



## The Impact of First Aid Training on Knowledge and Practical Skills Among Sports Vocational Students

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### ORIGINAL ARTICLE

#### ABSTRACT

Musculoskeletal injuries represent a significant challenge in youth athletics, necessitating effective immediate management to prevent complications. This study aimed to evaluate the effectiveness of a targeted musculoskeletal injury first aid training program on the knowledge and practical skills of Grade 10 student-athletes at the Indonesian Special Sports School (SKOI), East Kalimantan. Utilizing a pre-experimental, one-group pretest-posttest design, 30 student-athletes participated in a structured intervention covering dislocations, sprains and strains, fractures, bleeding, and muscle cramps. The findings revealed statistically significant improvements across all injury categories ( $p < 0.001$ ), with substantially large effect sizes indicating the program's strong efficacy. Notably, the sprain and strain category showed the most pronounced advancement, with practical skills rising from a low baseline to high proficiency (Cohen's  $d = 7.06$ ). Furthermore, robust practical skill acquisitions were consistently documented for fractures ( $d = 3.66$ ), bleeding ( $d = 3.09$ ), muscle cramps ( $d = 2.63$ ), and dislocations ( $d = 2.49$ ). These results demonstrate that the training successfully bridged the gap between theoretical comprehension and on-field application. In conclusion, structured first aid education significantly enhances student-athlete competence, supporting its integration as a sustainable core component of sports school curricula to mitigate injury-related risks.

**Keywords:** Musculoskeletal Injuries, Athletes, Students, Health Knowledge, Attitudes, Practice.

#### ABSTRAK

Cedera muskuloskeletal merupakan tantangan yang signifikan dalam olahraga remaja, yang memerlukan penanganan segera yang efektif untuk mencegah komplikasi. Penelitian ini bertujuan untuk mengevaluasi efektivitas program pelatihan pertolongan pertama cedera muskuloskeletal yang terarah terhadap pengetahuan dan keterampilan praktik siswa atlet kelas 10 di Sekolah Khusus Olahraga Indonesia (SKOI), Kalimantan Timur. Dengan menggunakan desain pre-experimental, one-group pretest-posttest, 30 siswa atlet berpartisipasi dalam intervensi terstruktur yang mencakup dislokasi, sprain dan strain, fraktur, perdarahan, serta kram otot. Temuan menunjukkan peningkatan yang signifikan secara statistik di semua kategori cedera ( $p < 0,001$ ), dengan ukuran efek (effect sizes) yang sangat besar yang menunjukkan kemanjuran program yang kuat. Terutama, kategori sprain dan strain menunjukkan kemajuan yang paling menonjol, dengan keterampilan praktik meningkat dari dasar yang rendah menjadi kemahiran tinggi (Cohen's  $d = 7,06$ ). Selain itu, perolehan keterampilan praktik yang kuat secara konsisten didokumentasikan untuk fraktur ( $d = 3,66$ ), perdarahan ( $d = 3,09$ ), kram otot ( $d = 2,63$ ), dan dislokasi ( $d = 2,49$ ). Hasil ini menunjukkan bahwa pelatihan berhasil menjembatani kesenjangan antara pemahaman teoretis dan aplikasi di lapangan. Sebagai kesimpulan, pendidikan pertolongan pertama yang terstruktur secara signifikan meningkatkan kompetensi siswa atlet, mendukung integrasinya sebagai komponen inti yang berkelanjutan dalam kurikulum sekolah olahraga untuk mengurangi risiko terkait cedera.

