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Doping in Martial Arts: How Is It Managed?

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Abstract

Background: Doping remains a persistent issue in martial arts, exacerbated by the easy access to over-the-counter medications containing banned substances. Despite existing regulations, athletes often lack comprehensive knowledge of anti-doping measures, leading to unintentional violations.
Aims: This study aims to evaluate the effectiveness of a doping management program in improving knowledge and awareness of doping among martial arts athletes.
Methods: A convergent parallel mixed-methods design was employed. Twenty-one national-level martial arts athletes were selected using purposive sampling. Data were collected through structured interviews and standardized questionnaires. The doping management intervention included a web-based doping screening tool, an anti-doping educational module, and a 24-hour online consultation clinic implemented during the 2024 National Sports Week (PON) training period.
Results: Results showed a significant increase in athletes' knowledge of doping, with the mean score rising from 54% to 76% ($p = 0.002$), especially in terms of understanding Therapeutic Use Exemptions (TUEs). However, the study also found low utilization of online doping clinics, confusion regarding TUE procedures, and continued reliance on coaches for drug use. Document analysis and institutional mapping showed that coordination between stakeholders was fragmented, and socialization of anti-doping services was not optimal.
Conclusion: The findings underscore that coaches play a pivotal role in doping management, serving as primary sources of information and guidance for athletes. Strengthening the involvement of coaches in anti-doping education is essential to maintaining a doping-free environment and ensuring the success of doping prevention strategies in martial arts.

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INTRODUCTION

Doping in sports continues to pose a serious threat to fair competition and athlete health, despite long-standing global regulatory efforts (Erickson et al., 2015; Mohan & Hazari, 2016; Momaya et al., 2015; Mottram, 2018; Umar et al., 2024). The World Anti-Doping Agency (WADA) defines doping as one or more violations of anti-doping rules, including the use or attempted use of prohibited substances or methods, as well as possession, trafficking, or tampering with doping controls (Naughton et al., 2024; WADA, 2021). Currently, However, some athletes resort to doping due to a lack of awareness about its adverse health effects (Fadlih et al., 2020). The World Anti-Doping Agency (WADA) consistently reports that positive findings from tests analyzed in WADA-accredited laboratories remain below 2% annually doping is widespread among professional athletes as a means to achieve success without undergoing rigorous training (Aguilar-Navarro et al.,

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2020; Meija et al., 2024; Houlihan et al., 2019). In contrast, several studies, particularly those based on self-reported doping cases, have found much higher prevalence rates, with estimates ranging from 14% to 57% among competitive athletes (Aguilar-Navarro et al., 2020). Despite decades of research on doping prevention and ongoing efforts by anti-doping organizations, the goal of achieving a doping-free sport (WADA, 2021) appears to remain unfulfilled (Huseynli et al., 2025).

In Indonesia, the challenge of doping is particularly pronounced in martial arts disciplines, especially during major national events such as the National Sports Week (Pekan Olahraga Nasional, PON). Given the physically demanding nature of martial arts and the high risk of injury, many athletes resort to over-the-counter medications, some of which may contain banned substances, to manage pain and recovery (Bhatia et al., 2015; Latif et al., 2022). Despite their strong patriotic spirit and determination to perform at their best, athletes often lack adequate knowledge of doping regulations. Commonly available medications, such as corticosteroids (e.g., dexamethasone, prednisone), cold remedies (e.g., pseudoephedrine), certain supplements (e.g., oxilofrine), and even eye drops (e.g., timolol), can contain prohibited substances. As a result, athletes may unintentionally violate anti-doping rules due to insufficient awareness (Fadlih et al., 2020). Although programs like the Doping Education Application (ADeL) and the involvement of Doping Control Officers (DCOs) have been introduced for PON XXI 2024 in collaboration with national and international sports bodies (Sepriani et al., 2023), the implementation of an integrated doping management system from coaching staff to competition level remains suboptimal.

The situation is exacerbated by various contributing factors, including performance pressure, external expectations, financial motivations, and the lack of education, monitoring, and access to safe alternatives (Engelberg & Skinner, 2016). Without comprehensive anti-doping guidance, athletes remain at high risk of unintentional doping, underscoring the urgent need for a structured, system-based management strategy involving all key stakeholders ahead of PON XXI 2024 (Kondric et al., 2011). However, previous studies rarely explore the practical implementation of anti-doping policies in decentralized athlete training systems like Pelatda. However, previous studies rarely explore the practical implementation of anti-doping policies in decentralized athlete training systems like Pelatda.

Coaches and sports organizations hold a central position in shaping athletes' behaviors and perspectives regarding doping. As daily companions in training and competition, coaches influence not only physical performance but also athletes' decision-making processes and ethical considerations (Patterson et al., 2023). However, when coaches lack sufficient anti-doping knowledge or when organizations fail to enforce consistent regulations, athletes become more vulnerable to inadvertent doping use (Hallward & Duncan, 2019). In many regional sports organizations, the absence of integrated systems for ongoing education, medication monitoring, and accessible consultation channels further hampers doping prevention efforts. Although the World Anti-Doping Code clearly outlines the shared responsibility among all sporting stakeholders, its implementation, particularly within national martial arts contingents, remains limited and fragmented. This gap reinforces the need to strengthen and evaluate doping management systems that can empower both athletes and their support teams to commit to clean sport values, especially in the context of high-stakes national events like PON XXI 2024.

