

# Influence of knowledge and beliefs on consumption of performance enhancing agents in north-western Saudi Arabia

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**BACKGROUND:** Consumption of performance enhancing agents (PEAs) has a wide range of negative health consequences, but knowledge of these consequences among gym users of PEAs in Saudi Arabia is not well understood.

**OBJECTIVES:** Identify the knowledge, awareness, beliefs and attitudes of gym users about negative health consequences of using PEAs, and the relationship between these factors and use of these agents.

**DESIGN:** Cross-sectional study.

**SETTING:** Five gyms in Madinah city, Saudi Arabia.

**SUBJECTS AND METHODS:** Convenience sampling was used to recruit gym users. An electronic self-administered questionnaire was used to collect data.

**MAIN OUTCOME MEASURE(S):** Level of knowledge about the negative health consequences of PEAs among gym users.

**RESULTS:** About 70% of 316 participants had used one or more of PEAs over the last six months. Of those, about 68.4% used protein powder supplements and 48.1% used energy drinks. Participants who believed that protein powder supplements ( $\chi^2=52.3$ ,  $P<.01$ ) and energy drinks ( $\chi^2=35.2$ ,  $P<.01$ ) had health hazards used these agents less often than others during the six months preceding data collection. Participants who had less knowledge about the negative health consequences were more likely to use protein powder supplement ( $t=2.38$ ,  $P=.018$ ). On the other hand, those who were more knowledgeable about the negative health consequences of insulin, were more likely to use insulin ( $t=2.45$ ,  $P=.015$ ).

**CONCLUSION:** Misuse of PEAs is widespread among gym users in Saudi Arabia. Improving the level of knowledge and awareness of possible serious health consequences would hopefully lead to reduced PEA consumption.

**LIMITATIONS:** The temporal sequence of cause and effect could not be determined in a cross sectional study. Convenience sampling in a single city limited the generalizability of the findings to all regions of Saudi Arabia.

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Performance-enhancing agents (PEAs) are nutritional and/or pharmacological agents that are used by gym users to enhance performance and/or improve personal appearance.<sup>1</sup> These agents are also called performance- and image-enhancing agents.<sup>2</sup> The most popular of these agents are the anabolic-androgenic steroids (AAS) hormones, stimulants, and diuretics.<sup>3,4</sup> PEAs have wide range of negative health consequences and may lead to death.<sup>5</sup> Recently, the increasing interest in body fitness and bodybuild-

ing among young male adults has been accompanied by an increase in consumption of PEAs. However, there is a lack of awareness about the effects of PEAs on health.<sup>6-8</sup> The World Anti-Doping Agency, established in 1999, regulates and controls consumption of prohibited substances.<sup>9</sup> In Saudi Arabia, doping agents are prohibited. In 2004, an independent national anti-doping organization called the Saudi Arabia Anti-Doping Committee was established to regulate and monitor the use of doping agents.<sup>10</sup>

Only three published reports have assessed the prevalence AAS and prohibited substances use (doping) among athletes and other sports players in Saudi Arabia.<sup>11-13</sup> A few studies have assessed the adolescent and student knowledge, attitudes, and beliefs about use of energy drinks.<sup>14-17</sup> No published articles were found that addressed the knowledge, awareness, beliefs and attitudes (KABA) of gym users about the negative health consequences of using PEAs. Al Ghobain et al concluded that some Saudi athletes use PEAs despite being aware of the punishment for using prohibited substances.<sup>11</sup> Jabari et al reported that there is a lack of knowledge about AAS side effects among Saudi athletes, and also reported that most athletes ignored the side effects and continued using them to enhance body shape.<sup>12</sup> Alshammari et al reported that 26% of Saudi participants reported they stopped using hormones because of side effects.<sup>13</sup> In previous Saudi studies that investigated knowledge and attitudes about energy drinks, the majority of the participants were males and started using energy drinks at adolescence. They were influenced by advertisements on media and friends or family members.<sup>14-17</sup> Also, the participants had a lack of knowledge of the presence and effects of caffeine in energy drinks,<sup>16</sup> and the adverse side effects of these energy drinks on blood pressure, blood glucose level, heart rate, and menstruation cycle.<sup>17</sup>

