

# Beyond the Arena to Health Strains: Doping, Misinformation, and the Community Burden of Performance-Enhancing Substances

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**How to cite this paper:** Ogama, D.W.  
(2025) Beyond the Arena to Health Strains:  
Doping, Misinformation, and the Commu-  
nity Burden of Performance-Enhancing  
Substances. *Health*, 17, 869-887.  
<https://doi.org/10.4236/health.2025.177057>

**Received:** July 1, 2025  
**Accepted:** July 22, 2025  
**Published:** July 25, 2025

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## Abstract

Non-athletic global consumption of performance-enhancing substances (PES), generally in anabolic androgen steroids (AAS) or selective androgen receptor modulators (SARMs) and fat-dissolving drugs such as clenbuterol, is a broadening health issue far beyond the highest levels of sport. This paper recontextualizes doping as a complex public health issue, which is promoted by misinformation systems, poorly regulated online marketplaces, social media intervention, and regulatory gaps. Translating epidemiological data, toxicological investigations, and media coverage into its inferences, it shows how PES has become widespread among young people, females, and recreational fitness men and women populations and depicts specific trends of physiological harm, mental illness, and extremely high pressure on healthcare delivery systems. The paper also criticizes the moralization of the use of PES by stating that there should be a transition to a public health model that acknowledges structural vulnerabilities and information asymmetries. The necessity of addressing the issue through multi-tiered interventions can be supported by comparing it with other challenges related to public health, such as opioid and tobacco use. They are intercontinental policy transformations, the control of digital platforms, educational prevention, gender-responsive outreach, and consumer authentication technologies. This paper has sought to help design a new discourse around the Doping phenomenon, one that will promote informed, fair, and prevention methods to a health pandemic that continues to escalate.

## Keywords

Doping, Public Health, Misinformation

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## 1. Introduction

Recent studies show that the overuse of performance-enhancing substances (PES), especially anabolic-androgenic steroids (AAS), is no longer a professional sporting field obsession but rather an issue permeating the community and youth groups [1]. A 2014 meta-analysis estimated the lifetime prevalence of anabolic-androgenic steroid (AAS) use at 3.3% in the general population and up to 18.4% among recreational athletes [1]. More recent findings by Piatkowski *et al.* (2023) report a prevalence of 6.4% among men and 1.6% among women, suggesting a gendered pattern of use [2]. Additionally, a systematic review by Mingxing and Yanfei (2025) indicates that AAS use continues to rise, particularly among youth populations and male gym-goers, highlighting a sustained upward trend in non-medical performance-enhancing substance (PES) use [3]. A 2021 population-based study of Icelandic adolescents (mean age 17.3, n = 10,259) referred to a 1.6% prevalence of AAS exposure, with a high occurrence of anxiety, depression and attempted suicide among users [4]. Moreover, more young people gain access to steroids and fat-burning chemicals such as clenbuterol through online medicine black-markets and body-builder circles, both through informal sources and internet reports [5]. All of these current statistics emphasize the importance of discussing the topic of PES misuse as a developing public health issue impacting the health of individuals within the community.

Interacting social, cultural, and informational domains can be identified as the correlates of the expanding normalization of the use of performance-enhancing substances (PES) among everyday individuals. Concerns about physical appearance, beauty ideals, and the desire to achieve quick body change, be it bulking or slimming down, have also been aggravated through visual culture and social media, which focus on fitness [6]. Not only do these platforms encourage different standards of beauty, but they are also provided with informal advice platforms where the advice, frequently given by non-professionals or the same age, is unregulated [7]. Without being able to assess the credibility of information themselves, people become even more vulnerable to inaccurate or partial information on PES safety and efficacy [8]. Notably, these decisions are often undertaken without formal consultation with the medical practitioner, hence increasing the scope of unintentionally inflicted harm [9]. With this in mind, therefore, the consumption of PES by non-elite users is not just an individual phenomenon, though it is also a structural concern, which in a way places doping as an urgency towards the current prevailing discourse of public health.

