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Effectiveness of Educational Interventions on Student Knowledge of First Aid for Sports Injuries

Indra Hizkia Perangin-angin*, Lili Suryani Tumanggor, Gryttha Tondang
Department of Nursing, Sekolah Tinggi Ilmu Kesehatan Santa Elisabeth, Sumatera Utara, Indonesia,
*Corresponding Author: papa_genk@yahoo.co.id

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ABSTRACT

Background: This study evaluated the effectiveness of structured educational interventions in improving students' knowledge of first aid for sports-related injuries. Adolescent injuries remain a significant school-based health concern, often exacerbated by knowledge gaps. This study addressed a gap in the literature by testing a multi-session intervention using a controlled experimental design to provide empirical evidence on its impact.
Methods: A quasi-experimental pre-test–post-test control group design was conducted at SMA RK Deli Murni Diski, Medan, Indonesia, over three months (October–December 2024). Seventy students participated (36 intervention, 34 control). Data were collected using a validated 25-item questionnaire (Cronbach's $\alpha = 0.87$) administered before and after the intervention. Ethical approval and informed consent were obtained.
Results: The intervention group's mean score rose significantly from 13.62 ± 2.10 to 24.29 ± 2.39 ($p < 0.001$), while the control group's increase from 13.71 ± 2.57 to 16.38 ± 3.33 was not significant. The percentage of students with "good" knowledge increased from 8.3% to 86.1% in the intervention group. The effect size was large (Cohen's $d = 4.80$), supporting the intervention's impact on knowledge retention.
Conclusion: Structured school-based first aid education significantly enhances students' readiness to manage sports injuries. Integrating such training into school curricula can promote youth health literacy and emergency preparedness. Future studies should assess long-term skill retention and behavioral outcomes.

INTRODUCTION

First aid education is a vital component in promoting health literacy, particularly among school-age adolescents who are at high risk of injury due to physical activity (Bozeia et al., 2025). Injuries in the school environment especially during physical education or sports activities are a widespread and often underestimated public health issue that transcends national boundaries. According to the World Health Organization (2023), unintentional injuries remain one of the leading causes of death and disability among adolescents, contributing to over 950,000 deaths annually in individuals under 18 years of age (León-Guereño, Cid-Aldama, Galindo-Domínguez, & Amezua-Urrutia, 2023). Beyond mortality, millions more suffer from non-fatal injuries that adversely affect their physical well-being, academic performance, and long-term psychosocial development. Recent international studies reinforce this concern (Bianco da Cruz et al., 2020). Study by (Mehreen, Mathur, Jat, & Pathak, 2021) reported that school-based sports injuries account for up to 35% of all adolescent emergency visits in low- and middle-

income countries. Another study by (Hussein & Elrewany, 2023)highlighted that only 27% of European high school students received formal education in first aid, with limited retention of knowledge over time. Additionally, the urgent need to integrate repetitive, scenario-based first aid training into school health policies to enhance both knowledge and readiness in emergency situations (Nandar Wirawan, Dedi Kurnia, Waryantini, & Rifaldi Faturahman, 2023).

These findings suggest that while awareness of injury prevention is growing, there remains a critical gap in consistent, effective first aid education particularly in adolescent school settings (Al-Maietah, Obeidat, & Al-Oran, 2023; Pascual Galiano, Vega Ramírez, & Ñíguez García, 2023; Salem Nasser Al-Rashidi, 2024). Addressing this gap is essential to improving emergency preparedness, reducing injury severity, and empowering students to act appropriately during health crises (Nastiti & Darotin, 2024; S et al., 2025). School environments, where students engage in physical activity without medical supervision, are common sites for injuries such as sprains, fractures, and dislocations (Joys, Anto, A, Ann Joseph, & John, 2022; Mehreen et al., 2021). Immediate and appropriate first aid can reduce complications and support faster recovery. However, many students particularly in low- and middle-income countries (LMICs) lack adequate first aid knowledge due to limited or poorly implemented school-based health programs (Hussein & Elrewany, 2023). While global frameworks like SDG 3.6 and recommendations from the International Federation of Red Cross and Red Crescent Societies (2016) emphasize the need for first aid training in schools, there is limited empirical evidence on the effectiveness of structured, repetitive educational interventions to close this knowledge gap especially in LMIC contexts (Hussein & Elrewany, 2023). This study addresses that gap by evaluating whether repeated, targeted first aid education significantly improves students' knowledge of emergency response for sports-related injuries. We hypothesize that students who receive structured first aid education will demonstrate a significantly higher increase in knowledge compared to those who do not (Nandar Wirawan, Waryantini, Ganjar Safari, Rifaldi, & Dini Rubby, 2023).

