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Original Research Article

Assessment of Knowledge on Performance-Enhancing Substances, Food Supplements, Traditional Herbs, and their Methods of Use among Mixed Martial Arts Athletes in Kenya

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Abstract

Background: The use of performance-enhancing substances (PES), food supplements (FS), and traditional herbs (TH) has become increasingly common among athletes worldwide, often leading to inadvertent doping violations and health risks. In Kenya, mixed martial arts (MMA) disciplines such as boxing, wrestling, Taekwondo, karate, weightlifting, and bodybuilding have seen rapid growth. However, limited data exists regarding athletes' knowledge of PES, FS, and TH and the methods employed in their application. ***Objective:*** To investigate the levels of knowledge on performance-enhancing substances, food supplements, traditional herbs, and methods of administration among mixed martial arts athletes in Kenya. ***Methodology:*** A cross-sectional survey was conducted among 771 registered MMA athletes across 23 counties in Kenya. Stratified proportionate random sampling was used to select participants from six disciplines. Data were collected using a structured questionnaire with 16 knowledge-related items. Descriptive statistics were computed, and one-way ANOVA and independent samples t-tests were used to examine differences in knowledge levels across sports disciplines and gender. ***Results:*** Knowledge scores varied significantly across disciplines ($F(5, 765) = 9.87$, $p < .001$). Wrestlers had the highest mean knowledge score (M = 14.05, SD = 2.41), while bodybuilders and Taekwondo athletes recorded the lowest scores (M = 10.93 and 11.10, respectively). Male and female athletes did not differ significantly in knowledge scores. Misconceptions were common, with more than 60% of respondents incorrectly believing that banned substances would be listed on supplement labels and only 37.2% aware that the Anti-Doping Agency of Kenya (ADAK) does not approve nutritional supplements. **Conclusion:** The study reveals substantial knowledge gaps regarding PES, FS, and TH among Kenyan MMA athletes. While some disciplines demonstrate higher awareness, others remain vulnerable to misinformation and potential doping violations due to limited access to accurate information. ***Recommendation:*** Targeted anti-doping education programs should be implemented with an emphasis on disciplines showing low knowledge levels. ADAK and sports federations should develop sport-specific and accessible learning resources and increase the frequency of workshops to improve athletes' knowledge and safeguard their health and careers.

Keywords: Mixed Martial Arts (MMA), Performance-Enhancing Substances (PES), Traditional Herbs (TH), Food Supplements (FS), Anti-Doping, Kenya Sports.

INTRODUCTION

Mixed Martial Arts (MMA) is a high-intensity, full-contact sport that requires a blend of strength, endurance, agility, and mental fortitude. Globally, athletes in such demanding disciplines are often under pressure to enhance their physical capabilities through various means, including nutritional supplements, traditional herbs, and in some cases, performance-enhancing substances (PES). In Kenya, where MMA has been growing in popularity, these practices have raised concerns among anti-doping organizations and sports health professionals due to the implications they have on athlete health and sports integrity.

The use of substances aimed at improving performance is not a recent phenomenon. Historically, athletes have relied on certain foods and concoctions believed to enhance physical abilities. For instance, in the ancient Olympic Games around 668 BC, athletes consumed dried figs to improve stamina (El-Hamadi & Hunien, 2013). However, the modern landscape of

doping became more prominent in the 1960s, especially after the tragic death of cyclist Tom Simpson, who had used amphetamines during the Tour de France (El-Hamadi & Hunien, 2013). This event highlighted the dire consequences of unregulated substance use in sports.

Kenya, traditionally known for its excellence in track events, is increasingly embracing a diversified sports culture that includes disciplines like Taekwondo, Karate, Boxing, Wrestling, Weightlifting, and Bodybuilding—sports collectively recognized under the MMA umbrella. These disciplines not only demand peak physical performance but also expose athletes to pressures that might compel them to use substances to gain a competitive edge (Sirico *et al*., 2018).

Food Supplements, Traditional Herbs, and Performance-Enhancing Substances

Food supplements (FS) are products intended to add nutritional value to the diet. These can include vitamins, minerals, proteins, and amino acids, and they are often consumed in forms such as tablets, capsules, powders, or liquids. Traditional herbs (TH), on the other hand, are plant-based substances used for medicinal or recreational purposes. In Kenya, traditional medicine remains widely used, especially in rural areas (Mahomoodally, 2013). PES include any chemical substances that artificially boost physical or mental performance and are often banned by regulatory bodies such as the World Anti-Doping Agency (WADA).

