

Behavioral Responses to Drill-Based Health Education in Sports Injury Management among Martial Arts Athletes: Evidence from a Quasi-Experimental Study

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ABSTRACT

Background: Sports injuries are frequent in martial arts and often worsen when early management is inadequate, leading to extended recovery and disrupted training. Practice-oriented health education, particularly through drill-based approaches, may improve behavioral readiness in injury management.

Aims: This study examined behavioral responses to drill-based health education in sports injury management among martial arts athletes, focusing on changes in knowledge, attitudes, and practices.

Methods: A quasi-experimental pretest–posttest control group design was conducted among 46 martial arts athletes recruited through purposive sampling from a university student club. Participants were assigned to an intervention group receiving structured drill-based health education and a control group without educational treatment. Data were collected using questionnaires and observation sheets. Statistical analyses included the Wilcoxon matched-pair sign rank test, chi-square correlation, and Mann–Whitney U test with a significance level of $\alpha \leq 0.05$.

Results: Athletes who participated in drill-based health education demonstrated statistically significant improvements in knowledge, attitudes, and practices related to sports injury management following the intervention. No meaningful behavioral changes were observed in the control group, indicating that the improvements were attributable to the educational intervention.

Conclusion: Drill-based health education effectively enhances behavioral responses in sports injury management among martial arts athletes. By reinforcing procedural understanding and practical readiness, this approach represents a viable strategy for injury management education in martial arts settings. Further studies should explore long-term behavioral retention and comparative instructional methods.

Keyword: Drill-based Health Education; Injury First Aid Behavior; Martial Arts Athletes; Quasi-Experimental Study; Sports Injury Management;

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INTRODUCTION

Sports injuries constitute a recurring concern in martial arts due to the sport's inherent physical intensity and direct body contact (Su et al., 2024; Tulendiyeva et al., 2021). This issue becomes urgent because even routine training sessions may expose athletes to acute injuries. When early injury management is inadequate, minor trauma can develop into more serious physical conditions (Kong et al., 2022; Meer et al., 2023). Such situations often result in extended recovery periods and disrupted training schedules. For student-athletes, these consequences may also interfere with academic responsibilities. Despite these risks, injury management during training is frequently handled informally. Many martial arts settings lack immediate access to professional medical assistance. As a result, athletes' own behavioral responses play a decisive role in injury outcomes.

The urgency of addressing injury management is closely linked to how athletes behave in the immediate aftermath of an injury (Aldapit et al., 2025; Kvist & Silbernagel, 2022). Decisions made within the first moments after an incident can significantly influence recovery trajectories. However, athletes are often required to respond under physical stress and emotional pressure. In such conditions, theoretical knowledge alone may not translate into appropriate action (Brauckmann et al., 2023; Tawde et al., 2023). Attitudes toward pain, toughness, and endurance further shape injury responses. In martial arts culture, injuries are sometimes perceived as an unavoidable aspect of training. This perception can discourage athletes from applying proper first aid procedures. Consequently, injury management behavior emerges as a critical area requiring systematic intervention.

Health education is widely recognized as a means to improve health-related behavior in various populations, including athletes (Smith et al., 2022; Turner et al., 2021). The urgency lies in ensuring that such education effectively prepares individuals for real-world situations. Traditional educational approaches often emphasize information delivery rather than skill application (Akour & Alenezi, 2022). While these methods may increase awareness, they do not always enhance behavioral readiness. Athletes may understand injury management principles yet hesitate when immediate action is required. This disconnect highlights the limitations of passive learning strategies. Practical competence requires more than cognitive understanding. Therefore, educational models that integrate practice and repetition are increasingly viewed as necessary.

Drill-based health education offers a structured approach that prioritizes repeated practice of specific procedures (Adams et al., 2021; Bajow et al., 2024). Its relevance becomes urgent when considering the need for athletes to act quickly and accurately during injury events. Through drills, learners repeatedly engage in simulated scenarios that resemble actual situations. This repetition helps transform procedural knowledge into habitual responses. Drill-based learning has demonstrated effectiveness in emergency and clinical training environments (Wu et al., 2025). These contexts share similarities with sports injury situations that demand prompt action. By fostering familiarity and confidence, drills may reduce hesitation during critical moments. Despite this potential, such methods remain underutilized in sports injury education.