Social-economic inequalities bring a major but poorly studied influence on non-medical PES uptake. Within the context of labor precarity, educational disadvantage and limited accessibility to a legitimate source of health and fitness resources, PES form a wider array of body-focused self-optimization strategies. In the lives of many users, especially in the economically disadvantaged societies, PES use is less aesthetic or recreational as it is entangled with economic survival, status mobility and employability. Antonopoulos and Hall (2016) draw attention to the fact that

anabolic-androgenic steroid (AAS) use in the UK has been integrated into local economies within local gyms where people shift between user and supplier, a situation caused by low employment and lack of social material resources [10]. These grey economies are regulated at minimal levels and are more often than not in conjunction with alternative grey-market or black-market practices in strengthening a structural susceptibility to a probability of health risk exposure as well as exposure to crime [11]. These dynamics help to understand how the PES utilization can be an indication of rational responses to systemic limitations, as opposed to merely deviant or ignorant practices, and this requires policy solutions that adhere to the social determinants of health.

Collectively, the proliferation of doping behaviors among non-elite communities and the institutional arrangements that cause them illustrate a transformation in the character of performance-enhancement on its own: that the status of an issue of ethics within sport has been supplemented with the growth and outreach of a public health problem. This paper argues that with the increasing abuse of PES, either willingly or unknowingly, by taking misrepresented products, the issue needs to be viewed skeptically, besides the gender specific perspective of an athlete. Particularly, it questions what the misinformation ecosystem, the presence on digital platforms, and socioeconomic vulnerability have allowed is the normalization of substance use routines, imposing severe physiological and psychological hazards. The paper changes the scope of the problem by putting it in the context of a larger community, so the topic of doping is no longer discussed as a personal responsibility but as an issue requiring the attention of the public health sector. With a conceptual and evidence-based exposure, the project seeks to demonstrate the scope of the problem, reveal the existing challenges with regard to doping and provide recommendations that respond to the health and informational inequality at the center of the problem.

## 2. The Expanding Landscape of Doping in Communities

The use of performance-enhancing substances (PES) in a non-elite environment comes with various compounds that include familiar anabolic-androgenic steroids (AAS) and growth hormone, to emerging agents of selective androgen receptor modulators (SARMs), thermogenic stimulants, and beta-agonists like clenbuterol [1]. A meta-analysis study cited that the world lifetime prevalence of AAS use is around 3.3%, which increases up to 18.4% in recreational sportsmen, highlighting prevalence among the non-elite users [1]. Clenbuterol is an off-label bronchodilator that is used as a fat-burning drug with off-label use and has been prohibited in food-producing animals in significant locations [12]. SARMs that are sold online as an alternative to AAS have also spread; a 2.7% current use has been reported in a study among young male gym goers, with their labels inaccurate and limited safety data [13]. This form of polypharmacy is enabled by internet availability and casual access through sporting facilities and peer groups. Numerous chemicals have no constitutional control or can be represented falsely, which ex-

poses patients to an elevated risk of dosing errors, drug reactions, and protracted toxicity.

## 2.1. Distribution Pathways

One major distribution channel of anabolic-androgenic steroids (AAS) is on the Internet, where thousands of web pages list for sale these drugs without any prescriptions being required. This accessibility was also validated by a 2005 U.S. Government Accountability Office (GAO) investigation: among the 22 online AAS purchases, ten led to delivery of genuine steroids through the mail by foreign suppliers [14]. Later studies (e.g., McBride *et al.*, 2018) confirm that websites often support the sale of non-prescription AAS (such as injectable testosterone, SARMs, post-cycle therapy drugs, and erectile dysfunction products) and place the necessary legally focused disclaimers on their websites, and go to the extent of offering prescriptions on how to stack and the doses to be taken [15]. A significant survey made in the qualitative sense of Web-based information revealed that the sites involved with AAS significantly outweighed the online existence of the majority of illegal drugs and were actively spreading the user-determined regimens and downplaying the adverse consequences of their use [16]. They also show that there is an unregulated global online supply by suggesting that meta-analyses report that about 36% of black-market AAS are counterfeit [16]. The combination of this evidence concludes that the Internet has become a big, mostly unregulated channel for AAS distribution with little regulation and profound implications for the population's health.