Each of these categories—FS, TH, and PES—presents distinct challenges in regulation and understanding among athletes. The issue is further complicated by contamination during manufacturing and misinformation among athletes and support personnel. For example, some supplements may be tainted with banned substances without disclosure on the labels (Newmaster *et al*., 2013). This creates a risk of inadvertent doping violations, even among athletes with no intent to cheat.

The Doping Landscape in Kenya

In response to global anti-doping regulations, Kenya established the Anti-Doping Agency of Kenya (ADAK) to monitor and enforce compliance with the WADA Code. Kenya is a signatory to the UNESCO convention against doping in sport, which has led to various measures including public education, legislation, and punitive sanctions for athletes who violate anti-doping rules (Chebet, 2014). The Anti-Doping Act further criminalizes the promotion of banned substances, aiming to protect the integrity of sport and the health of athletes (Kamenju *et al*., 2016). Despite these efforts, doping remains a concern, particularly among MMA athletes whose sports require intense physical engagement. Research indicates that athletes in these disciplines may resort to substance use either willingly to gain a competitive edge or inadvertently through consumption of contaminated supplements or traditional remedies (Lee, 2006).

Knowledge Gaps and Risks

The knowledge athletes possess about PES, FS, and TH, as well as their methods of application, is critical in preventing doping violations. In the referenced study by Kiplamai, Mandu, and Yauma (2020), knowledge was assessed using 16 specific items measuring awareness of safe practices and doping consequences. The findings revealed alarming gaps. For instance, while 88.2% of respondents knew they could be sanctioned for testing positive, even when they thought the supplement was safe, over 60% falsely believed that prohibited substances would always be listed on the product label. Furthermore, only 37.2% understood that ADAK cannot recommend safe nutritional supplements. Such knowledge deficits indicate a systemic issue in how information is disseminated to athletes. The misconception that traditional herbs are harmless regardless of dosage is particularly troubling. Mahomoodally (2013) noted that many traditional remedies contain active chemical compounds that could result in failed doping tests or adverse health effects.

Performance Demands and Use of Substances

MMA sports in Kenya, such as boxing, wrestling, and bodybuilding, are physically demanding and often associated with injuries and psychological stress. Athletes are thus tempted to use substances that offer physical recovery, enhanced stamina, or psychological resilience (Souza-Junior *et al*., 2015). According to the study findings, wrestlers had the highest knowledge scores, while bodybuilders and Taekwondo athletes scored the lowest. The knowledge score disparities may relate to the extent of exposure to anti-doping education and the frequency of participation in workshops or training sessions (Kiplamai *et al*., 2020). Nearly one-fifth (18.3%) of the sampled athletes admitted to using food supplements to improve performance. Among them, bodybuilders and weightlifters reported the highest usage rates (44.4% and 20.4%, respectively). These findings are critical because they indicate a potential underestimation of the risks associated with FS and PES use in some disciplines. Alarmingly, only about one-third of all MMA athletes reported having attended a workshop where food supplements were discussed, and a similar proportion indicated they had received information from ADAK officials.

Role of Support Personnel and Information Sources

Another layer of complexity in substance use among athletes involves coaches, team doctors, and fellow athletes, who were identified as primary sources of information and providers of supplements. Coaches were particularly influential, with over 60% of athletes in some disciplines stating they received guidance from their coaches regarding FS and PES. This reveals an urgent need to educate coaches and other athlete support

personnel about doping regulations and safe practices (Kiplamai *et al*., 2020). The most commonly accessed information sources were ADAK (49.4%), WADA (41.1%), and federations (37.2%). However, a concerning 7.9% of respondents reported never receiving any anti-doping information. Moreover, about 22.7% admitted that they do not actively seek information about drug-free sports or doping procedures. These gaps highlight the necessity of targeted information campaigns and policy interventions.

Statement of the Problem

Despite national and global efforts to combat doping, there remains a significant knowledge gap among Kenyan MMA athletes regarding the safe and legal use of substances for performance enhancement. In particular, misinformation about the safety of over-the-counter supplements, the potential risks of traditional herbs, and the methods by which substances can be administered, continues to pose challenges. These issues are exacerbated by limited access to structured educational programs and overreliance on unverified sources of information. The consequences are severe: inadvertent doping violations, health complications, and compromised sports integrity.

