odds Ratio against National Prevalence in Similar Population

Comorbidity	NSTI Cohort (n=247)	Observed Prevalence (%)	National Prevalence (%) ¹	Odds Ratio (95% CI)	p-value
Diabetes	119	48.2	53.0	0.82 (0.64–1.05)	0.13
Hypertension	125	50.6	41.47	1.44 (1.13–1.83)	0.003
COPD	29	11.7	16.5	0.67 (0.45–0.99)	0.044
Coronary artery disease	73	29.6	62.0	0.26 (0.20–0.34)	<0.001
Cancer	22	8.9	3.2	3.00 (1.9–4.7)	<0.001
Liver disease	20	8.1	5.4	1.54 (0.99–2.39)	0.054
Tobacco use	88	35.6	27.78	1.44 (1.11–1.87)	0.007
Alcohol use	67	27.1	9.06	3.74 (2.84–4.93)	<0.001
Recreational drug use	88	35.6	14.61	3.24 (2.50–4.20)	<0.001

Table 1 Findings

- Substance use demonstrated the strongest associations, with alcohol use, recreational drug use, and tobacco use occurring markedly more frequently among NSTI patients.
- Hypertension was significantly more common in the NSTI (p = 0.003)
- Diabetes prevalence did not differ significantly when compared with a high-risk national comparator population (p = 0.13).
- Coronary artery disease was significantly less common (p < 0.001) among NSTI patients and COPD was modestly, but significantly less prevalent (p = 0.044).

Table 2 Findings

- Increasing LRINEC scores were significantly associated with higher odds of amputation (OR 3.60, p = 0.001), representing the strongest observed relationship among wound care outcomes.
- Higher LRINEC scores were also associated with increased odds of requiring surgical debridement (OR 2.40, p = 0.02)
- In contrast, LRINEC score was not significantly associated with the need for fasciotomy (OR 3.42, p = 0.18) or skin grafting (OR 2.62, p = 0.52).

Table 3 Findings

- Significant associations were observed between β -hemolytic group A *Streptococcus* and multiple aggressive interventions, including debridement (p = 0.014), fasciotomy (p = 0.040), and amputation (p = 0.003).
- *Vibrio* species were also significantly associated with the need for debridement (p = 0.036).
- Skin grafting was more frequently associated with other streptococcal species (p = 0.041) and *Candida* infections (p = 0.007).
- Gram-negative organisms were significantly associated with other wound care interventions (p = 0.012).

Table 2. LRINEC score predicting Wound Care Needs

Wound Care Needs	Odds Ratio	p-value	r ²
Amputation	3.596	.001	.12
Debridement	2.40	.021	.04
Fasciotomy	3.42	.18	.04
Skin-Graft	2.62	.52	.00

Table 3. Relationship between microorganism and wound care

Intervention	Microorganism	P value
Debridement	β -hemolytic group A <i>Streptococcus</i>	.014
	<i>Vibrio</i>	.036
Fasciotomy	β -hemolytic group A <i>Streptococcus</i>	.040
Amputation	β -hemolytic group A <i>Streptococcus</i>	.003
	<i>Clostridium</i>	.067
Skin-grafting	Other streptococci	.041
	<i>Candida</i>	.007
	<i>Clostridium</i>	.059
Other	Gram-negative bacteria	.012

CONCLUSION

- In this retrospective single-center cohort, social risk factors, particularly alcohol use, recreational drug use, and tobacco use, were significantly more prevalent compared to national data, while traditional comorbidities such as diabetes showed no significant difference.
- Higher LRINEC scores were associated with increased likelihood of surgical debridement and amputation, supporting their role in risk stratification and continued support as first line intervention.
- β -hemolytic group A *Streptococcus* was strongly associated with more aggressive surgical interventions.
- Although comorbidities did not demonstrate strong predictive value for NSTI presence, these findings suggest that both environmental factors, such as chronic hypoxia, and social determinants of health may play an important role in disease severity at high altitude.
- Highlights the need for larger, multi-center investigations across varying elevations to better define the impact of altitude on NSTI outcomes, refine risk prediction models, and improve early diagnosis and management.

LIMITATIONS

- Important limitation to consider is the lack of control group within the cohort for comparative risk. While OR was calculated against national prevalence of comorbidities, this study lacked a comparison against similar patient population at altitude.