Besides exclusive online merchants, the possibility to purchase anabolic-androgenic steroids (AAS) has also become the dominant marketing channel due to the influence of social media. An Inside Out investigation by the BBC discovered that rogue AAS sellers have joined exclusive Facebook groups to market and distribute products such as the prohibited drug, Prostasia, to friends [17]. Facebook enables peer-to-peer transactions with limited interference. It is very widespread; in one investigation, a journalist saw 30 groups selling steroids without prescription [17]. This trend is in line with the results, according to which about a third of deals with performance- and image-enhancing drugs (PIED) now go through such popular online services as Facebook, Instagram, and TikTok with the help of the active promotion of content and recommendations of peers [18]. Depending on the code words, star endorsements and feedback interactions, vendors easily achieve the trust factor and evade the implementation of the policy [19]. These social media free-market pharmacies do not carry any official health warnings or drug dosage recommendations, significantly reducing the bar of initiation and increasing the chances of counterfeited or tainted products [19]. These online channels have all worked collectively to institutionalize the availability of AAS at scale, thereby strengthening accessibility and making doping behavior seem like normal practices in everyday fitness environments.

Recent surveys of internet-based vendors of anabolic androgenic steroids (AAS)

provide evidence that announced origin of manufacture is with greater certainty detected in so-called medicinal AAS (97.9%) compared with dietary supplement AAS (66.7%) [20]. In the medicinal segment, there are a few firms like British Dragon, Organon, Zambon, Asia Pharma, Schering, and Body Research that have more than 50 percent of the medicines available on the internet and there is usually a dedicated company site [20]. On the contrary, supplement-category AAS, such as those found in Oregon Labs, HI TECH Pharmaceuticals, SDI-Labs, AMS, and Natrol, are often sold by less accountable online vendors that retail through anonymous means [20]. Such differential transparency has a significant implication in terms of regulatory effects and regulatory loopholes within illicit AAS markets: supplements can be used to evade prescription and regulatory checks at the customs points [21]. Together with the information that nearly a quarter of sports supplements labeled as AAS are counterfeit or contaminated, this dynamic establishes a two-pronged means (deliberate doping through illicit pharmaceuticals and accidental exposure through wrongfully labeled athletic supplements) of community-level risks to health.

## 2.2. Regulatory Blind Spots

Studies conducted on international trafficking of anabolic-androgenic steroids (AAS) show that there are numerous regulatory gaps within which performance-enhancing substances (PES) can be transported and abused in different parts of the world. In high-income and low-income nations alike, lax regulation, divided surveillance, and porous online trade allow the spread of PES well outside the sphere of elite sports [11]. A good example is the United Kingdom, where the trading framework in the country can be characterized as decentralized and fluid, being integrated into the subcultures of gyms and bodybuilding, and people can move among the spheres of use, distribution, and importation without much attention [10]. Although AAS are legally regulated in the UK under the Misuse of Drugs Act, AAS are regularly imported unhindered in the form of individual orders by manufacturers of licit and illicit organizations selling them, such as British Dragon and Organon [22]. Such a pattern is not specific to the UK. The development and subsequent propagation of e-commerce and social media networks like Facebook and Instagram in Europe, Asia, and Africa have facilitated the open marketing of PIED, which, in most cases, online evade local laws owing to weak pre-market surveillance and enforcement on the internet [23]. These regulatory gaps, as a concern all over the globe, demonstrate the necessity of the implementation of international coordinated mechanisms of limitation of online sales, customs screening, and development of effective systems of consumer protection against unsafe, misbranded, or counterfeit PES.

## 3. The Misinformation Ecosystem

### 3.1. Sources of Misinformation

Brennan *et al.* (2013) report that the internet is one major source of information

when it comes to PES. According to the author, numerous sites offer medical information of different quality when it comes to the side effects of the use of PES, such as AAS [16]. Some of the sites provide a balanced presentation of the drugs while citing peer-reviewed articles [16]. However, the majority of the sites indicate that the use of PES substances is safe and that the dangers of the substances are grossly exaggerated by government bureaucrats, biased scientists and incomplete physicians [16]. The information provided regarding the side effects of PES on internet sites includes gynecomastia, hypothalamic pituitary testicular axis, and absences that develop from nonsterile AAS injections [16]. Such information is not provided with the aim of deterring people from using PES but to assist them in minimizing the potential side effects of the medicine. Cordaro *et al.*'s (2011) results support this assertion as they indicate that a majority of the internet sites rarely focus on the adverse side effects of the AAS substances that they are selling [20]. While on the internet, users always use discussion forums to seek medical information and they often receive a lot of detailed responses from other users, who allow individuals to start using PES utilizing their medical advice [16].