Another pressing concern is the limited focus on behavioral outcomes in sports injury education research (Pennock & McKenzie, 2025; Tranaeus et al., 2024). Many studies concentrate primarily on knowledge acquisition. However, behavior encompasses attitudes and practices that determine whether knowledge is applied effectively (Kumah et al., 2022). In martial arts, injury

management often occurs without direct supervision. Athletes must independently assess injury severity and select appropriate actions. This autonomy heightens the importance of integrated behavioral competence. Evaluating educational interventions solely on knowledge gains provides an incomplete assessment. A comprehensive evaluation must include attitudes and practical actions. Addressing this gap is essential for developing effective educational strategies.

The urgency of this issue is particularly evident among university-based martial arts athletes (Brown & Lloyd, 2024; Kettunen et al., 2023). These athletes often balance intensive physical training with academic obligations. Limited medical resources during training sessions increase reliance on self-management. Improper injury handling in this context may lead to repeated injuries or chronic conditions (Daunt et al., 2023; Everard et al., 2021). Such outcomes can negatively affect both athletic performance and academic engagement. Preventive and responsive education thus becomes a critical component of athlete support systems. Universities increasingly acknowledge the need for structured health education programs. However, these programs require empirical evidence to justify their design and implementation.

Martial arts present distinct injury patterns that differ from those observed in non-contact or endurance sports (Kuśnierz et al., 2025). Techniques involving strikes, throws, and joint locks pose specific risks. Generic first aid instruction may fail to address these sport-specific scenarios. Drill-based education allows training content to be tailored to realistic injury situations. This contextual relevance can enhance athlete engagement and learning effectiveness (Alkasasbeh et al., 2025; Thomas et al., 2023). When educational content reflects actual experiences, behavioral change is more likely to occur. Despite this advantage, empirical studies focusing on martial arts remain scarce. This lack of evidence limits the development of targeted educational interventions.

Considering these factors, research on drill-based health education in sports injury management is both timely and necessary (Clemente et al., 2024). There is a clear need for evidence-based approaches that strengthen behavioral responses rather than knowledge alone. Quasi-experimental designs offer a practical means to evaluate educational effectiveness in real training settings (Ruzafa-Martínez et al., 2023). Focusing on martial arts athletes addresses a high-risk group with unique educational needs. The findings of such research can contribute to the broader field of sports health education. Moreover, they may inform coaches and institutions in designing effective training programs. Improving injury management behavior has the potential to reduce injury severity. Ultimately, this study responds to an urgent demand for practical, behavior-oriented health education in martial arts contexts.

Building on the preceding background, which highlights the high injury exposure in martial arts, the time-sensitive nature of first responses, and the frequent absence of immediate medical support during training, existing literature has approached the problem largely from injury profiling, performance demands, and contextual influences rather than from education-driven behavior change. Evidence on structured preparation suggests that safety-oriented programs can improve readiness and movement quality, as reflected in the prehabilitation model described by Wilson et al., 2026, which aligns with the argument that practical rehearsal may strengthen action under pressure. Injury surveillance findings further reinforce the urgency of competent early management, with emergency-department data indicating meaningful injury burdens in combat sports, including upper-extremity trauma, as reported by Zakeri et al. (2026), a pattern that resonates with the background's emphasis on consequences when injuries are handled informally. From the performance side, studies such as de Almeida et al. (2025) and Kons et al., 2026 underscore that combat sport participation requires consistent training continuity and rapid, accurate responses, implying that education should not stop at awareness but must support procedural execution.