**Kata Kunci:** Pertolongan Pertama, Cedera Muskuloskeletal, Atlet; Siswa, Pengetahuan, Sikap, dan Praktik Kesehatan.

## INTRODUCTION

Musculoskeletal injuries involve trauma to the muscles, bones, tendons, ligaments, and other soft tissues. Globally, the World Health Organization (WHO) estimates that approximately 1.71 billion people are affected by musculoskeletal conditions (World Health Organization, 2022). In Indonesia, national health data have also reported a substantial burden of musculoskeletal injuries and related conditions (Sureskiarti, 2020). Indicated a 9.2% prevalence of injuries that disrupt daily activities, with adolescents identified as a highly vulnerable demographic (Fredianto & Ulfa, 2024). Sports schools such as SKOI face elevated risks due to intensive physical activity, where community-based health and educational approaches play a vital role in improving health awareness and knowledge (Gumilang, Sundayani, & Remami, 2026). In youth sports academies, musculoskeletal injuries present a significant public health and athletic challenge. Student-athletes endure rigorous training schedules that combine academic demands with high-intensity physical conditioning, exponentially increasing their vulnerability to acute and overuse injuries (Weishorn et al., 2023). Despite a growing awareness of sports injuries among young athletes (AlFawaz, 2023), initial on-field management is frequently delayed or poorly executed due to a pervasive lack of basic first aid literacy among peer athletes and school stakeholders (Fredianto & Ulfa, 2024; García-Blaya et al., 2025; Jamaludin et al., 2024). Consequently, there is an urgent need to establish accessible, structured first aid training programs tailored to this high-risk population, utilizing effective media and educational strategies to enhance adolescent health literacy to mitigate long-term health complications and prolonged sports absenteeism (Sari et al., 2025).

Theoretical models of sports injury prevention, such as van Mechelen's sequence of prevention, emphasize that modifying behavioral factors including immediate first aid response is critical to reducing injury severity (Lima et al., 2022). While extensive literature evaluates first aid proficiencies among coaches and physical education teachers, limited empirical focus has been directed toward the student-athletes themselves (Cheng et al., 2024). Furthermore, existing studies predominantly examine elite adult cohorts, leaving a distinct research gap regarding youth athletes in specialized sports schools (McLellan et al., 2022). Grade 10 student-athletes represent a highly vulnerable transitional cohort within this framework; as newly admitted student-athletes entering a highly intensive sports academy environment, they face a sudden increase in training volume while lacking the baseline injury-management literacy possessed by their senior peers (Young, 2024). Targeting this specific baseline group ensures that preventive education is delivered at the onset of their athletic careers, maximizing the long-term utility of the intervention (Yadav et al., 2026).

The study assesses changes in participants' cognitive knowledge and practical first aid skills before and after the intervention across five common musculoskeletal injury categories: dislocations, sprains and strains, fractures, bleeding, and muscle cramps. Consistent with recent evidence demonstrating the high efficacy of structured first aid training among secondary school students and adolescents (Al-Maietah et al., 2023; Bulduk & Özdemir, 2024), it is hypothesized that participation in this training program will result in statistically significant improvements in both knowledge and practical skills. Ultimately, this study seeks to provide robust empirical evidence to support the integration of comprehensive first aid education into the curriculum of specialized sports schools (Dianti & Susilawati, 2023; İbrahimoglu et al., 2024). This study aims to evaluate the effectiveness of a structured musculoskeletal injury first aid training program in improving the knowledge and practical skills of Grade 10 student-athletes at the Indonesian Special Sports School (*Sekolah Khusus Olahraga Indonesia*), East Kalimantan.

## RESEARCH METHODS

This study employed a pre-experimental one-group pretest–posttest design to evaluate the effectiveness of a structured musculoskeletal injury first aid training program. This design is appropriate for educational and training interventions conducted in specialized field settings where the establishment of a true control group is not feasible due to logistical constraints. The intervention served as the independent variable, whereas participants' knowledge and practical first aid skills constituted the dependent variables.

Data were collected at two measurement points: immediately before the implementation of the training program (pretest) and immediately after the completion of the intervention (posttest).

Both assessments were conducted in November 2025 to determine changes in participants' cognitive knowledge and practical competencies following the training.

The study population consisted of 60 students enrolled at the Indonesian Special Sports School (*Sekolah Khusus Olahraga Indonesia*), East Kalimantan. A total of 30 Grade 10 student-athletes who met the predetermined inclusion criteria were recruited using a total sampling technique. This sampling approach ensured that all eligible participants were included in the study, thereby maximizing the representation of the target population.

Data were collected using two validated research instruments. The first instrument was a cognitive knowledge assessment comprising structured multiple-choice questions designed to measure participants' theoretical understanding of musculoskeletal injury first aid. Responses were evaluated using the Guttman scale. The second instrument was a practical skills evaluation consisting of a standardized observation checklist developed according to established Standard Operating Procedures (SOPs). This instrument assessed participants' ability to perform essential first aid procedures, including splinting, bandaging, and the immediate application of the RICE (Rest, Ice, Compression, Elevation) protocol.