A study by Hilkens *et al.* (2021) explored the prevalence of steroid use among young males in the Netherlands [13]. According to the study, social media plays a critical role in allowing individuals to access information on supplements and training, with 32% of individuals indicating that social media is their primary source of information [13]. Vainio (2024) analyzes social media and suggests that numerous social media influencers who have experience with the use of steroids often hold varying views on the issue of steroid use as they communicate different ideological stances [24]. Most of the issues involve the readiness to use steroids as well as the criteria for readiness, while indicating that individuals who use the substances should be aware of the risks involved. In turn, they stress the need for medical supervision [24]. The author notes that the emphasis for such medical oversight can serve as a means of the influencer distancing themselves from the responsibility of providing harmful information, especially since different individuals do not have equal access to medical supervision. Despite their warnings on social media, Vainio (2024), study reports that viewers can perceive such individuals as role models as they use steroids, thus copying their behavior instead of heeding their warnings [24]. Also, numerous studies in gym settings indicate that individuals always have a positive attitude towards the use of steroids and are thus more likely to use the substances in order to achieve their body goals.

Cordaro *et al.* (2011) provide evidence that the internet offers misleading information with regard to the use of PES substances. In their study, they indicate that there are issues with recommended doses of different products, which are always larger when compared to what is indicated for therapeutic purposes [20]. For example, therapy for nandrolone is recommended to be around 25 - 100 mg every 3 - 4 weeks, up to 50 - 200 mg weekly. However, on sites selling nandrolone, individuals are advised to take doses up to 600 - 800 mg a week [20]. This represents 6 - 24 times increase and provides evidence that online platforms do not only fa-

facilitate access but actively contribute to dose escalation. There are even recommendations for the use of boldenone undecylenate, which has only been approved for veterinary services [20].

### 3.2. Disguised Labels and Marketing

Geyer *et al.*'s (2014) study reveals that since 2003, there has been an increase in the number of nutritional supplements that advertise with claims of an enormous increase in muscle growth as well as strength [25]. According to the labels and marketing of the products, the biological impacts of the supplements arise as a result of formulas and new ingredients with unapproved names [25]. Analysis of numerous such products indicates that they contain exogenous AAS such as methandienone, oxandrolone and stanozolol that are not declared in the label. Also, nutritional supplements that have been contaminated with clenbuterol are usually advertised for their fat-burning effect. Cordaro *et al.* (2011) analyzed internet websites selling AAS products and examined them [20]. In their analysis, they found out that several declared AAS specifically in dietary supplements were just fake names, such as 3-undecanodrol, which in some way resembles nandrolone decanoate [20]. Such strategies are utilized with the aim of deceiving the buyers to make them believe that the products do not contain certain compounds.

Cordaro *et al.* (2011) further examined the PES products sold on the internet and noted that the majority of the benefits are presented from a recreational point of view [20]. The therapeutic benefits of the products are mentioned in a few instances and a lot of emphasis is placed on their low risk and absence of estrogenic effects, which mainly affects bodybuilders. Also, numerous information regarding the side effects of PES products available with regards to marketing include the less serious effects such as acne, hirsutism and gynecomastia, which have an impact on the physical appearance of an individual [26]. Serious and irreversible side effects such as virilization and a lower voice tone are mentioned in only 15% of the products despite nearly all the products being recommended to women [20].

### 4. Gendered and Youth Vulnerability

The group of young individuals is a particularly exposed population to the misuse of performance-enhancing substances, and the two most recent systematic reviews proved the claims of both prevalence and versatility of associated risks. The review conducted by Nicholls *et al.* (2017) on 52 studies involving 187,288 young people aged 10 - 21 years recognized a constellation of nine predictive factors, which included age, gender, sport type, psychological factors, and the effects of the entourage [27]. In particular, the level of self-esteem and peer pressure resistance were identified as protective factors, and aggression, weight concern, and suicidal ideation were associated with increased risk level. Empirical studies show that prevalence of lifetime or current steroid use among adolescent gym rat is between 1% and 6% in North America and Europe and as much as 13% among male high-school athletes nationally in the U.S. as well experimentation with nutri-

tional supplements common among this group exposes adolescents to pharmacologically active compounds that are usually unlabeled and put the youth on a more vulnerable position [28]. These numbers, combined with the multifaceted psychology and social factors that determine its occurrence, are a clear indication that immediate, specific preventative approaches need to be implemented at the school and community level.