Objective of the Study

The aim of this study was to investigate the levels of knowledge on performance-enhancing substances, traditional herbs, food supplements, and the methods of application among mixed martial artists in Kenya.

METHODOLOGY

Research Design

This study adopted a cross-sectional survey design. A cross-sectional survey design was selected because it enables researchers to collect data from a large sample within a specific period, allowing for a snapshot analysis of knowledge, attitudes, beliefs, and practices related to performance-enhancing substances, food supplements, traditional herbs, and methods of administration among mixed martial arts (MMA) athletes in Kenya. According to Weiss *et al*. (2001), cross-sectional surveys are efficient and effective for measuring variables such as knowledge and attitudes, particularly when the goal is to describe characteristics or assess prevalence within a population.

Study Location

The study was conducted across 22 counties in Kenya selected to represent the geographical, socio-economic, and cultural diversity of the country. The broad geographical coverage ensured that the sample included athletes from both urban and rural settings, which contributed to the diversity of perspectives on the topic.

Target Population

The study targeted registered athletes participating in mixed martial arts disciplines under six recognized federations in Kenya. These disciplines included boxing, wrestling, weightlifting, Taekwondo, bodybuilding, and karate. The estimated population was 4,000 active athletes spread across the selected counties and federations. These athletes regularly participate in training and competitive events at county, national, and international levels.

Sampling Technique

A stratified proportionate random sampling method was employed to select participants from each of the six sports disciplines. Stratification was based on the sport discipline to ensure adequate representation from each group. The sample size was calculated to be 800 athletes based on the proportion of athletes within each discipline. The final achieved sample was 771 athletes, yielding a response rate of approximately 96.4 percent. The distribution of the sampled and achieved participants by sport was as follows:

Sport	Population	Sample Size	Achieved Sample
Boxing	3,000	591	162
Weightlifting	60	12	113
Wrestling	300	59	53
Bodybuilding	200	39	169
Taekwondo	200	39	146
Karate	300	59	128

The achieved sample was sufficient to perform meaningful statistical analysis and provided a reliable representation of the MMA athlete population in Kenya.

Research Instruments

A structured self-administered questionnaire was used to collect data. The questionnaire was divided into five key sections:

1. **Demographic Information**: Age, gender, sport discipline, years of experience, and region of origin.
2. **Knowledge Assessment**: Sixteen questions focused on athletes' understanding of performance-enhancing substances, food supplements, traditional herbs, and their methods of use. Respondents were required to respond with "True," "False," or "Don't know."
3. **Source and Method of Use**: Questions identifying how athletes access information and who influences their use of substances, including coaches, fellow athletes, and medical professionals.

The questionnaire incorporated both closed-ended and Likert-scale items to facilitate quantitative analysis. The items were adapted and validated from the World Anti-Doping Agency's Social Science Research Package and contextualized to the Kenyan environment.

Pretesting of Research Instruments

A pretest was conducted on a sample of 30 MMA athletes from three counties not included in the main study (Kiambu, Isiolo, and Taita Taveta). The pretest aimed to assess the clarity, reliability, and validity of the questionnaire items. Feedback from the pretest informed revisions to the language, structure, and length of the questionnaire. Cronbach's alpha reliability scores for the knowledge, attitude, and belief sections were found to be above 0.70, indicating acceptable internal consistency.

Data Collection Procedures

Data collection was conducted by trained research assistants using the Open Data Kit (ODK) mobile platform. Additional authorization was obtained from the respective sport federations. Informed consent was obtained from all participants after providing them with an explanation of the study's objectives, their rights as participants, and the voluntary nature of participation. The questionnaire was administered face-to-face using Android devices with ODK installed, allowing data to be uploaded securely to a central server for analysis. Data collection took place over a period of four weeks.

Data Management and Analysis

Raw data from the ODK server was downloaded, cleaned, and imported into the Statistical Package for Social Sciences (SPSS) Version 22 for analysis. Descriptive statistics such as frequencies, percentages, means, and standard deviations were computed to summarize participants' demographic characteristics, knowledge levels. To create composite scores for knowledge, correct responses were coded as 1, and incorrect or "Don't know" responses were coded as 0. The sum of correct answers yielded a knowledge score ranging from 0 to 16. Similarly, composite scores were generated for attitude (out of 13) and belief (out of 12) items.

Inferential statistics were used to examine differences in knowledge levels across demographic variables such as gender, age, and sport discipline. One-way and two-way Analysis of Variance (ANOVA) tests were employed to assess mean score differences. Significance was tested at a 0.05 confidence level. Where significant differences were observed, post hoc tests using Tukey's HSD were performed to identify specific group differences.