Importantly, behavior is shaped not only by knowledge but also by psychological tendencies and cultural expectations, which is why findings on links between athlete traits and response tendencies in mixed martial arts by Eid & Al Assaad (2026) provide a relevant behavioral lens for understanding why correct procedures may not be applied even when known. Complementing this, qualitative work on coaching environments and skill learning in real-world combat sport settings, including Kirk et al. (2026) and Hjortborg et al. (2026), supports the background's claim that training culture can normalize risk and influence what athletes do immediately after an incident. Clinical case evidence further demonstrates that injury-related decisions can carry substantial long-term implications, as illustrated by Reyes et al., 2026, while research involving specialized athlete groups broadens the understanding of performance and support needs in combat sport contexts, as discussed by Van Biesen et al. (2026). Finally, scholarship on changing combat sport spectacles suggests that shifting participation cultures may reshape norms around risk and injury tolerance, as argued by Nosal & Brzowska-Brywczyńska (2026), which helps explain why educational interventions must account for context, not just information. Taken together, the literature supports the problem's urgency and complexity described in the background, yet it still leaves a clear empirical gap regarding the testing of practice-oriented, drill-based health education that directly targets injury management behavior as an integrated outcome of knowledge, attitudes, and actions.

As outlined in the preceding background and literature review, sports injury management in martial arts unfolds within contexts that demand immediate decisions, often in the absence of professional medical assistance. In such situations, athletes' responses are shaped not only by what they know but also by how prepared they are to act under pressure. This condition raises a fundamental question regarding the suitability of conventional health education models that emphasize information transfer rather than behavioral rehearsal. Drill-based health education offers an alternative that aligns more closely with the experiential nature of sports training, as it allows athletes to repeatedly practice injury management procedures in simulated situations. Through repetition and guided practice, correct responses may become more automatic and less dependent on conscious deliberation. Despite this conceptual alignment, the practical value of drill-based health education for injury management has not been clearly established through empirical research. Without such evidence, recommendations for its implementation remain largely speculative. Therefore, a systematic investigation is needed to determine whether this approach can meaningfully influence athletes' injury management behavior.

While prior studies have contributed important knowledge regarding injury risks, performance demands, and psychological or contextual factors in martial arts, they leave several critical questions unanswered. Much of the existing research concentrates on identifying injury patterns or describing athlete characteristics, with comparatively little emphasis on intervention-based solutions. When educational efforts are examined, their evaluation often stops at changes in knowledge, overlooking attitudes and practical actions that define actual behavior. Moreover, experimental or quasi-experimental designs capable of assessing causal relationships remain relatively rare in this area. Martial arts athletes are also frequently subsumed under broader combat sport categories, which may obscure sport-specific behavioral dynamics. As a result, the literature provides limited guidance on how to design and evaluate educational programs that are both contextually relevant and behaviorally effective. This lack of targeted, practice-oriented intervention research constitutes a clear gap. Addressing this gap is necessary to advance evidence-based approaches to sports injury management education.

In response to the identified gaps, this study was designed to examine how martial arts athletes respond behaviorally to drill-based health education in the context of sports injury management.

Using a quasi-experimental approach, the study sought to evaluate whether a structured, practice-oriented educational intervention could produce measurable changes in athletes’ knowledge, attitudes, and practices. It was hypothesized that athletes who participated in drill-based health education would show greater improvements in injury management behavior than those who did not receive the intervention. By focusing on integrated behavioral outcomes rather than isolated knowledge gains, the study aims to provide clearer evidence of educational effectiveness. The findings are expected to complement existing descriptive research by offering intervention-focused insights. In doing so, the study contributes to a more comprehensive understanding of how injury management behavior can be strengthened through education. Ultimately, this work seeks to inform the development of practical, evidence-based training strategies for martial arts settings.

METHOD

Research Design

This study adopted a quasi-experimental pretest–posttest control group design to examine the influence of drill-based health education on sports injury management behavior. The design was chosen to accommodate the real training environment of martial arts athletes, where random assignment was not practically feasible. Two groups were observed over the same period, consisting of an intervention group and a control group, with measurements conducted before and after the intervention. The intervention group participated in structured drill-based health education sessions focusing on injury management procedures, while the control group continued their regular training activities without additional educational input. This approach enabled a focused comparison of behavioral changes attributable to the intervention while preserving ecological validity. The sequence of research activities, from participant selection to data analysis, is illustrated in Figure 1.