To ensure instrument quality, both the knowledge questionnaire and the practical skills checklist were reviewed by experts in sports medicine to establish content validity (Fredianto & Uifa, 2024). Furthermore, two independent assessors participated in a standardized four-hour training session before data collection to ensure consistency in scoring procedures and to minimize observer bias. Inter-rater reliability for the practical skills assessment was evaluated using Cohen's kappa ( $\kappa$ ), resulting in a coefficient of 0.84, indicating strong agreement between the two assessors (Ntumi, 2025).

Quantitative data were analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics were used to summarize participants' knowledge and practical skill scores, with continuous variables presented as means (M) and standard deviations (SD). Prior to hypothesis testing, the normality of the difference scores between pretest and posttest measurements was assessed using the Shapiro–Wilk test. Because the assumption of normality was satisfied ( $p > 0.05$ ), a paired-samples t-test was performed to determine whether the intervention produced statistically significant improvements in participants' knowledge and practical skills. Statistical significance was established at  $\alpha = 0.05$ , with p-values less than 0.05 considered statistically significant.

In addition to significance testing, Cohen's d was calculated to determine the magnitude of the intervention effect. Effect sizes were interpreted according to conventional criteria as small ( $d = 0.20$ ), medium ( $d = 0.50$ ), and large ( $d \geq 0.80$ ). To enhance the transparency and interpretability of the findings, 95% confidence intervals (CIs) for the mean differences were also reported, providing a more comprehensive evaluation of the intervention's effectiveness beyond statistical significance alone. The study received ethical approval from the Health Research Ethics Committee of Universitas Muhammadiyah Kalimantan Timur (UMKT) (Protocol No. 034/KEPK-UMKT/I/2025).

## RESULTS

**Table 1.** Respondent characteristics.

| Characteristic | Frequency (n) | Percentage (%) |
|----------------|---------------|----------------|
| Male           | 20            | 66,7%          |
| Female         | 10            | 33,3%          |
| Age 15         | 19            | 63,3%          |
| Age 16         | 9             | 30,0%          |
| Age 17         | 2             | 6,7%           |

Table 1 shows that the study included 30 Grade 10 student-athletes. The demographic analysis revealed that the majority of participants were male ( $n = 20$ ; 66.7%), with females accounting for 33.3% ( $n = 10$ ). The age distribution was predominantly 15 years old ( $n = 19$ ; 63.3%), followed by 16 years old ( $n = 9$ ; 30.0%) and 17 years old ( $n = 2$ ; 6.7%).

**Table 2.** Paired-samples t-test and effect sizes for knowledge and practical skills across injury categories.

| <b>Injury Category</b> | <b>Aspect/Domain</b> | <b>N</b> | <b>Pre-test (Mean±SD)</b> | <b>Post-test (Mean±SD)</b> | <b>Cohen's d</b> | <b>P-Value</b> |
|------------------------|----------------------|----------|---------------------------|----------------------------|------------------|----------------|
| Dislocation            | Knowledge            | 30       | 55.00±10.65               | 81.63±12.73                | 2.27             | 0.000*         |
|                        | Skills               | 30       | 60.33±14.68               | 88.83±6.78                 | 2.49             |                |
| Sprain/Strain          | Knowledge            | 30       | 41.07±12.16               | 85.73±8.38                 | 4.28             |                |
|                        | Skills               | 30       | 25.83±8.39                | 86.00±8.65                 | 7.06             |                |
| Bleeding               | Knowledge            | 30       | 56.00±13.09               | 82.27±11.73                | 2.11             |                |
|                        | Skills               | 30       | 40.00±14.22               | 82.50±13.25                | 3.09             |                |
| Fracture               | Knowledge            | 30       | 67.13±12.40               | 78.80±10.96                | 1.00             |                |
|                        | Skills               | 30       | 54.20±10.14               | 85.27±6.54                 | 3.66             |                |
| Muscle Cramp           | Knowledge            | 30       | 36.83±13.93               | 72.00±20.58                | 2.01             |                |
|                        | Skills               | 30       | 38.17±10.54               | 71.83±14.71                | 2.63             |                |

*\*Note: All analyses were performed using paired-samples t-tests (N = 30), and all improvements across knowledge and skill domains yielded a statistically significant value of  $p < 0.001$*