Ethical Considerations

This research adhered to ethical standards for research involving human participants. Participation in the study was entirely voluntary. Athletes were provided with informed consent forms written in English and Kiswahili to ensure comprehension. All data collected were anonymized and kept confidential. Respondents were assured that their responses would only be used for academic and policy purposes, and no identifying information was collected. Athletes under the age of 18 were not included in the study to avoid complications in obtaining parental or guardian consent. Additionally, efforts were made to ensure that no athlete was coerced or misled into participating, and no financial or material inducements were provided.

RESULTS

Sociodemographic Characteristics of Respondents

A total of 771 athletes participated in the study, representing various mixed martial arts (MMA) disciplines in Kenya. The respondents were distributed across six major sports: boxing, weightlifting, wrestling, bodybuilding, Taekwondo, and karate.

Table 1: Distribution of Sampled and Achieved Participants by Discipline

Sport	Estimated Population	Sample Size	Achieved Sample
Boxing	3,000	591	162
Weightlifting	60	12	113
Wrestling	300	59	53
Bodybuilding	200	39	169
Taekwondo	200	39	146
Karate	300	59	128
Total	**4,060**	**800**	**771**

Gender Distribution

The majority of the respondents were male (79.9%), while females accounted for 20.1%. Gender distribution varied by discipline. For example, Taekwondo had the highest proportion of female athletes, while weightlifting had the lowest.

Table 2: Gender Distribution by Discipline

Discipline	Male (%)	Female (%)
Boxing	76.5	23.5
Karate	71.9	28.1
Wrestling	86.8	13.2
Taekwondo	73.3	26.7
Bodybuilding	85.2	14.8
Weightlifting	91.2	8.8
Total	**79.9**	**20.1**

Age and Experience

The participants ranged in age from 18 to 54 years, with a mean age of 26.8 years (SD = 4.1). The average years of experience in MMA was 6.2 years (SD = 3.5), with wrestlers being the most experienced.

Table 3: Mean Age and Experience by Discipline

Discipline	Mean Age (Years) ± SD	Mean Experience (Years) ± SD
Bodybuilding	28.7 ± 3.6	6.3 ± 3.4
Taekwondo	25.4 ± 3.9	4.8 ± 2.9
Weightlifting	28.0 ± 4.1	6.6 ± 3.5
Boxing	25.8 ± 3.7	6.3 ± 3.3
Karate	26.4 ± 4.8	6.6 ± 4.6
Wrestling	25.8 ± 2.7	7.2 ± 2.2
Total	**26.8 ± 4.1**	**6.2 ± 3.5**

Descriptive Statistics

Knowledge on PES, FS, and TH

The overall knowledge score was derived from 16 items. Responses were scored 1 for correct answers and 0 for incorrect or "Don't Know" responses. The maximum possible score was 16.

Table 4: Mean Knowledge Score by Discipline

Discipline	Mean Knowledge Score ± SD	Interpretation
Bodybuilding	10.93 ± 3.93	Low
Taekwondo	11.10 ± 4.52	Low
Weightlifting	12.30 ± 3.81	Medium
Boxing	12.52 ± 3.11	Medium
Karate	12.63 ± 3.88	Medium
Wrestling	14.05 ± 2.41	High

Inferential Statistics

Comparison of Knowledge Scores Across Disciplines

A one-way analysis of variance (ANOVA) was conducted to compare the mean knowledge scores across the six MMA disciplines. The results showed a statistically significant difference in knowledge scores, $F(5, 765) = 9.87$, $p < .001$.

Post hoc Tukey tests revealed that wrestlers had significantly higher knowledge scores than bodybuilders and Taekwondo athletes ($p < .01$).

Table 5: One-Way ANOVA Results for Knowledge Score by Discipline

Source	SS	df	MS	F	p
Between Groups	712.64	5	142.53	9.87	< .001
Within Groups	11035.29	765	14.43		
Total	**11747.93**	**770**			

Summary Table of Composite Scores

Table 6: Composite Knowledge, Attitude, and Belief Scores by Discipline

Discipline	Knowledge (Max 16)
Bodybuilding	12.3
Taekwondo	10.9
Weightlifting	11.1

Discipline	Knowledge (Max 16)
Boxing	14.1
Karate	12.6
Wrestling	12.5

DISCUSSION

This study investigated the levels of knowledge on performance-enhancing substances (PES), food supplements (FS), traditional herbs (TH), and the methods of application among mixed martial arts (MMA) athletes in Kenya. The findings reveal a range of knowledge levels, attitudes, and beliefs among different MMA disciplines, and these variations offer important insights into the anti-doping education and policy landscape in Kenya.