Recent studies have explored various approaches to doping prevention, including cognitive, affective, and behavioral strategies aimed at modifying athletes' beliefs, attitudes, and decision-making processes (Lauer et al., 2018; Mudrak et al., 2018; Sagoe et al., 2016). Barkoukis et al. (2019) identified key psychosocial factors such as peer and coach influence, doping stigma, and perceived norms, while Ntoumanis et al. (2017) emphasized the role of motivation and moral disengagement in doping behavior. Meanwhile, Patterson et al. (2023) and Hallward & Duncan (2019) highlighted the crucial role of coaches, medical personnel, and sport organizations in shaping anti-doping environments. Despite these valuable insights, prior research has primarily focused on individual-level psychological factors or elite international settings, with limited attention given to system-based doping management at the national level, particularly in martial arts disciplines. In the context of Indonesia's National Sports Week (PON), there is a lack of empirical studies assessing the effectiveness of integrated anti-doping management systems that combine education, screening tools, and support services involving athletes, coaches, and medical staff. Research on systemic doping management in regional training camps in Indonesia remains limited, despite its crucial role

in the context of decentralized sports governance. This research addresses that gap by evaluating a doping management intervention specifically designed for martial arts athletes in preparation for PON XXI 2024. The study aims to assess how the use of a web-based screening database, anti-doping education modules, and a 24-hour online consultation clinic can enhance athletes' doping knowledge and awareness. The findings are expected to contribute to the development of more effective doping prevention strategies in national sport programs and underscore the strategic role of coaches in maintaining a doping-free environment.

Despite ongoing educational efforts, anti-doping measures in regions like KONI DIY remain limited by weak coordination and a lack of system-level integration. In addition, gender-specific considerations are still overlooked, despite physiological differences that may influence doping risk. These gaps highlight the need to evaluate not only athlete knowledge but also the broader management and support systems that shape anti-doping practices. To date, there is limited empirical evidence on how decentralized training centers implement anti-doping policies in practice, making this study among the first to evaluate such systems at the regional level in Indonesia.

METHOD

Research Design

This study employed a mixed-methods approach using a convergent parallel design, which enabled simultaneous collection and analysis of quantitative and qualitative data. This design was chosen to allow for triangulation of findings, combining the numerical assessment of knowledge improvements with the exploration of athletes' and coaches' subjective perceptions. Quantitative data were analyzed using a paired samples t-test to compare pre- and post-intervention knowledge scores obtained from the survey results, with the analysis conducted in SPSS version 21. Meanwhile, qualitative data from focus group discussions (FGDs) and interviews were analyzed using thematic content analysis following the steps proposed by Braun & Clarke (2006). Manual coding was conducted independently by researchers to ensure inter-coder reliability and credibility.

Population and Sample

The target population in this study consisted of 59 martial arts athletes who were selected to represent the Special Region of Yogyakarta (DIY) Province in the Regional Training Center towards the XXI National Sports Week (PON). A purposive sampling technique was used to determine the sample, and 21 athletes (10 male and 11 female) with an age range of 17-27 years were obtained. The sample of 21 respondents was deemed sufficient as it represented the entire population of martial arts athletes in the KONI DIY regional training center. The athletes came from various martial arts disciplines, including pencak silat, kempo, judo, kickboxing, taekwondo, hapkido, kurash, jujitsu, and combatives. Purposive sampling was used because the researcher wanted to specifically select individuals who had characteristics relevant to the research objectives, namely athletes who had been officially selected to represent DIY in the XXI PON event and were potentially exposed to doping risks during training and competition. This selection ensured that the data collected came from subjects who were involved in the anti-doping context, had experience at the national training center, and were in the environment that was the focus of the anti-doping management evaluation. All participants met the eligibility criteria for PON competition and provided written informed consent before participating in the study.

Data Collection Technique

Data collection was conducted in three main stages. First, an online survey was administered to assess athletes' baseline conditions, including the types of medications and supplements consumed during training, any illnesses experienced, and existing medical conditions that may predispose athletes to the use of substances listed on the WADA Prohibited List. Second, FGDs were conducted with selected martial arts athletes to explore their perceptions of the anti-doping training and its impact on their readiness for competition. Third, in-depth interviews were carried out to further investigate how athletes perceived the roles of coaches and medical teams in supporting clean sport practices. All data collection procedures were facilitated by the KONI DIY education team and conducted following ethical standards, with informed consent obtained from all participants.

Instrument Development and Validation

The doping knowledge questionnaire used in the pre-test and post-test was developed in a multiple-choice format, covering key training content such as the use of over-the-counter (OTC) medications with doping risks, the management of Therapeutic Use Exemptions (TUE), and ethical considerations in medication use. The items were constructed based on WADA's ADeL modules and training materials provided by KONI DIY. Content validity was assessed by two pharmacology experts, and face validity was tested on five external respondents to ensure clarity and relevance. For the qualitative instruments, an FGD guide and interview protocol were developed to elicit participants' experiences and evaluations of the doping education program. These tools were piloted with three athletes outside the study sample to refine question structure and ensure interpretability.

Data Analysis

Quantitative data from the pre- and post-tests were analyzed using a paired samples t-test to determine whether there were statistically significant improvements in doping-related knowledge following the intervention, with analysis conducted in SPSS version 21. Qualitative data, including transcripts from focus group discussions (FGDs), interviews, and selected institutional documents, were analyzed using thematic content analysis based on Braun and Clarke's (2006) six-phase approach: familiarization, coding, theme development, theme review, defining and naming themes, and reporting.

To enhance credibility, coding was conducted independently by two researchers, followed by reconciliation discussions to resolve discrepancies and finalize core themes. Document analysis included the International Standard for Education (ISE) by WADA (2021) and the Mekanisme Evaluasi Kinerja Doping Control from IADO (2022), which provided insights into the structural, procedural, and educational aspects of anti-doping governance. The combination of empirical data and document analysis enabled robust triangulation, linking athletes' and coaches' lived experiences with institutional management practices. This integrated approach strengthened the validity of the study outcomes and offered a multi-level understanding of how doping is managed in the context of martial arts in Indonesia.