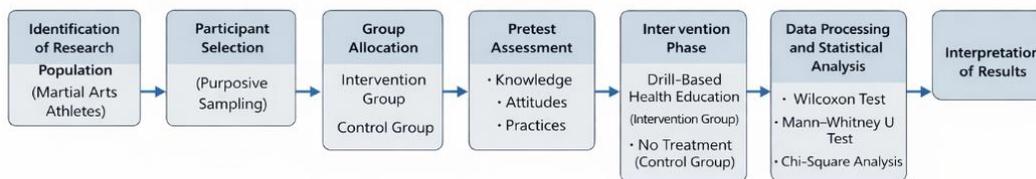


Figure 1. Flowchart of the research

Participant

Participants were recruited from a university-based martial arts student organization using purposive sampling. Eligibility criteria included active involvement in regular martial arts training and willingness to complete all stages of the study. A total of 46 athletes met these criteria and were included in the analysis. Participants were then assigned to either the intervention or control group. This sampling strategy ensured that the study involved individuals who were routinely exposed to injury risk during training. Prior to data collection, all participants provided informed consent, and ethical principles regarding confidentiality and voluntary participation were strictly observed.

Instrument

Data collection employed a combination of questionnaires and observation sheets to capture injury management behavior comprehensively. The questionnaire assessed three core components

of behavior, namely knowledge, attitudes, and practices related to sports injury management. Observation sheets were used to document practical responses demonstrated during simulated injury situations. The instruments were designed to reflect essential concepts in sports health education and were adapted to the specific context of martial arts training. Before use, the instruments were reviewed to ensure clarity and contextual relevance. The integration of self-reported and observational data strengthened the robustness of behavioral assessment.

Data Analysis

Data analysis was performed using non-parametric statistical procedures appropriate for the sample size and data characteristics. Changes within each group between pretest and posttest were analyzed using the Wilcoxon matched-pair sign rank test. Differences between the intervention and control groups following the intervention were examined using the Mann-Whitney U test. Chi-square analysis was applied where categorical associations were explored. All statistical tests were conducted with a significance level of $\alpha \leq 0.05$. The results were interpreted to determine whether the drill-based health education intervention produced meaningful behavioral changes.

RESULTS AND DISCUSSION

Results

The findings show that the implementation of drill-based health education coincided with noticeable changes in sports injury management behavior among martial arts athletes. At the beginning of the study, both the intervention and control groups displayed relatively similar behavioral profiles, indicating that initial conditions were broadly comparable. After the intervention period, a different pattern emerged between the two groups. Athletes who participated in the drill-based education demonstrated clearer progress in their understanding of injury management, more positive attitudes toward appropriate responses, and improved practical behavior during injury-related situations. In contrast, participants in the control group tended to maintain patterns that were largely unchanged from baseline. These descriptive trends are consistent with the results of the non-parametric analyses, which indicated meaningful within-group improvements for the intervention group and significant differences when compared with the control group at posttest. To provide a concise overview of these behavioral shifts, Table 1 summarizes the pretest and posttest profiles for both groups across the measured components.

Table 1. Comparison of Pretest and Posttest Behavioral Profiles Between Groups

Behavioral Component	Group	Pretest Profile	Posttest Profile
Knowledge	Intervention	Moderate	High
	Control	Moderate	Moderate
Attitudes	Intervention	Moderate	High
	Control	Moderate	Moderate

The table presents a descriptive comparison of behavioral profiles before and after the intervention. Improvements are evident in the intervention group across knowledge, attitudes, and practices, whereas changes in the control group remain minimal.

Discssion

This study set out to examine how drill-based health education influences sports injury management behavior among martial arts athletes, and the findings indicate that structured practice can meaningfully shape behavioral responses. Athletes who engaged in repeated injury-management drills demonstrated clearer improvements across knowledge, attitudes, and practices compared with those who followed routine training alone. This pattern suggests that behavioral readiness in martial arts is not an automatic by-product of experience. Instead, it appears to require intentional learning situations that mirror real injury contexts. In training environments where injuries can occur suddenly, preparedness becomes a functional necessity rather than an abstract concept. The results therefore reinforce the premise that experiential educational strategies deserve closer attention in sports health education. Drill-based instruction seems to help athletes move beyond knowing what to do toward being ready to do it. This shift is central to effective injury management.