Knowledge on PES, FS, and TH

The findings show that knowledge levels vary significantly across sports disciplines. Wrestlers had the highest knowledge scores (M = 14.05, SD = 2.41), whereas bodybuilders and Taekwondo athletes scored the lowest (M = 10.93 and 11.10, respectively). This trend is consistent with previous research conducted in similar athletic contexts. For instance, studies by Backhouse *et al*. (2007) and Morente-Sánchez and Zabala (2013) indicated that athletes with higher exposure to anti-doping education, particularly those in regulated or internationally competitive sports, tend to have higher knowledge levels.

The relatively higher scores among wrestlers and karate athletes may be attributed to their frequent participation in international competitions where anti-doping rules are strictly enforced and doping education is more prominent. Conversely, the lower scores among bodybuilders and Taekwondo athletes may be due to limited access to anti-doping workshops and a greater reliance on peer-shared information rather than official guidance. This explanation aligns with the findings from the World Anti-Doping Agency (WADA, 2015), which emphasizes the need for sport-specific education initiatives.

Furthermore, the misconception that supplements purchased over the counter are inherently safe (a belief held by 14.8% of respondents) reflects global concerns. Research by Newmaster *et al*. (2013) found that many commercially available supplements are contaminated with substances not listed on their labels, leading to unintentional anti-doping rule violations. This reinforces the importance of educating athletes not only about the WADA prohibited list but also about the risks of supplement contamination.

Sources of Information and Testing Experience

A significant proportion of athletes (over 33%) had never attended a workshop where FS and PES were discussed, and nearly 8% reported never having received any information on anti-doping. Additionally, only about 20.6% of athletes reported having been tested for doping out of competition. These statistics reveal major gaps in both education and enforcement.

The findings support the assertion by Smith *et al*. (2010) that many athletes, especially in developing countries, are insufficiently exposed to anti-doping interventions, due in part to logistical, financial, and organizational barriers. The study also found that coaches and fellow athletes are the primary sources of doping-related information, a trend similarly identified by Rintaugu, Mwisukha, and Munayi (2011). This dependence on informal sources increases the risk of misinformation and the normalization of risky behaviors.

Reasons for Use and Methods of Administration

Economic incentives were the primary motivation for the use of PES, FS, and TH, with over 70% of respondents citing monetary rewards as a reason. This is consistent with global studies linking doping to socioeconomic conditions, where athletes from lower-income backgrounds are more likely to use banned substances as a means to improve performance and secure financial stability (Henning & Dimeo, 2014). Pressure from coaches, colleagues, and lack of confidence were also influential factors, especially among wrestlers.

The belief that an athlete could provide a urine sample that was not their own, held by 34.4% of respondents, and the admission by 1.4% that they had done so, highlights the need to strengthen doping control procedures and athlete education on ethical responsibilities.

CONCLUSION

This study examined the levels of knowledge among mixed martial arts (MMA) athletes in Kenya regarding performance-enhancing substances (PES), food supplements (FS), traditional herbs (TH), and their methods of application. The results revealed significant disparities in knowledge across different sports disciplines. Wrestlers demonstrated the highest knowledge scores, while bodybuilders and Taekwondo athletes had notably lower levels of awareness.

The findings also exposed widespread misconceptions among athletes, including the incorrect belief that banned substances are always listed on supplement labels and the assumption that national Anti-Doping authorities can recommend safe supplements. These knowledge gaps pose a significant risk of inadvertent doping violations and health hazards. Limited exposure to formal Anti-Doping education and

reliance on informal sources such as coaches and peers further compounds the issue. Therefore, improving athletes' knowledge is essential to ensuring compliance with Anti-Doping regulations and promoting health and fairness in sport.