Training Implementation Procedure

The anti-doping training program was implemented in five structured stages to systematically improve athletes' awareness and understanding of doping-related issues. The first stage involved baseline data collection, focusing on athletes' medical conditions, medication and supplement intake, and potential exposure to substances on the WADA Prohibited List. This was followed by a pre-test to assess participants' initial knowledge of anti-doping concepts. In the next stage, a comprehensive anti-doping training was conducted using various learning tools, including a web-based doping product screening platform, printed modules, and an online clinic to facilitate personalized consultations (diagram of doping management control scheme can be seen in Figure 1). A post-test was then administered to evaluate knowledge improvement following the intervention. In the final stage, focus group discussions and in-depth interviews were carried out to explore the perceived effectiveness of the program and gather insights into its impact on athlete readiness and support systems.

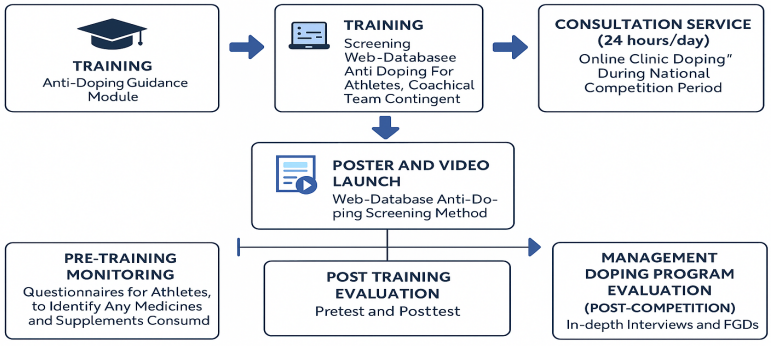

Figure 1. Diagram of Doping Management Control Scheme at PON 2024 National Sports Competition

RESULTS AND DISCUSSION

Result

Athlete Baseline Profiles

The study involved 21 martial arts athletes (10 men and 11 women) representing various disciplines, including hapkido, judo, jujitsu, kempo, kickboxing, kurash, pencak silat, and tarung derajat. The participants were aged between 17 and 29 years, with most identifying as collegiate students (n = 14), followed by professional athletes (n = 5) and school-age scholars (n = 2). The athletes' body weights ranged from 45 to 95 kilograms. In terms of health status, more than half of the athletes reported no health issues during the training period. However, several participants reported conditions that could potentially lead to medication use, including injuries (n = 4), muscle fatigue, abdominal pain, sleep disturbances, and blood pressure concerns. Notably, those with injuries or fatigue were more likely to be involved in physically intense disciplines such as pencak silat, hapkido, and kempo.

This baseline data highlights the diversity in athlete profiles and underscores the importance of individualized anti-doping education, particularly concerning over-the-counter medications and health-related risks associated with unintentional doping violations. In addition to demographic and health data, medication screening conducted during the training camp revealed that several athletes had unknowingly used substances included on the WADA Prohibited List, particularly pseudoephedrine and dexamethasone. These substances were found in common cold and flu medications such as Panadol, Siladex, and Decolgen FX. Most usage was associated with self-medication for symptoms like flu, pain, or fatigue. These findings underscore critical gaps in athletes' awareness of doping regulations and highlight the urgency for targeted educational interventions to improve medication literacy and self-monitoring practices (Table 1).

Table 1. The Most Common Cold Medications Used by Athletes (Before Training Camp)

WADA Code 2024: Prohibited Category	WADA Code 2024: Monitoring Category	Not Listed in WADA Code 2024
Panadol Cold + Flu (pseudoephedrine)	Intunal (phenylpropanolamine)	Mucos (ambroxol)
Dikom (pseudoephedrine)	-	Bisolvon (bromhexine hydrochloride)
Siladeks (pseudoephedrine)	-	-
Decolgen FX (pseudoephedrine)	-	-

Pre-Test and Post-Test Results

The results of the pre-test and post-test evaluations indicate a pattern of change in athletes' knowledge levels regarding doping, as shown in Figure 2.

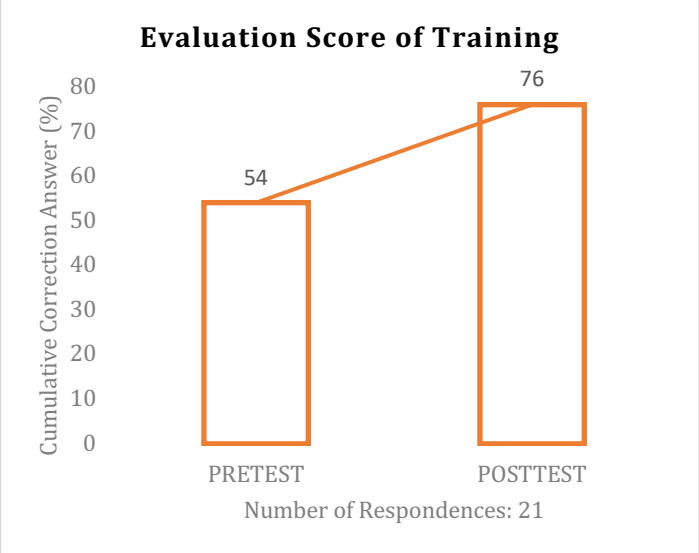

Figure 2. Evaluation Scores Before and After Anti-Doping Training. Cumulative scores increased by 22% following the training (N = 21 athletes).

Athletes' baseline knowledge was indicated by a pre-test score of 54% (see Figure 1). Following the training, post-test scores increased to 76%. This improvement demonstrates that martial arts athletes' understanding of doping has become more comprehensive and enhanced. Subsequently, a t-test analysis was conducted to determine whether there was a significant effect between pre-test and post-test results of the athletes' anti-doping education, as shown in Table 2.