Additionally, studies also show that the use of anabolic-androgenic steroids (AAS) in women is by far magnified and has unique characteristics, thereby requiring gender-based interventions in the field of public health. Piatkowski *et al.* (2023) highlight the various, exclusive psychosocial and physiological needs of female users, many of whom take oral drugs, including oxandrolone and clenbuterol and feel socially isolated because of stigma and a lack of information that is specially designed to suit their needs [29]. The qualitative research that they conducted in Australia highlights the fact that women have often been left out of any normal talks on harm reduction of AAS and therefore they are in a disadvantaged structural position. A complement to this, a systematic review of 18 studies tabled a pooled lifetime prevalence of AAS among women of 4%, with results soaring to 16.8 percent in bodybuilding circles and 4.4 percent in leisure gym-goers [2]. Moreover, the cross-sectional study conducted in a large gym reported the prevalence of active AAS female use in 6.5 percent of participants [30]. Gendered implications are far-reaching: women experience gender-specific hormonal disturbances, including deepening of the voice, disruptions of menstrual regularity, as well as increased psycho social stressors as a result of social constructs and stigmatization [29]. All these data prove that AAS use is not an insignificant problem among women, but something that poses an increasing threat to the public population that requires gender-responsive intervention approaches.

The vulnerability to PES due to cultural and social pressures is significantly increased when targeting women and young members of society, since they feel the most pressure in digital areas where ideal body images are both created and controlled. To the female population, dominant images of hyper-toned femininity usually supported by fitness coaches, celebrities, and online social groups propagate an unrealistic image suggesting a pursuit of fat-burners, such as clenbuterol, or minor anabolic substances such as oxandrolone [2] [29]. It can potentially be further burdened by the lack of female-focused messaging concerning harm-reduction, which further increases the risk of taking it improperly or experimenting on oneself in a secluded manner. In teenage boys and young men, the absorption of muscularity ideals, which some researchers refer to as the “drive of size”, is also ubiquitous. A systematic review by Nicholls *et al.* (2017) identified body dissatisfaction and peer appearance comparisons as key psychological predictors of AAS use among boys. Notably, the review reported cases of initiation occurring before the age of 10, highlighting the early onset of risk in some youth populations [27]. In both, the social enforcement of physical conformity proves to be an even more powerful driver, and its power is increased exponentially by the algorithmically

catered content praising extreme bodies and punishing perceived insufficiency. The social normalization of the frequency of PES utilization in gym settings, groups of friends, and even internet commentary further reduces the perceived danger and stresses the idea that chemical enhancement is a mandatory, even responsible, method of personal improvement.

Additionally, psychological aspects are decisive in determining the PES use trajectories and, in many cases, they work hand in hand with the structural and social vulnerabilities. The perceived ability to attain body or performance goals, also called self-efficacy, negatively correlates with initiation of AAS; individuals with lower self-efficacy are more likely to seek chemical enhancement to attain their internalized ideals of leanness and muscularity [27]. Moreover, adolescent and young adult PES users tend to experience low self-esteem, social anxiety, and various depressive symptoms, which are also considered some of the risk factors regardless of engagement in sports by multiple studies [27] [28]. The influence of peer factors such as peer norms and perceived social support can also have a bearing on decision-making, especially when the setting is a male-dominated gym or an online social community where the doping behavior is normalized and even valorized. Substance use in these kinds of environments is not merely condoned, but may be shown as a common sense or a required action to improve oneself physically, particularly when mixed up with body inhibition or distorted belief in oneself. Furthermore, those saying that they felt isolated or stigmatized by others tend to use PES, like clenbuterol or oxandrolone, to achieve unrealistic body ideals, and have few resources about psychologically safe and female-informed harm reduction [29]. These findings show the need to integrate mental health frameworks in PES prevention, focusing on self-worth, body neutrality, and emotional resilience.