Recommendations

1. **Strengthen Anti-Doping Education on PES, FS, and TH** Develop and implement targeted education programs focusing specifically on knowledge related to performance-enhancing substances, food supplements, and traditional herbs. These should be integrated into athlete training schedules and federations' development plans.
2. **Prioritize High-Risk Disciplines for Intervention** Disciplines such as bodybuilding and Taekwondo, which demonstrated the lowest knowledge levels, should be prioritized for intensive knowledge-focused interventions and outreach.
3. **Develop and Disseminate Sport-Specific Educational Materials** Create user-friendly and discipline-specific resources that clearly explain what substances and methods are banned, including examples of contaminated supplements and risks associated with traditional herbal remedies.
4. **Increase Access to Verified Information Sources** Expand access to information through digital platforms, printed materials, and community outreach. Leverage ADAK, WADA, and federations to circulate up-to-date content in both English and Kiswahili.
5. **Mandatory Training for Coaches and Athlete Support Personnel** Since many athletes rely on coaches for guidance, it is essential to train support personnel in anti-doping knowledge to ensure accurate information is passed on to athletes.
6. **Conduct Routine Knowledge Assessments** Introduce periodic assessments of athletes' knowledge on PES, FS, and TH to identify persistent knowledge gaps and evaluate the impact of educational programs.
7. **Enhance Workshop Coverage and Participation** Increase the frequency and geographical reach of workshops and seminars, especially in rural and underserved counties, to ensure widespread awareness among all registered athletes.

Declarations

Competing Interest: The author declare that they have no competing interests.

Authors & Contributions: Martin Sisa Yauma conceived the paper, designed and performed the study. The author read and approved the final manuscript.

REFERENCES

- Backhouse, S. H., McKenna, J., Robinson, S., & Atkin, A. (2007). International literature review: Attitudes, behaviours, knowledge and education – Drugs in sport: Past, present and future. Leeds Metropolitan University. https://eprints.leedsbeckett.ac.uk/id/eprint/1505
- Henning, A., & Dimeo, P. (2014). The new front in the war on doping: Amateur athletes. *International Journal of Drug Policy, 25*(2), 242–243. https://doi.org/10.1016/j.drugpo.2013.11.002
- Kiplamai, F., Mandu, A., & Yauma, M. (2020). *Report on the use of food supplements by athletes in mixed martial arts in Kenya* [Unpublished PhD thesis]. Kenyatta University.
- Laure, P., & Binsinger, C. (2007). Adolescents and the use of doping agents: The contribution of a study of French schoolchildren and students. *European Journal of Public Health, 17*(5), 505–509. https://doi.org/10.1093/eurpub/ckl289
- Lentillon-Kaestner, V., Hagger, M. S., & Hardcastle, S. (2012). Health and doping in elite-level cycling. *Scandinavian Journal of Medicine & Science in Sports, 22*(5), 596–606. https://doi.org/10.1111/j.1600-0838.2010.01281.x
- Mazur, Z. (2009). Martial arts and ethics in sports. *Archives of Budo, 5*, 15–20. https://www.archbudo.com/view/abstract/id/8577
- Morente-Sánchez, J., & Zabala, M. (2013). Doping in sport: A review of elite athletes' attitudes, beliefs, and knowledge. *Sports Medicine, 43*, 395–411. https://doi.org/10.1007/s40279-013-0037-x
- Newmaster, S. G., Grguric, M., Shanmughanandhan, D., Ramalingam, S., & Ragupathy, S. (2013). DNA barcoding detects contamination and substitution in North American herbal products. *BMC Medicine, 11*, 222. https://doi.org/10.1186/1741-7015-11-222
- Okumura, K., Ibe, R., & Kimura, M. (2020). Education for doping prevention: Evaluation of effects on knowledge and behavior among high school athletes. *Journal of Physical Fitness and Sports Medicine, 9*(1), 1–10. https://doi.org/10.7600/jpfsm.9.1
- Petroczi, A. (2002). *Attitudes towards doping: Development of a doping attitude scale* [Unpublished master's thesis]. University of Leeds.
- Rintaugu, E. G., Mwisukha, A., & Munayi, S. (2011). Doping: Implications for sports and public health. *East African Journal of Physical Education, Sports Science, Leisure and Recreation Management, 1*(2), 150–159. [No DOI available]
- Smith, A. C. T., Stewart, B., Oliver-Bennetts, S., McDonald, S., Ingerson, L., Anderson, A., Dickson, G., Emery, P., & Graetz, F. (2010). Contextual influences and athlete attitudes to drugs in sport. *Sport Management Review, 13*(3), 181–197. https://doi.org/10.1016/j.smr.2009.05.007
- World Anti-Doping Agency. (2015). *2015 World anti-doping code*. https://www.wada-ama.org/en/resources/the-code/2015-world-anti-doping-code