The observed improvement in knowledge among athletes in the intervention group indicates that learning through drills does not diminish cognitive outcomes. On the contrary, embedding information within repeated action appears to strengthen understanding. Traditional educational approaches often rely on verbal explanation or written material, assuming that comprehension will naturally guide behavior. However, under conditions of physical strain and emotional pressure, recall may be limited. Drill-based learning allows information to be reinforced through experience, not memorization. This outcome is consistent with the structured preparation perspective described by Wilson et al. (2026), who emphasized readiness and safety awareness in combat sports. While their focus was on movement preparation, the learning mechanism is comparable. The present findings extend this logic to injury management contexts.

Attitudinal change emerged as another important outcome of the intervention. In many martial arts settings, injuries are normalized as part of training, and athletes may be reluctant to prioritize first aid. The shift in attitudes observed in this study suggests that drill-based education can subtly reshape these perceptions. When appropriate injury responses are repeatedly practiced, they become framed as routine rather than exceptional. This finding aligns with behavioral considerations raised by Eid & Al Assaad (2026), who highlighted how individual tendencies influence responses in mixed martial arts. Attitudes play a critical role in determining whether knowledge is applied. Without supportive attitudes, correct procedures may be ignored. The present results indicate that drills can influence this often-overlooked dimension of behavior.

The most pronounced change was found in practical injury management behavior. This is particularly significant, as practices represent the most tangible indicator of educational effectiveness. Martial arts athletes frequently handle minor injuries independently due to limited on-site medical support. The improvement in practices suggests that repeated rehearsal promotes quicker and more confident responses. This observation resonates with performance-oriented studies in combat sports by de Almeida et al. (2025) and Kons et al. (2026), which emphasize the importance of rapid, well-learned responses in physically demanding situations. Although these studies focus on performance rather than safety, the underlying principle of automaticity applies to injury management as well. Practice-oriented learning appears to reduce hesitation when action is required.

The lack of comparable change in the control group highlights the limits of conventional

training routines. Simply participating in regular martial arts practice did not substantially alter injury management behavior. This supports qualitative insights from Kirk et al. (2026) and Hjortborg et al. (2026), who noted that coaching environments often emphasize skill execution and performance outcomes over structured reflection on injury response. In such contexts, injury management is frequently informal and reactive. The present findings suggest that without targeted educational input, these patterns persist. Drill-based education offers a way to introduce intentional learning moments into established training cultures. By doing so, it may help shift behavioral norms toward safer practices.

Clinical perspectives further underline the importance of strengthening injury management behavior. Case-based evidence presented by Reyes et al. (2026) illustrates how inadequate injury decisions can have serious long-term consequences. While the current study focused on routine training injuries rather than extreme cases, it addresses the foundational behaviors that precede more severe outcomes. Improving everyday injury responses may reduce cumulative harm over time. This preventative orientation aligns with broader goals in sports health education. Rather than reacting to serious injury after it occurs, drill-based education emphasizes preparedness. Such an approach supports sustained athlete participation and well-being.

The applicability of drill-based education is also evident when considering different athlete populations. Research involving para-karate athletes by Van Biesen et al. (2026) demonstrates the importance of context-sensitive educational approaches. Although the present study involved non-disabled athletes, the principle of tailoring education to real conditions remains relevant. Drill-based methods allow injury scenarios to be adapted to specific sport demands. This flexibility increases relevance and engagement. When athletes recognize training scenarios as realistic, learning is more likely to be internalized. Consequently, behavioral change becomes more durable.

Broader changes in combat sport culture also provide a useful backdrop for interpreting these findings. Nosal & Brzozowska-Brywczyńska (2026) described shifts in combat sport spectacles and participation patterns that may influence attitudes toward risk and injury. As martial arts environments evolve, educational strategies must respond accordingly. Drill-based education can be integrated into existing routines without challenging the identity of the sport. Instead, it reinforces safety within familiar practices. This compatibility increases the likelihood of long-term adoption. Educational interventions that align with cultural dynamics are more likely to be sustained.