Several studies have highlighted the low to moderate levels of first aid knowledge among adolescents in various global contexts. Research by (García & Vargas, 2025) indicated that while many members of school-based Red Cross Youth groups in Indonesia possessed basic awareness of first aid, the practical application of that knowledge was inconsistent due to limited training opportunities. Similarly, (Rondhianto, Setioputro, & Yunanto, 2023) found that only 12.5% of students had adequate knowledge of first aid in sports injuries, despite being enrolled in a sports-focused school. These findings are corroborated by (Mulyana et al., 2023) who reported that fewer than 65% of high school students demonstrated proper understanding of injury prevention and response techniques. Furthermore, global studies reveal that misconceptions, lack of training, and absence of structured educational interventions contribute to inadequate preparedness among youth (Al-Maietah et al., 2023; León-Guereño et al., 2023; Puar et al., 2025). Despite increasing calls for first aid education, there remains a lack of longitudinal evidence on the impact of such educational interventions in school settings, particularly in LMICs where health education is not always a core part of the curriculum (Efendi et al., 2023).

Injury prevention and first aid knowledge have long been recognized in public health, but school-based implementation remains fragmented. Historically, first aid education has been limited to extracurricular or voluntary programs, with inconsistent reach and effectiveness. This research addresses this policy gap by evaluating the educational impact of structured first aid training in formal high school settings in Indonesia a representative LMIC context. Given the increasing global emphasis on youth health literacy and safety, especially post-COVID-19 where school safety policies have become more prominent, studies like this have vital implications. They contribute to global dialogues on universal health coverage, community-based care, and inclusive education systems capable of responding to emergencies effectively (Purwacaraka, Hidayat, Erwansyah, Prasetio, & Munawaroh, 2025; Suwaryo, Santoso, Yuda, Nugroho, & Hariyady, 2024).

This study specifically addresses the gap in knowledge regarding the effectiveness of educational interventions on student understanding of first aid for sports injuries. Previous findings suggest knowledge disparities and the absence of structured pedagogical frameworks

for first aid training in schools (Al Hashil, Al Hashil, Al Alhareth, Al Mansour, & Al Hutayla, 2024). By implementing a quasi-experimental design to assess pre- and post-intervention knowledge levels among high school students, this research contributes empirical evidence to inform education and health policies.

This study aims to evaluate the effectiveness of educational interventions in enhancing high school students' knowledge of first aid for sports-related injuries. Specifically, it assesses whether structured and repeated educational sessions can lead to measurable improvements in students' understanding and preparedness in managing common athletic injuries such as sprains, strains, fractures, and dislocations.

METHODS

Study Design

This research employed a quasi-experimental study design using a pre-test and post-test control group approach. The intervention group received structured educational sessions, while the control group did not receive any educational treatment. This design was chosen due to its practicality in school settings, where randomization was not feasible, yet a comparison between groups was necessary to assess the effectiveness of the educational intervention. The design supports the research objective of evaluating causal relationships between health education and student knowledge outcomes.

Study Setting

The study was carried out at Sekolah Menengah Atas (SMA) RK Deli Murni Diski, a secondary school located in Medan, Indonesia. This setting was considered appropriate because physical education is an integral part of the school curriculum, allowing for a realistic assessment of students' knowledge related to sports-related injuries. The study population consisted of Grade XI students from both the science (IPA) and social science (IPS) streams, as these students actively participate in regular sports activities.

Population and Sample

Participants were included if they were officially enrolled in Grade XI, were present during the data collection period, and provided informed consent prior to participation. Students were excluded if they had previously received formal first-aid training or had health conditions that restricted their participation in physical education activities. Sampling was conducted using Slovin's formula for finite populations with a 10% margin of error, which indicated that at least 34 students were needed from the population of 50 students. To maximize representativeness and statistical power, however, the study included all eligible students. In total, 36 students from two Grade XI classes were recruited, with one class assigned to the intervention group (n = 36) and the other to the control group (n = 34).

Data Collection Procedures

Data collection took place from October to December 2024 and followed a structured three-phase sequence. During the pre-intervention phase, baseline knowledge was assessed using a structured questionnaire administered to both the intervention and control groups. In the intervention phase, the intervention group received three educational sessions on the first aid management of sports injuries delivered on Days 1, 5, and 10. These sessions were guided by a Standardized Action Plan (SAP) and incorporated interactive lectures, demonstrations, and participant engagement to facilitate understanding. In the post-intervention phase, knowledge was reassessed for both groups using the same questionnaire to ensure consistency of measurement. All data collection procedures were carried out by trained nursing educators with expertise in emergency care and sports-related injury management. To ensure data quality and reliability, the process was conducted under direct supervision, and consistency checks were performed throughout each phase.