Table 2 demonstrates the efficacy of the first aid training program in enhancing the knowledge and practical skills of student-athletes across five categories of musculoskeletal injuries. The paired-samples t-test analysis revealed statistically significant improvements in all evaluated domains ( $p < 0.001$ ), which were further corroborated by substantial effect sizes (Cohen's  $d \geq 1.00$ ). Specifically, the most pronounced advancements were observed within the sprain and strain category, where theoretical knowledge exhibited a notable increase ( $d = 4.28$ ) and practical skills demonstrated a remarkable transition from a low baseline to a high level of proficiency ( $d = 7.06$ ). Comparable skill acquisitions were also documented in the management of dislocations, bleeding, fractures, and muscle cramps, as evidenced by the consistently large effect sizes across these variables. Collectively, these findings indicate that the targeted intervention was highly effective in bridging the gap between theoretical comprehension and practical application, thereby equipping the students with the essential competencies required for immediate on-field injury management.

## DISCUSSION

The findings of this study underscore the profound impact of structured educational interventions on the emergency response capabilities of student-athletes. When examining the demographic profile of the participants, which was predominantly male (66.7%), literature indicates that baseline knowledge, attitudes, and practical skills regarding health interventions are fundamentally driven by educational factors rather than demographic variables (Wang et al., 2025). While some evidence suggests varying information-seeking behaviors between genders, these differences tend to diminish among individuals within uniform educational backgrounds. Therefore, the successful acquisition of injury management skills observed in this study is primarily attributed to the targeted training and structured experience rather than inherent gender differences (Al-Maietah et al., 2023; Møgelvang et al., 2024). In parallel with demographic considerations, the age distribution of the cohort centering largely on 15-year-old adolescents (63.3%) represents an optimal developmental window for integrating new health competencies. Age serves as a crucial determinant of intellectual maturity and the capacity to process and retain complex procedural information (Lima et al., 2022). Because individuals in this specific developmental stage possess robust cognitive capabilities, interactive first aid interventions become highly effective (Al-Maietah et al., 2023). This period of adolescence positively facilitates systematic skill acquisition, motor competence, and the psychomotor adaptation necessary to execute emergency responses during musculoskeletal injury simulations (Burton et al., 2023).

Building upon these cognitive and motor capabilities, the intervention resulted in a clear and measurable improvement in both the theoretical understanding and practical execution of the student-athletes across all evaluated injury categories. Such positive outcomes align with existing literature confirming that basic first aid training effectively enhances the foundational knowledge levels of school-aged children (İbrahimoglu et al., 2024). Furthermore, the notable shift from limited baseline abilities to high practical proficiency highlights the specific value of experiential-based learning methodologies for middle-stage students (Yadav et al., 2026). Bridging this gap between conceptual theory and real-world, on-field application is especially critical in youth athletics. The ongoing necessity for such proactive injury management and preparedness continues to be a prominent focus in contemporary sports medicine research and clinical presentations (Onks, 2024). Ultimately, these findings reaffirm that delivering targeted, hands-on first aid education to secondary school students is a highly practical and effective measure (Bulduk & Özdemir, 2024).

Given the inherent physical risks associated with youth sports, establishing a structured framework for injury awareness and response among adolescent athletes is imperative (Al-qahatani et al., 2023; AlFawaz, 2023). The significant practical improvements demonstrated in this study strongly advocate for the formal integration of first-aid training methodologies directly into the physical education curriculum of secondary schools (Parada-Espinosa et al., 2025). By treating essential life-saving skills as core educational competencies, institutions can ensure that young athletes are actively equipped to manage unforeseen on-field emergencies rather than acting as mere bystanders (Jamaludin et al., 2024). Furthermore, establishing collaborative university-school interactions can provide the necessary clinical expertise and pedagogical support to sustain these critical training programs over time. Looking forward, the evolution of such experiential training could be further enhanced by emerging digital environments; for instance, integrating multimodal Extended Reality (XR) applications offers a promising, albeit ethically complex, frontier for creating highly immersive injury simulations (Kourtosis, 2024). Ultimately, these findings reaffirm that delivering targeted, hands-on first aid education to secondary school students is a highly practical and effective measure (Bulduk & Özdemir, 2024).