## 5. Public Health Implications

### 5.1. Physiological Harms

The risks of performance-enhancing substance (PES) abuse are tremendous in terms of physiological and psychological impact, as well as not limited to the gym. One of the most alarming ones is related to cardiovascular pathologies; there are high systolic and diastolic blood pressure (~12 and ~8 mmHg respectively) and faster coronary artery disease development, arrhythmias, and cardiomyopathy in AAS users and an increased risk of myocardial infarction, heart failure, and venous thromboembolism (2.4 - 8.9) [3]. Much is known about hepatic damage due to AST/ALT enzyme elevation to cholestasis, hepatic adenomas, and infrequent hepatocellular carcinomas, particularly with the 17 alpha-alkylated AAS (e.g., stanozolol, methandrostenolone) [31]. Activated endocrine lesions, namely, hypogonadism, disturbed lipid profiles (LDL, HDL) and insulin resistance, further add to metabolic risk [9]. A not insignificant minority of users experience psychiatric sequelae, including aggression, mood disturbance, dependence and subsequent vulnerability to suicide (12 all the way up to 33 percent), and structured

interviews verify that prescriptions of antipsychotics (2.5-fold) and anxiolytics (2.2 times) are significantly upped in users [32]. It is worth noting that the nature of PES also determines the physiological effect a great deal. Although cardiovascular and hepatic toxicity is related to AAS use, selective androgen receptor modulators (SARMs) have been implicated in liver enzyme abnormalities, inhibitory effects on testosterone, and endocrine disruption, despite being marketed as safer versions [13]. Similarly, the consumption of the  $\beta$ 2-adrenergic agonist or asthma medication known as clenbuterol, commonly misused as a fat-burning drug, is linked closely to tachycardia, electrolyte disturbances, arrhythmias, and even permanent cardiac stress or damage in some instances [12]. The clinical implications of these compounds also differ, with AAS mostly used by bodybuilding men, whereas SARMs are mostly used by younger people in the gym who want a leaner body, and lastly, clenbuterol is mainly used by women who were under the influence of thinness ideology [2] [29]. They are multifaceted harms that justify the need to identify PES misuse as a matter of urgent concern in the health of the population.

## 5.2. Invisible Burden

The use of performance-enhancing substances (PES) among non-athletic populations is unidentified and underreported, thus making it a silent burden to the public health systems [32]. According to qualitative studies, community users are likely not to report PES consumption when visiting a healthcare facility because of the stigma (social or personal) or ignorance on the part of medical professionals or in fear of consequences [33]. Therefore, there are falsely attributed complications like hypertensive cardiomyopathy, liver dysfunction and psychiatric symptoms [34]. Studies indicate that a significant proportion of AAS users do not disclose their use to medical professionals and 70% would remain undiagnosed during routine health assessments [1]. Moreover, PES has no universal screening tool, which is hardly implemented in many outpatient clinics, which is why even physical indicators of the condition, such as acne, gynecomastia, or menstrual cycle abnormalities, are not investigated [34]. Such diagnostic invisibility interferes with early intervention, drives up rather than drives down the sum long-term healthcare expenditure, and obfuscates the epidemiological insight required in policy design and wood-allocation.

## 5.3. Healthcare Strain

Abuse of performance-enhancing substances (PES) is a burden on healthcare systems, which are presented either as an economic or clinical burden. Chronic complications, such as hypertension, cardiomyopathy, polycythemia, liver dysfunction, as well as endocrine disruption, need intensive and long-term medical actions [35]. Nevertheless, PES-related screening or monitoring protocols are not part of routine healthcare delivery, as most healthcare professionals do not feel confident in the recognition and/or management of PES misuse [36]. A 2019 sur-

vey in the UK showed that 71 percent of anabolic steroid users gave their experiences with general practitioners an overall negative rating, and 65 percent did not consult a clinician because of stigma or possible judgment [37]. This eventually leads to an increase in several complications, which become critical through their progress without being realized and, thus, urgent treatment must be afforded or a specialist must be called, making it a very expensive process [38]. The fact that there are no validated PES screening instruments in the primary care setting only compounds the issue, as it delays the diagnosis and negates community-wide public health surveillance [39]. To eliminate these gaps, specific clinician education, screening procedures, and early intervention methods should be designed to reduce the long-term burden on the health system.