Table 2. T-Test Analysis Results of Pretest and Posttest

	Mean	Std. Deviation	Df	Sig. (2-tailed)
Pretest-posttest	-21.909	29.539	21	0.002

The pretest-posttest evaluation revealed a pattern of change in martial arts athletes' knowledge regarding doping, with a p-value (2-tailed significance) of 0.002 ($p < 0.005$). This indicates a significant difference in athletes' knowledge levels following the anti-doping education.

To examine specific areas of knowledge improvement, scores were analyzed by question category (see Figure 3). Overall, respondents demonstrated a reasonable baseline understanding of general non-doping medications commonly available on the market. However, their knowledge significantly increased in areas requiring a more detailed understanding. For instance, scores related to identifying doping-safe cold medications rose markedly from 20% to nearly 60% after the training. The most substantial improvement was observed in knowledge of TUE regulations, with scores increasing from 29% pre-training to 83% post-training. These results suggest that athletes initially had limited awareness of TUE procedures and that the educational module was effective in addressing this critical gap.

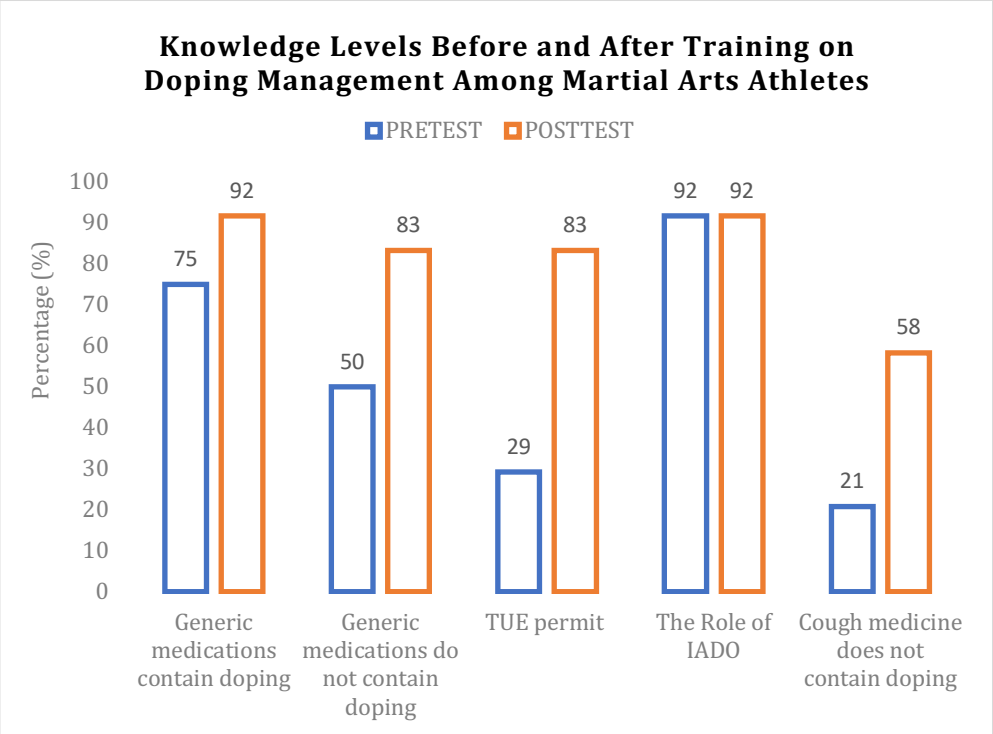

Figure 3. Knowledge Levels Before and After Training on Doping Management Among Martial Arts Athletes.

Based on Figure 3, the cumulative score increased by 22%, with the highest partial score improvement observed in the topic of TUE. This indicates that before the intervention, most athletes were unaware of TUE regulations, and the conducted anti-doping training successfully addressed this knowledge gap. Overall, the management of doping in martial arts is effectively carried out through systematic educational interventions that enhance athletes' understanding of key anti-doping issues. The training notably improved knowledge not only on TUE but also clarified misconceptions regarding the doping content in generic and over-the-counter medications such as cough syrups. For instance, awareness that generic medications do not always contain doping

substances rose from 50% to 83%, while understanding of the risk in common cough medicines increased from 21% to 58%. Additionally, the consistently high knowledge of the role of the Indonesia Anti-Doping Organization (IADO), remaining at 92% before and after training, indicates prior familiarity with national anti-doping efforts. These findings confirm that educational programs play a central role in managing doping risks, helping athletes make informed, ethical decisions, and supporting fair play in martial arts competition.

Overall, three main anti-doping training topics were delivered to athletes. The first topic covered the use of the Doping Screening Web-Database to check whether a medication contains prohibited substances. The second focused on WADA's criteria for classifying doping substances and supplements. The third addressed the application of special permits for the use of doping-containing medications under specific medical conditions (TUE). During the education on exemptions, it was found that the majority of respondents did not know that the use of doping substances is permitted in emergencies or special cases, such as athletes with asthma, cardiovascular issues, musculoskeletal problems, severe pain, ADHD, anaphylaxis, renal failure and kidney transplantation, or adrenal insufficiency. This finding aligns with the low pretest score in the TUE topic, reinforcing the urgency of education in this area. It is particularly notable considering that Indonesia has had a National Anti-Doping Agency (IADO, formerly LADI) since 2006, and the official IADO website already provides detailed information on TUE. These results suggest that further intensive dissemination and communication efforts by IADO and related authorities are necessary to close the remaining knowledge gaps among athletes.

Post-Competition Evaluation

Qualitative analysis from post-competition focus group discussions (FGDs) and in-depth interviews revealed three dominant themes: athletes' dependency on coaches in medication use decisions, limited utilization of the 24-hour online doping clinic, and challenges in compliance with TUE protocols. These findings provide valuable insight into the systemic and interpersonal factors affecting anti-doping implementation during the PON XXI 2024 national martial arts competition.