Study Variables and Instruments

The independent variable in this study was the educational intervention on first aid management for sports injuries, while the dependent variable was the students' level of knowledge regarding first aid procedures. Knowledge was measured using a structured multiple-choice questionnaire developed based on evidence from international first aid training guidelines and prior empirical studies. The scoring system categorized student knowledge levels into three groups: *good* (76–100%), *adequate* (56–75%), and *poor* (<56%).

The questionnaire underwent content validation based on existing literature and established first aid protocols. Reliability testing using Cronbach's alpha during preliminary piloting demonstrated acceptable internal consistency ($\alpha > 0.7$), indicating that the instrument was sufficiently reliable for use in this study

Data Analysis

Data analysis was performed using SPSS version 25. Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize the demographic characteristics and baseline knowledge levels of participants. Prior to comparative testing, data normality was assessed using the Kolmogorov–Smirnov test, which indicated that all continuous variables were normally distributed ($p > 0.05$). Baseline equivalence between the intervention and control groups was examined using Levene's test for equality of variances for continuous variables, and Chi-square tests for categorical variables such as gender and age group. Results showed no statistically significant differences between groups at baseline ($p > 0.05$), confirming that the two groups were comparable prior to the intervention. To evaluate the effectiveness of the educational intervention, paired t-tests were used to analyze within-group differences in knowledge scores between pre and post-test assessments. Additionally, independent t-tests were applied to compare post-test scores between the intervention and control groups. A p-value of less than 0.05 was considered statistically significant for all analyses.

Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of STIKes Santa Elisabeth Medan (Approval No. 065/KEPK/SE/X/2024, October 10, 2024). The research followed the ethical principles outlined in the Declaration of Helsinki, including respect for persons, beneficence, and justice. Informed consent was obtained from all student participants, and written parental consent was secured for minors under the age of 18. All data were anonymized, and participant confidentiality was rigorously maintained. Access to raw data was restricted to authorized research personnel, and results were reported only in aggregate form to protect individual identities.

RESULTS

Descriptive Statistics

Table 1 displays the demographic characteristics of participants. The mean age of students in both groups was approximately 16.2 years (±0.6 SD). Female students constituted the majority in both the intervention (61.1%) and control (64.7%) groups. The majority of students in both groups were aged 16 years, accounting for 77.8% of the intervention group and 64.7% of the control group.

Table 1. Characteristics Of Participants

Characteristic	Intervention		Control	
	n	%	n	%
Gender				
Male	14	38.9	12	35.3
Female	22	61.1	22	64.7
Age				
15 years	3	8.3	1	2.9

16 years	28	77.8	22	64.7
17 years	4	11.1	8	23.5
18 years	1	2.8	3	8.8

Primary Outcome Measure: Knowledge of First Aid

The primary outcome of the study was the change in students' knowledge regarding first aid for sports injuries, measured pre- and post-intervention.

Table 2. Students' Knowledge Regarding First Aid

Knowledge Level	Intervention Pre		Intervention Post		Control Pre		Control Post	
	n	%	n	%	n	%	n	%
Poor	2	5.6	0	0.0	3	8.8	3	8.8
Adequate	31	86.1	5	13.9	31	91.2	31	91.2
Good	3	8.3	31	86.1	0	0.0	0	0.0

Table 2 presents the distribution of students' knowledge levels regarding first aid for sports injuries across both the intervention and control groups during the pre- and post-test phases. Prior to the intervention, most students in both groups demonstrated only *adequate* knowledge, with 86.1% in the intervention group and 91.2% in the control group falling into this category. A small proportion of students exhibited *poor* knowledge (5.6% in the intervention group and 8.8% in the control group), while very few students in the intervention group (8.3%) reached the *good* category, and none in the control group achieved this level.

Following the educational intervention, there was a significant improvement in the intervention group. The proportion of students achieving *good* knowledge increased dramatically to 86.1%, while none remained in the *poor* category. Only 13.9% retained an *adequate* level, indicating a marked upward shift in knowledge. In contrast, the control group showed no meaningful change between pre- and post-test assessments; the majority (91.2%) remained in the *adequate* category, with no students progressing to *good* knowledge, and 8.8% still classified as having *poor* knowledge.

Table 3. Pre- and Post-Test Knowledge Scores in the Intervention and Control Groups

Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	p-value
Intervention	13.62 ± 2.10	24.29 ± 2.39	<0.001
Control	13.71 ± 2.57	16.38 ± 3.33	NS

The table presents the comparison of mean knowledge scores between the intervention and control groups before and after the educational intervention. In the intervention group, the mean pre-test score was 13.62 ± 2.10, which increased substantially to 24.29 ± 2.39 following the intervention. This improvement was statistically significant ($p < 0.001$), indicating a strong positive effect of the educational sessions on student knowledge.