#### 5.4. Ethical Reframe

The issue of using a performance-enhancing substance (PES) has been historically constructed as a question of a moral offence or an individual choice, when it must be reinterpreted as a form of systemic vulnerability to promote a public health approach [40]. Such media analyses find that descriptive horror stories ignore facts and can contribute to the manifestation of moral panic that dehumanizes anyone using steroids and reduces them to the status of a deviant [41]. This stigmatization can be related to the wider studies of substance use disorders in which positions taken in terms of morality can reinforce the dichotomies of us versus them, and it contributes to health disparities because moral stigmatization is believed to reduce the intention to seek care. Additionally, the unseen status of PES users is obscured by the bias of the clinicians because research demonstrates that medical workers give poorer impressions to AAS users than patients with cocaine addiction or eating disorders [42]. This frame shift, ethically, corresponds with the patterns in other public health forms, such as tobacco, alcohol, and opioids approaches to addiction, where failure to address structural factors like misinformation, online circulation, and the absence of control are recognized as a component of health problems [43]. There is a prospect of systemic interventions that would intrude without stigma or the implication of blame, and that would enhance the public health response in terms of memory and its effectiveness.

#### 5.5. Public Health Parallel

Surveys comparing the PES to other behaviorally affected drugs highlight the wider trend toward the substance's relevance to public health and welfare [44]. Like tobacco and alcohol, legal drugs that must be targeted, branded and culturally redefined early enough, PES misuse is a part of the normalization pattern by social and marketing-based forces. PES use commences, like that of nicotine and alcohol, when users are young under peer pressure or the exposure created through the media and is repeated after that regardless of the long-term health costs. The worries are similar to those in opioid abuse: PES users are likely to take part in polypharmacy (e.g., stimulants, diuretics, pain or side-effect suppressing opioids).

Opioid harm-reduction measures, such as screening, education, and referrals to treatment, have been effectively expanded, providing a model of PES interventions pointed to the evidence-based model of opioid harm-reduction measures, including screening, education, and referrals to treatment, as a model by which to administer PES interventions [45]. Opioid harm-reduction measures, such as screening, education, and referrals to treatment, have been successfully expanded and thus provide a model through which to implement PES interventions [45]. Therefore, PES misuse fits the essential public health conditions, such as these other drugs, that is, large accessibility, social support, addiction potential, and expensive to individuals and societies. The use of these parallels helps promote harm reduction, regulation changes, and community education with their focus on PES use.

## 6. Recommendations

### Policy Reform

There is a need to tackle the international use of performance-enhancing substances (PES) by creating a strong policy-reform system, especially with the constant legal and regulatory loopholes. Most nations do not have a requirement for pre-market testing, which means that supplements and products related to PES will be available on the market without any confirmed safety or purity [46]. Unlike the U.S. Dietary Supplement Health and Education Act (DSHEA, 1994) where a post-market measure can only take place after complaints on the harmful effects of products, the Natural Health Products Regulations in Canada includes pre-screening of ingredient data and manufacturing conditions of products giving a better model that can be used in other countries [47] [48]. Moreover, there are incoherent or nonspecific labeling requirements that allow active substances in supplements to be hidden, particularly by the omission of chemical names [49]. To further protect the consumer, there would be a resulting benefit of implementing internationally standardized protocols in the labeling process, which would involve full disclosure, *i.e.*, the use of an International Union of Pure and Applied Chemistry (IUPAC) name [50]. Last but not least, online sales of PES are a poorly regulated horizon; international collaboration with customs administrations, health jurisdiction, and internet service providers is necessary to break illegal markets of online sales that are readily immune to national authorities and legally expose millions of people to high-risk and unregulated goods.

### Online Platform Regulation

Online-based avenues have led to a major source of sale and normalization of performance-enhancing substances (PES) [20]. As reported on numerous occasions, it has become very easy to find anabolic-androgenic steroids (AAS) and other substances that are related to them and order them online without prescriptions or governmental control [20]. These websites sometimes place a disclaimer that pretends to be legal to give direct access to untested and possibly non-authentic goods [20]. Moreover, they are often engaged in spreading misleading or sci-

entifically unproven efficacy and safety claims, thereby causing a lot of misinformation in the population [39]. To check this, governments have to tighten the supervision of websites that deal with online activities, close down rogue internet trading stores and intensify external cooperation on this front of surveillance. In addition to the former, social media, notably Instagram and Facebook, acts as an informal means of marketing since influencers and the so-called closed community groups would sell PES under the pretext of fitness recommendations [17]. Although they are not always direct sellers, those spaces strengthen demand and misinformation. Regulatory frameworks should therefore focus on not only catering to distribution (internet vendors) but also to demand generation (social media), where digital platforms should be made responsible to the extent that they contribute towards augmenting access to PES and the risk that accompanies it.