1. Dependency on Coaches in Medication Use Decisions

FGDs indicated that although most athletes demonstrated proficiency in using the Web-Based Doping Screening tool (https://doping.konidiy.com/) and the anti-doping pocketbook module, their actual medication decisions were still largely dictated by their coaches. Athletes acknowledged that these tools were useful for verifying the safety of medications, especially in cases involving common over-the-counter drugs such as cold and flu medicine. However, before consuming any medication, athletes consistently consulted their coaches, reflecting the central role of coaches in influencing athlete behavior and decision-making regarding medication use.

"So we can check from the provided website whether the medication we intend to take, for example, Intunal (a common cold medicine brand in Indonesia), contains doping substances or not." - Statement 1

"We always ask our coach first before consuming anything." - Statement 2

This pattern underscores the need to ensure that coaches are not only aware of anti-doping regulations but are also well-equipped to guide athletes based on scientifically accurate and up-to-date information.

2. Limited Utilization of the 24-Hour Online Doping Clinic

Although KONI DIY provided a 24-hour online doping clinic during the PON XXI 2024 competition to offer immediate assistance regarding medication safety, this service was severely underutilized. Most athletes reported that they were unaware that such a service existed. This low level of awareness was primarily attributed to inadequate promotion and the absence of clear, practical instructions on how and when to access the service.

"We (athletes) did not know there was a 24-hour online doping clinic available during PON." - Statement 3

This finding points to missed opportunities for real-time consultation and intervention, which could have served as a safeguard against accidental doping violations. It also reveals the necessity for more proactive and visible communication strategies regarding the availability and importance of anti-doping support services.

3. Challenges in TUE Compliance

The issue of TUE emerged as a particularly significant challenge. Several athletes, including those recovering from injuries, reported difficulties understanding the clearance times of prescribed medications such as corticosteroids (e.g., triamcinolone) and over-the-counter medications like pseudoephedrine. Some expressed concern over their lack of knowledge regarding how long such substances remain in the body and whether their usage would require TUE documentation.

"We need to know how long the medication will remain in our bodies before competition." - Statement 4

Confusion also arose over the rules regarding intravenous infusions. While athletes were aware that infusions could constitute a doping violation, there was ambiguity regarding whether such infusions were permissible in hospital settings versus during off-site treatment.

"Infusions outside the hospital are considered doping, but inside the hospital, they are not. This understanding needs to be shared with all coaching and medical staff involved." - Statement 5

Despite these challenges, the study found that comprehensive medical documentation is crucial for obtaining valid TUE permits. In this regard, KONI DIY's collaboration with a pharmacologist from the Faculty of Medicine at Universitas Gadjah Mada proved instrumental. This expert provided intensive assistance to the contingent's medical staff to ensure the completeness and accuracy of all required documents.

Participants also offered constructive suggestions for improving the doping management infrastructure. These included establishing on-site doping consultation booths at competition venues, developing simple visual aids to support athletes' pharmacological literacy, and conducting mandatory refresher briefings for coaches and medical personnel on current anti-doping regulations.

"Education should not stop at training activities but must be followed up with concrete actions, such as creating on-site posts." - Statement 6

The management of doping in martial arts at the national level is currently characterized by a combination of digital innovation, regulatory support, and interpersonal dynamics, yet it still faces substantial gaps in operational execution. While educational interventions, such as the use of web-based screening tools and anti-doping modules, have increased athlete awareness, their practical decision-making remains heavily influenced by coaches, whose level of regulatory understanding is inconsistent. This dependency, although culturally embedded, risks undermining compliance if not accompanied by systematic capacity building for athlete support personnel.

Furthermore, the underutilization of critical services like the 24-hour online doping clinic reflects communication deficiencies and weak dissemination strategies. The challenges surrounding TUE compliance, ranging from uncertainty about drug clearance times to confusion over intravenous infusion rules, highlight the urgent need for continuous education and streamlined protocols. Ultimately, doping management in martial arts is only partially effective unless it evolves beyond passive information delivery toward a more integrated system that reinforces regulation through real-time support, clear accountability, and institutional collaboration across athlete, coach, and medical domains.

Institutional and Policy Mapping of Anti-Doping Management

In addition to empirical findings from athletes and coaches, this study conducted a document-based analysis to map the institutional structure and field implementation of anti-doping policies in Indonesia.

Table 3. Institutional Roles and Field Implementation of Anti-Doping Management in Indonesia

Component	Relevant Institution	Field Findings	Source
National Anti-Doping Authority	IADO	ADEL modules, 24-hour consultation service, online education.	iado.id, kominfo.jatimprov.go.id
Supervision and Testing Implementation	LADI	Socialization, doping sample testing, and DCO training.	deputi3.kemenpora.go.id
Regulatory and Operational Support	Kemenpora + LADI	Support for training & monitoring through Deputy III.	deputi3.kemenpora.go.id
Coach's Role	Martial Arts Coaches	Coaches are key decision-makers on medication, but lack a full understanding of TUE.	rri.co.id, iado.id
Medical Team's Role	KONI DIY Medical Team	Assists with TUE documentation, but requires further technical training.	iado.id
Dissemination of Clinic & Digital Services	IADO + KONI + Kemenpora	Online doping clinic underutilized due to limited promotion.	iado.id
Funding & Infrastructure	LADI + Foreign Laboratories	Samples still sent abroad; LADI's funding was previously reduced.	Kompas.id
Partnerships & MoUs	IADO + KONI + FKKMK UGM + BNN + UNESCO	MoUs with multiple stakeholders; synergy through UGM and digital screening apps.	iado.id, kominfo.jatimprov.go.id

Based on table 3 presents a structured mapping of the key institutions and actors involved in Indonesia's anti-doping management system, along with their roles and associated challenges observed in the field. The Indonesia Anti-Doping Organization (IADO) leads the national effort by delivering education modules, 24-hour consultation services, and online resources. LADI is responsible for sample testing and the training of Doping Control Officers (DCOs), while Kemenpora provides regulatory and operational support in collaboration with LADI. At the implementation level, martial arts coaches play a central role in athletes' medication decisions, although many lack adequate understanding of TUE. Medical teams, particularly those from KONI DIY, are involved in TUE documentation but require more comprehensive technical training. Digital tools such as the online doping clinic remain underutilized due to limited promotion and awareness among athletes. Infrastructurally, doping samples are still being sent abroad, highlighting Indonesia's continued dependence on foreign laboratories and reflecting previous budget limitations experienced by LADI. Lastly, the table outlines several strategic partnerships, including with UGM, BNN, and UNESCO, which have contributed to digital innovations and educational synergies through joint training and screening application development.