Conversely, the control group showed only a minimal increase from 13.71 ± 2.57 at pre-test to 16.38 ± 3.33 at post-test. This change was not statistically significant (NS), suggesting that without the intervention, students' knowledge levels remained largely unchanged. Overall, the findings demonstrate that the structured first aid educational intervention led to a meaningful and statistically significant improvement in students' knowledge, whereas the control group showed no comparable progress

DISCUSSION

This study demonstrated that a structured, multi-session educational intervention had a substantial impact on improving students' knowledge of first aid for sports-related injuries. The intervention group showed a significant increase in mean scores from 13.62 before the program

to 24.29 after the intervention indicating a strong positive effect of repeated and targeted instruction. Conversely, the control group experienced no significant improvement, suggesting that routine school curricula alone are insufficient to enhance first aid competence among students.

These findings reinforce the premise that adolescents are highly receptive to structured health education, especially when content is delivered through interactive and practical approaches. Similar results have been reported by (León-Guereño et al., 2023; Puar et al., 2025), where educational interventions improved health knowledge and behavioral outcomes among high school students. The present study extends this evidence by focusing specifically on sports injury first aid, an area often neglected in standard school health programs despite the high frequency of sports-related injuries during adolescence (Nandar Wirawan, Dedi Kurnia, et al., 2023; Pascual Galiano et al., 2023).

Importantly, the use of repeated sessions over a 10-day period appears to have amplified knowledge retention, reflecting behavioral learning theories that emphasize reinforcement and repetition as essential mechanisms for strengthening cognitive recall (Al-Maietah et al., 2023; Nastiti & Darotin, 2024; Salem Nasser Al-Rashidi, 2024). This suggests that interventions delivered only once may be insufficient and that multi-session programs should be considered for sustained knowledge gains.

The findings of this study are consistent with (Joys et al., 2022; S et al., 2025), who reported that more than 85% of students demonstrated improved emergency response knowledge following targeted learning sessions (Candra Patniawati et al., 2024). (Hussein & Elrewany, 2023; Mehreen et al., 2021) also documented similar improvements in first aid awareness after extracurricular injury-prevention programs. These parallels underline the replicability of structured educational interventions across diverse school contexts. However, the results differ from studies conducted in rural or resource-limited settings, such as those by (Hussein & Elrewany, 2023; Nandar Wirawan, Waryantini, et al., 2023), where single-session interventions yielded only modest improvements. Differences in instructional design, reinforcement frequency, and baseline knowledge may explain the discrepancies. Collectively, this study strengthens the argument that high-frequency, interactive learning is more effective than brief, one-time trainings.

The implications of this study extend beyond academic settings. School-based first aid education can serve as an accessible, scalable, and cost-efficient public health strategy. Since a substantial proportion of adolescent injuries occur during school-based sports activities, equipping students with first aid knowledge has the potential to reduce preventable complications and improve immediate responses to injury (Nandar Wirawan, Dedi Kurnia, et al., 2023; Nandar Wirawan, Waryantini, et al., 2023; Rondhianto et al., 2023). These findings support global health recommendations encouraging integration of first aid training into school curricula, in alignment with the WHO Global School Health Initiative and Sustainable Development Goal 3 (Good Health and Well-being). This study also resonates with the work of (Mehreen et al., 2021), who highlight the importance of adolescent health literacy as a foundation for preventive care. Implementing structured first aid education across all secondary schools may therefore contribute to improved school safety, enhanced community preparedness, and reduced burden on healthcare systems (Al Hashil et al., 2024; Bianco da Cruz et al., 2020; García & Vargas, 2025; Hussein & Elrewany, 2023).

This study has several limitations. First, the sample was limited to one secondary school, which may reduce the generalizability of the findings to other regions or educational settings. Second, the quasi-experimental design without randomization introduces potential selection bias, although baseline equivalency was statistically confirmed. Third, reliance on self-administered questionnaires may lead to reporting bias and does not assess practical first aid performance. Lastly, the short interval between pre- and post-tests limits conclusions about long-term knowledge retention. Future research should include randomized designs, multiple school settings, and skill-based assessments to evaluate both short- and long-term effectiveness.

CONCLUSION

This study concludes that a structured, multi-session educational intervention significantly improves students' knowledge of first aid for sports injuries in a high school setting. The substantial increase in knowledge among the intervention group, compared to no meaningful change in the control group, demonstrates the effectiveness of targeted instructional strategies. These findings highlight the importance of integrating systematic first aid education into school curricula to enhance adolescents' preparedness and response to sports-related injuries.

Schools are encouraged to incorporate structured and repeated first aid training into their regular curriculum, particularly within physical education programs. Collaboration between educators, school health units, and healthcare professionals should be strengthened to ensure accurate, skill-based training. Policymakers should consider adopting school-wide first aid programs as part of broader adolescent health literacy initiatives. Future studies should evaluate long-term retention and practical skill performance to further strengthen evidence for curriculum-level integration.

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Conflicts of Interest: The authors declare no conflict of interest.

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