### **Education and Community-Based Prevention**

To deal effectively with the rising use of performance-enhancing substances (PES), a community-based education based on the whole strategy approach should be widely deployed both within and outside the elite sports environment. It is important to include components of anti-doping into the curriculum of secondary and tertiary health education, since in most cases, PES experimentation starts in adolescence due to misinformation and pressure created by peers. According to evidence obtained in Europe by school-based programmers, the exposure to proper information at an early age minimizes the tendency to engage in risky activities and normalizes the health-based body image expectations [51]. Additionally, to formal education, frontline players in the community (fitness instructors, coaches, pharmacists, and others) must be empowered to act as gatekeepers, as they would be able to learn how to recognize warning signs and can provide some advice or refer issues to a specialist [29]. These messages can be supported by the use of gym-based workshops and local awareness campaigns, especially in recreational fitness spaces, that otherwise can be ignored by more established interventions. Additionally, the gender- and style-advising matter is indispensable: women are uniquely exposed to the dangers of hormone imbalances and stigmatization, and young people are the most susceptible to pressure in terms of their looks created with the help of a digital tool [29]. Outreach programmers in education should thus be addressed specifically to these groups so that the prevention of PES should be inclusive, creditworthy and incorporated in the daily settings that expose substance use risks.

### **Consumer Verification Tools**

The most important element of combating the rampant abuse of performance-enhancing substances (PES) and tainted dietary supplements would be the provision of useful tools to consumers, enabling them to check the product safety and authenticity on their own. Examples of digital interventions include barcode readers and mobile applications, which have shown positive potential. As an example, an app called NSF Certified for Sport allows one to scan the packaging of supplements and spot immediately whether a product has been tested on banned sub-

stances, which is especially helpful to athletes and sports enthusiasts [52]. On the same lines, Labdoor and ConsumerLab are test labs that buy and do their testing and provide analytical reports to users so they can see what supplements are accurate and free of contaminants [53] [54]. Other apps, such as “Prove It”, compare product ingredients to scientific research and doping databases to state possible health hazards [55]. Moreover, authentication technologies have been implemented, including QR-code tracking and blockchain-based traceability systems, to detect counterfeit or mislabeled supplements at the time of purchase [56]. These tools would have the potential to reduce accidental doping when frequently used and part of consumer health education in countries where markets are not regulated, causing the problem of the healthcare burden of mislabeled or non-reputable products.

## 7. Conclusions

The use of performance-enhancing substances (PES) outside of elite sports and into the general community has become an important topic of focus regarding their health effects on the general population. Mised with uncontrolled digital markets, general misinformation, and low literacy levels among consumers, PES abuse continues to be a problem that mainly targets youth, women, and recreational users who are usually uneducated about the consequences of consuming such drugs. Whereas the topic of elite sports doping can be elaborately discussed as a subject of attention, the overall usage of PES in society remains truthful with non-visible implications: consisting of the cardiovascular and psychological dangers, along with the pressure on the healthcare and regulating systems. This paper shows that the overuse of PES at the community level is not just an expression of personal preference but a symptom of structural weaknesses, such as deficient oversight, poor implementation of policies and inability to educate the locals with such community-wide problems.

In the context of this problem in the process of its further development, the inefficiency of intervention will add to its consequences on the general health condition of the population, particularly in disadvantaged communities. There is an immediate need for multi-level interventions between regulatory changes, digital content control, harm-reduction education, and outreach that should be gender- and age-based. Short- and long-term solutions can be found in providing consumers with means of verification and incorporating anti-doping literacy into their daily lives. In conclusion, the misuse of PES needs to be addressed differently as a preventative health issue rather than a deviant behavior to be governed by structural inequalities and information deficiency. Such a shift is essential to reduce preventable health burdens, address socio-digital misinformation, and inform ethical and equitable public health policy.

## Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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