Building on the institutional mapping and field implementation challenges identified in Table 3, the following figure illustrates how anti-doping policies are operationalized at the Regional Training Center level. Figure 4 presents a sequential flow of doping management, starting from athlete registration and education, through daily monitoring, controlled medication procedures, and ending with doping sample collection and result follow-up. This model bridges the macro-level responsibilities of national institutions with the micro-level practices observed in martial arts training environments. It demonstrates that while policy structures are in place, the effectiveness of doping management is ultimately determined by how consistently these processes are carried out on the ground, especially by athlete support personnel, including coaches and medical teams.

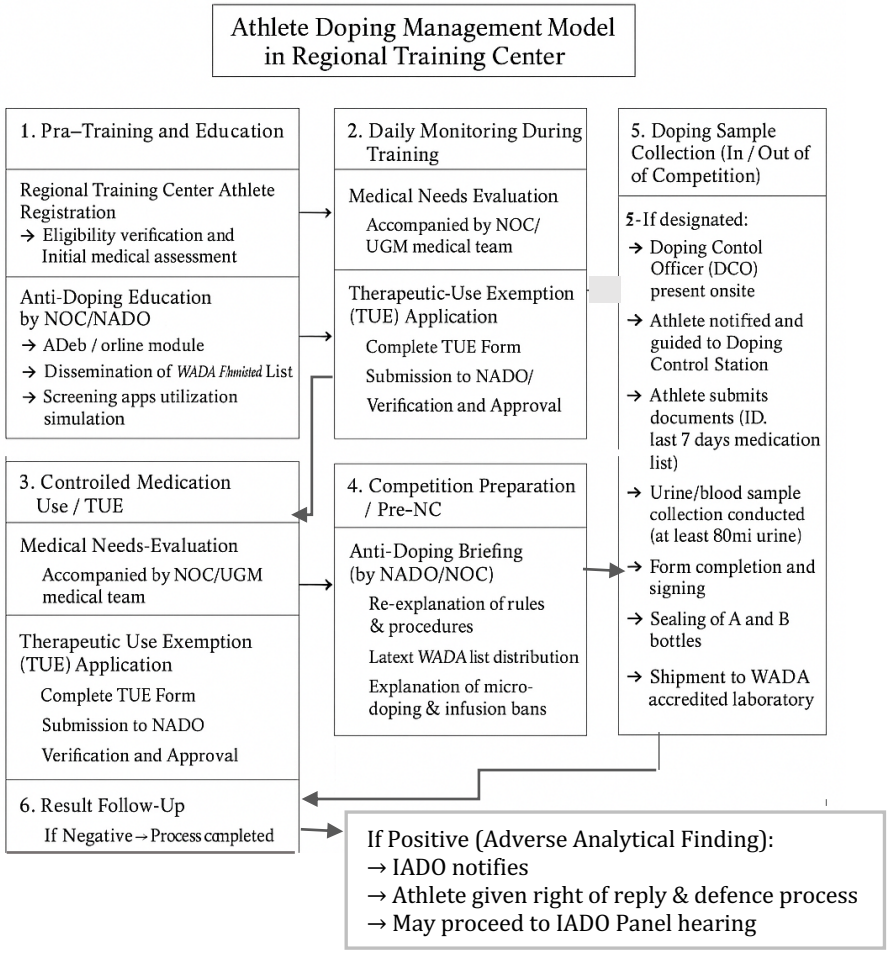

Figure 4. Athlete Doping Management Model in Regional Training Center

Figure 4, presented above, outlines a structured framework for managing doping among athletes in Regional Training Centers in Indonesia. Rather than merely sequencing procedural tasks, the model reflects the complexity of doping governance by incorporating educational, medical, regulatory, and legal dimensions. It begins with proactive measures, such as eligibility verification and anti-doping education, then progresses through daily monitoring and the TUE process. These early stages emphasize a preventive approach, relying on athlete awareness and guided medical oversight to mitigate the risk of unintentional violations. Importantly, the presence of both national and regional bodies (NOC/NADO, KONI, UGM) illustrates the collaborative nature of this system, which combines policy directives with ground-level application.

However, the flowchart also reveals latent vulnerabilities in the implementation chain. For example, while the controlled medication and TUE components are explicitly documented, the effectiveness of these measures depends heavily on athletes' access to expert consultation and real-time feedback services that, in practice, remain underutilized. Furthermore, the final segments involving doping sample collection and result follow-up highlight the reactive dimension of the system, where violations, once detected, are handled through administrative procedures, such as the right to defense and panel hearings. Although this legal recourse aligns with international anti-doping standards, its inclusion also underscores the need for earlier-stage capacity building, particularly among coaches and medical staff who are critical gatekeepers but may lack sufficient training in TUE compliance and digital reporting protocols. Thus, while the model is structurally complete, its efficacy relies on consistent policy enforcement, inter-agency coordination, and the digital literacy of personnel at every stage.