The remarkable improvements observed in this study, particularly the dramatic enhancement of practical skills in managing sprains and strains, underscore the efficacy of the chosen pedagogical methods. Interactive educational approaches combining lectures, demonstrations, and simulation improve learners' comprehension of sports injury management by presenting theoretical concepts within realistic clinical scenarios (Aljawfi et al., 2023). As sprains and strains are among the most common injuries encountered during sports participation, improving students' knowledge is essential to ensure timely recognition and appropriate initial treatment (Al-qahatani et al., 2023). This principle is directly reflected in the study's quantitative results, where participants demonstrated the most pronounced practical skill acquisition transitioning from a remarkably low baseline to high proficiency specifically in the sprain and strain category. Furthermore, simulation-based learning is particularly effective for first aid education because it enables learners to translate theoretical knowledge into practical competence, a crucial step when teaching laypersons (Correia et al., 2024). By bridging this conceptual gap, the experiential approach significantly increases students' confidence and preparedness to respond to sports-related musculoskeletal injuries in real-world, dynamic settings (Elendu et al., 2024; Yadav et al., 2026).

When examining the effectiveness of the intervention across specific injury categories, the findings reveal statistically significant improvements in all evaluated domains ( $p < 0.001$ ), corroborated by substantial effect sizes. The most pronounced advancements were observed in common athletic conditions such as sprains and strains, alongside significant skill acquisitions in managing dislocations, bleeding, fractures, and muscle cramps. Managing such acute trauma and physical injuries effectively is crucial in active populations to prevent long-term complications and ensure proper recovery (Maas et al., 2022). Furthermore, optimizing these educational outcomes relies on integrating structured teaching frameworks and innovative pedagogical approaches into learning environments (Hussein et al., 2025; Parada-Espinosa et al., 2025). Ultimately, these targeted interventions successfully bridge the gap between theoretical comprehension and practical execution (Wang et al., 2025) equipping student-athletes with the essential capabilities required for immediate on-field injury management.

The success of the program in bridging theoretical comprehension to practical application on-field provides crucial implications for school curricula. To maintain these standards and competencies, structured first-aid teaching methodologies should ideally be integrated directly into secondary school physical education curricula (Elendu et al., 2024). Through this integration, students and young athletes can master foundational cognitive concepts while simultaneously developing the psychomotor skills required to recognize and respond to sports-related injuries accurately (Wang et al., 2025). Consequently, educational institutions can establish themselves as proactive leaders in fostering competency-based safety frameworks.

Furthermore, strengthening strategic collaborations and interactions between health institutions, such as universities, and secondary schools serves as an effective long-term strategy to expand health education coverage. Such partnerships can provide essential clinical expertise, evidence-based guidelines, and structured support to ensure proper recovery pathways and injury management (Astin et al., 2023). By leveraging modern instructional frameworks and institutional synergy driven by contemporary educational innovations, the transfer of first-aid knowledge can be widely distributed, ultimately fostering a secure, emergency-responsive, and injury-preventative scholastic sports ecosystem (Hussein et al., 2025). The limitation of this study is that the assessment of knowledge and practical first-aid skills was conducted immediately after the intervention, so the study could not determine whether the improvements were retained over time or translated into effective responses during actual sports-related emergencies. Further research with longer follow-up periods is needed to assess the sustainability and real-world applicability of the acquired competencies.

## CONCLUSION

In conclusion, this study demonstrates that a structured first aid training program significantly improves the immediate knowledge and practical skill performance of Grade 10 student-athletes regarding musculoskeletal injuries at SKOI East Kalimantan. However, due to the pre-experimental one-group design and the relatively small sample size confined to a single institution, these findings should be interpreted with caution and cannot be widely generalized to all youth sports schools. While the immediate efficacy of the program is promising, definitive causal conclusions regarding its widespread impact remain limited by the absence of a randomized control group.

Consequently, broad institutional curriculum mandates should be withheld until more robust empirical evidence is established. Future research is strongly recommended to employ rigorous randomized controlled trials (RCTs) or comparative designs involving multiple sports academies and larger, more diverse cohorts of student-athletes. Additionally, longitudinal studies are required to evaluate the long-term retention of these first aid skills and their direct impact on reducing field-side injury complications before large-scale policy generalizations are implemented.

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