From a theoretical perspective, the study contributes to sports health education by treating behavior as an integrated construct. Many previous studies have examined knowledge, attitudes, or practices separately. The present findings suggest that meaningful change occurs when these components are addressed together. Drill-based education appears to function as a bridge between cognitive understanding and practical action. This supports experiential learning perspectives that emphasize learning through doing. The quasi-experimental design provides empirical support for this view. As such, the study adds explanatory depth to existing descriptive research.

Overall, the discussion highlights the value of drill-based health education as a practical and effective approach to improving injury management behavior in martial arts. By aligning educational strategies with the realities of training environments, such interventions can enhance readiness without disrupting performance goals. The findings respond directly to the need identified in the background for behavior-oriented health education. They suggest that structured practice can play a central role in promoting safer responses to injury. In this way, the study contributes to both theory and practice in sports injury management education.

Implications

The outcomes of this study suggest several implications for both practice and theory in sports health education. At the practical level, the findings indicate that injury management training in martial arts can be strengthened through structured drills that mirror real training situations. Such an approach allows athletes to internalize appropriate responses without interrupting the flow of regular practice. For coaches, this implies that safety-oriented education does not need to be separated from performance training, but can be embedded within it. From an educational standpoint, the results reinforce the importance of learning environments that prioritize action and repetition rather than passive instruction. Conceptually, the study supports the view that behavioral change in sports contexts emerges from the interaction of knowledge, attitudes, and practices. By demonstrating that these elements can be influenced simultaneously through drill-based education, the study contributes to a more integrated understanding of sports injury management behavior.

Limitations

Several limitations should be acknowledged in relation to the present study. The use of a quasi-experimental design means that the findings should not be interpreted as definitive causal evidence. Participants were drawn from a single institutional setting, which may limit the extent to which the results reflect the experiences of martial arts athletes in other contexts. In addition, some aspects of behavior were measured through self-reported instruments, which may be subject to individual interpretation or response bias. The relatively short duration of the intervention also limits insight into the long-term stability of behavioral changes. Furthermore, differences in prior injury experience and training intensity among participants were not fully accounted for. These factors may have influenced how athletes responded to the educational intervention.

Suggestions

In light of these limitations, several recommendations can be proposed for future research and practice. Subsequent studies may benefit from involving broader samples across multiple institutions and martial arts disciplines. Longer follow-up periods would allow researchers to examine whether behavioral improvements are sustained over time. Future research could also compare drill-based education with alternative instructional approaches to clarify relative effectiveness. The inclusion of more objective behavioral assessments, such as structured simulations or observational scoring, may enhance measurement precision. From a practical perspective, closer collaboration between coaches, sports educators, and healthcare professionals is recommended to refine injury management training. Such collaboration may help ensure that educational content remains both contextually relevant and medically sound.

CONCLUSION

This study shows that drill-based health education can meaningfully strengthen sports injury management behavior among martial arts athletes. Athletes who followed the structured drill sessions demonstrated clearer improvements in knowledge, more constructive attitudes toward appropriate injury handling, and better practical responses compared with those who continued routine training without the intervention. These findings indicate that effective injury management is not simply a consequence of training experience, but can be shaped through deliberate, practice-centered learning that rehearses what athletes must do in real situations. By linking understanding to action through repetition, drill-based education appears to reduce hesitation and improve readiness when injuries occur. The results also reinforce the value of viewing behavior as an

integrated outcome, where knowledge, attitudes, and practices develop together rather than independently. In practical terms, the study supports embedding injury-management drills into regular martial arts training as a feasible way to promote safer responses without disrupting performance preparation. Although broader testing is still needed across settings and longer timeframes, the present evidence positions drill-based health education as a promising strategy for improving injury management readiness in martial arts contexts.

AUTHOR'S CONTRIBUTION

Nuzulia Azizi Islamia conceptualized the study, designed the research framework, conducted data collection, performed data analysis, and interpreted the results. She also prepared the original manuscript draft and finalized the article for publication. Erna Dwi Wahyuni provided primary academic supervision, contributed to the refinement of the research design, guided the methodological approach, and critically reviewed the analytical process. Deni Yasmara offered secondary supervision, supported the conceptual development of the study, evaluated the interpretation of findings, and contributed to improving the clarity and academic rigor of the manuscript. All authors reviewed and approved the final version of the manuscript prior to submission.

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