Discussion

This study revealed a multi-layered landscape of doping prevention efforts among martial arts athletes in the lead-up to the 2024 PON competition. At the operational level, initial findings showed a significant increase in athletes' anti-doping knowledge after structured education was implemented, evident in the jump from a 54% to 76% average test score. A paired t-test confirmed that the increase was statistically significant ($p = 0.002$). Moreover, knowledge regarding TUE increased from 29% to 83%, underscoring the importance of structured, evidence-based education using WADA-aligned materials. The use of digital tools, such as web-based doping screening platforms, was preferred over printed materials, reflecting the findings of Striegel et al. (2010) and Lucidi et al. (2017), who emphasize the value of digital interventions in improving anti-doping literacy.

Despite these gains, three persistent challenges emerged: low utilization of the 24-hour Online Doping Clinic, athletes' continued reliance on over-the-counter medications without proper verification, and the dominant role of coaches in medication decision-making. These findings reflect limited internalization of anti-doping literacy and emphasize the influence of interpersonal dynamics. Coaches and medical staff are often trusted as primary decision-makers, which aligns with Barkoukis et al. (2019), who identify coaches as key influencers of athletes' doping-related attitudes. Beyond individual-level insights, the study uncovered broader systemic and policy-level limitations. The anti-doping ecosystem, although supported by KONI DIY through planning, organizing, education, and monitoring, remains fragmented and coordinated. There is a disconnect between national regulations based on WADA's International Standard for Education (ISE) and the implementation at regional levels, which remains ceremonial and uneven. The limited dissemination of IADO's educational modules and poor promotion of services like the 24-hour clinic point to gaps in governance, as highlighted by Skinner et al. (2016) and Kuhlmann et al. (2024). Inadequate understanding of TUE procedures and infusion legality by athletes and staff further demonstrates regulatory and managerial shortcomings.

Gender-responsive education remains absent from national frameworks, despite physiological differences in substance metabolism between male and female athletes. Inclusive programming that considers gender-specific needs is essential to improving policy effectiveness. Indonesia's reliance on foreign laboratories and weak inter-agency coordination, evidenced by past WADA sanctions, showcases the need for a more integrated national anti-doping system, as emphasized by Qvarfordt et al. (2021). Furthermore, doping management practices in Indonesia still have gaps compared to international practices. Countries such as Australia, Germany, and Japan have digitalised and integrated doping testing and reporting systems between sports federations, anti-doping agencies, and medical authorities. In contrast, in Indonesia, coordination between institutions such as IADO, KONI, and Kemenpora tends to be partial, with limited logistical and financial support, and reliance on overseas laboratories for sample testing. This was highlighted when Indonesia was sanctioned by WADA for failing to submit 300 doping test samples, which resulted in a ban on flying the national flag at international events (Mansoor, 2025). This case shows the importance of a doping management system that is responsive, integrated, and has continuous performance evaluation.

To summarize the critical gaps identified and proposed interventions based on field data, Table 4 presents a synthesized overview of challenges, root causes, and potential recommendations for improving anti-doping governance in regional training camps.

Table 4. Synthesis of Challenges and Recommended Interventions in Anti-Doping Management

Focus Area	Key Findings	Problems Identified	Recommendations
Athlete Education and Awareness	Athletes prefer digital tools (e.g., web-based screening) but have a limited understanding of banned substances in OTC meds.	Superficial understanding; risk of unintentional doping persists.	Expand digital anti-doping education platforms and update content regularly.
Coach and Medical Staff Influence	Athletes heavily rely on coaches for medication decisions, regardless of individual knowledge.	Coach dependence may perpetuate misinformation or delay proper action.	Provide targeted training for coaches and medical staff on doping rules.

Focus Area	Key Findings	Problems Identified	Recommendations
Access to Support Services	Low awareness and underutilization of the 24-hour Online Doping Clinic due to poor promotion and integration.	Missed opportunities for real-time intervention; service not embedded in routines.	Integrate support services into athlete training routines; improve promotion.
Therapeutic Use Exemption (TUE)	Athletes and support staff are confused about TUE procedures, medication clearance times, and infusion rules.	Knowledge gap leads to procedural errors and risk of TUE non-compliance.	Deliver procedural briefings on TUE and provide simple visual guides.
Policy and Institutional Coordination	Policy implementation lacks integration; IADO, KONI, and federations operate with weak coordination and limited dissemination.	Fragmented governance; gaps between national standards and local practice.	Strengthen coordination among institutions; ensure consistent policy execution.

Thus, the findings emphasize that effective doping prevention cannot rely solely on improving athlete awareness or compliance. It requires a synchronized management system that integrates coaches, medical staff, athletes, and federations under a coherent institutional framework. A coordinated and inclusive approach—rooted in digital literacy, gender responsiveness, and inter-agency cooperation—is essential for fostering a doping-aware and compliant sports environment at both regional and national levels.

Implication

This study reinforces that doping prevention requires not only athlete education but also a strong system-level management approach. Consistent with Engelberg & Skinner (2016), who highlighted the fragmentation of anti-doping responsibilities, our findings suggest that the absence of a centralized and proactive anti-doping system in Indonesia contributes to gaps in athlete compliance and knowledge. Limited awareness of available services and a lack of integration between coaching staff and medical protocols further emphasize these structural shortcomings.

In this context, coaches emerge as critical gatekeepers in athletes' substance-related decisions. The study found that athletes tend to rely on their coaches not only for training but also for validating the use of medications, reflecting a trust-based dynamic. This finding supports Barkoukis et al. (2019), who identified the strong influence coaches have in shaping athletes' attitudes toward doping. Therefore, coaches should be equipped with targeted training to ensure their guidance supports compliance with anti-doping rules, rather than contributing to uncertainty. Moreover, athletes' preference for digital tools such as web-based drug screening platforms presents a promising avenue for expanding anti-doping education. Compared to printed handbooks, digital platforms are valued for their speed, ease of access, and real-time updates. This reflects a global shift toward e-learning and suggests that future anti-doping strategies should prioritize digital literacy and mobile-friendly content. Institutional support for app- or SMS-based interventions could also address accessibility gaps across regions and sports disciplines.

Despite the presence of a 24-hour Online Doping Clinic during the national competition period, the service remained largely underutilized. Focus group discussions revealed that this underuse stemmed from inadequate promotion and a lack of integration into athletes' routines. The failure to socialize such a crucial service reflects deeper communication and governance issues. As Skinner et al. (2016) Suggest, governance structures must ensure not only the existence of support systems but also their adoption through stronger institutional coordination and stakeholder engagement. Another key issue identified was confusion surrounding the TUE process and the legality of medical infusions. Both athletes and medical personnel showed limited understanding of WADA's regulations, particularly in terms of substance clearance periods and documentation requirements. These knowledge gaps highlight the urgency of extending anti-doping education to coaches and medical staff through clear, procedural briefings, especially before competition.

These findings collectively suggest that doping prevention among martial arts athletes cannot rely solely on individual awareness. It requires a comprehensive, multi-stakeholder approach

involving athletes, coaches, and medical teams. Strengthening digital-based education, ensuring timely promotion of support services like the Online Doping Clinic, and maintaining consistent coordination between KONI, coaches, and health personnel are essential to create a doping-aware sports ecosystem.

Research Contribution

Theoretically, this study contributes to the growing body of literature on doping prevention by emphasizing the collective responsibility shared across the athlete support network. Practically, the findings highlight the need for targeted coach training, real-time digital screening tools, and institutionalized pre-competition briefings. These recommendations may inform future anti-doping strategies led by KONI and IADO, ensuring anti-doping principles are embedded in athlete development and national sports governance.

Limitations

However, the limited number of respondents involved in this study is a limitation that needs to be addressed. Furthermore, the generalizability of the findings to other sports disciplines or broader athlete populations remains very limited. Therefore, a more comprehensive evaluation with a larger sample population is needed to obtain a clearer and more accurate picture of the information gathered.

Suggestions

Based on the findings and limitations of this study, several suggestions are proposed to enhance future anti-doping efforts. First, anti-doping education should be expanded through digital platforms such as mobile applications, SMS-based services, or QR code access linked to online databases, given athletes' preference for easily accessible and regularly updated media. Second, regular and mandatory anti-doping training should be institutionalized for coaches, team doctors, and athlete support personnel to ensure accurate guidance on medication and supplement use. Third, it is recommended that competition organizers provide on-site doping consultation booths or hotlines to offer immediate guidance and prevent unintentional violations. Fourth, the development of simple and user-friendly visual guides is necessary to explain medication elimination timelines, TUE procedures, and emergency protocols for substance use. Fifth, stronger coordination among institutions such as KONI, IADO, and local sports federations is needed to avoid overlaps or gaps in anti-doping responsibilities. Lastly, further research is strongly encouraged with larger and more diverse samples across different sports, using longitudinal designs to assess the long-term impact of anti-doping interventions more comprehensively.

CONCLUSION

This study examined the anti-doping management system for martial arts athletes at the regional training center, focusing on its implementation, policy limitations, and practical challenges. Doping should not be seen solely as a personal moral failure, but rather as a systemic issue rooted in policy-level fragmentation, operational gaps, and lack of institutional synergy. The findings reaffirm that effective doping prevention depends on a structured and coordinated system involving coaches, medical staff, federations, and national authorities. Although KONI DIY has implemented a well-defined anti-doping management flow from athlete registration, education, daily monitoring, to pre-competition procedures, several barriers remain. Athletes preparing for PON 2024 were still found to unintentionally consume over-the-counter medications containing WADA-prohibited substances. Despite the presence of digital tools like web-based screening platforms, awareness and usage of the 24-hour Online Doping Clinic remained low, highlighting outreach and integration issues in policy execution.

The policy gaps observed, such as uneven service accessibility, insufficient promotion, and limited understanding of TUE procedures, suggest the need for stronger implementation of anti-doping policies at the local level. Practical strategies proposed by athletes and coaches include the establishment of doping consultation booths at venues, simple visual guides on drug clearance timelines, and mandatory briefings for support personnel. These proposed measures, as summarized in Table 4, offer a practical and actionable roadmap for KONI and IADO to close the existing gaps in

anti-doping governance and implementation. Despite limitations in sample size and follow-up duration, this study provides meaningful insight into how structured anti-doping policy and management flows at the Pelatda level can improve compliance and athlete readiness. The anti-doping approach adopted by KONI DIY successfully ensured that all martial arts athletes remained doping-free during PON 2024. Moving forward, national anti-doping programs should strengthen institutional collaboration, scale up effective Pelatda-based models, and improve policy dissemination to create a more doping-aware sports ecosystem across Indonesia. Integrating gender-sensitive doping education is essential, considering physiological differences that affect substance metabolism and risk. These findings also highlight the need for further research to explore systemic doping management practices across other regions and sports, particularly with attention to gender responsiveness and long-term behavioral outcomes.

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AUTHOR CONTRIBUTION STATEMENT

AN collaborated with research partners, conducted theoretical reviews and discussions; AJW assisted in instrument development, data analysis, and conclusion. Both AN and AJW contributed equally to the writing of this article. HW provided expert input on physical activity frameworks and contributed to refining the conceptual framework, coordinated field data collection and ensured adherence to ethical research standards. SB was responsible for supervising data validation and assisted in statistical analysis. DPI contributed to the critical revision of the manuscript and ensured the scientific rigor of the final draft. R and L participated in the integration of theoretical findings with practical implications and helped structure the discussion section. All authors reviewed and approved the final version of the manuscript.

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