The specific objectives of this study were to: 1) identify the prevalence of use of PEAs among gym users in Madinah; 2) determine gym user knowledge and attitudes on the negative health consequences of using PEAs; 3) identify the relationship between the beliefs about the possible hazards of PEAs and use over the last six months; and 4) identify the association between knowledge of the negative health consequences and use of PEAs.

## SUBJECTS AND METHODS

In this descriptive, cross-sectional study, data was collected by means of a structured questionnaire developed by the researchers based on a review of previous studies<sup>5,6,11</sup> and the updated Swedish clinical guidelines on the abuse of AAS and other hormonal drugs.<sup>7</sup>

### *Instrument*

The questionnaire consisted of three sections: the first section was designed to assess knowledge and attitudes toward PEAs; the second section assessed beliefs about use of some popular PEAs used in Saudi Arabia; the third section assessed the knowledge and awareness of possible negative health consequences of PEAs. In the third section, participants responded on a 5-point

Likert subscale (1=strongly disagree; 2=disagree; 3=neither agree nor disagree, 4=agree; and 5=strongly agree). To enhance the presentation and interpretation of findings, the researchers combined "strongly disagree" and "disagree", and "strongly agree" and "agree". Based on an English literature search,<sup>5,7,8,11</sup> the researcher developed the questionnaire in English. The questionnaire was then translated to Arabic, and back translated to English by an accredited bilingual translator. This bilingual translation is recommended in the translation of questionnaires for behavioral and clinical researchers to validate the questionnaires.<sup>19</sup> To assess the content validity a panel of three experts (specialists in sport medicine and community health studies) were asked to rate each item of the questionnaire by using a four-point ordinal scale as: 1=not relevant; 2=somewhat relevant; 3=quite relevant; and 4=highly relevant. For each item, the researchers summed the total score and divided each score by three (the total number of experts). Items rated less than 60% were excluded from the questionnaire.

### *Sampling*

Male gym users were recruited using convenience sampling. The inclusion criteria were that participants be young adult males (between 18 and 35 years old) who had used the gym for at least the last 6 months, and were able to speak, write and understand Arabic. Any gym user who participated in national or international sport competitions was excluded from participation. Participants were recruited from five gyms in Madinah. The five gyms were chosen by manual random selection from a list of all gyms identified using the Google search engine.

A statistical power analysis estimated that a minimum of 246 participants were required for a power of 0.80,  $P=.05$ , and a moderate effect size (0.30).<sup>20,21</sup> Based on the estimated sample size, 340 participants were asked to participate in this study, but 24 refused, leaving 316 subjects who completed the electronic questionnaire.

### *Data collection*

Institution review board approval was obtained from the Research Ethics Board at Taibah University. Researchers interviewed gym users individually in the selected gyms. After explaining the objectives, and the inclusion and exclusion criteria, eligible gym users who met the inclusion criteria were invited to participate in this study. Moreover, an explanation sheet stating the objectives and inclusion/exclusion criteria was provided to eligible subjects to confirm that they understood the

eligibility and detailed information about this study. The researchers' contact information and a consent form was attached to the questionnaire. All participants gave verbal consent to participate. They were informed that data would be kept confidential, and that participation was voluntary and they could withdraw at any time. To ensure anonymity, personal contact information, demographics and work-related data were not collected.

All eligible participants were asked to complete the self-administered electronic questionnaire using iPads and other mobile devices. The participants took between 10 and 15 minutes to complete the self-administered questionnaire. The data was collected between 5 June 2016 and 4 August 2016.

### *Pilot study*

After measuring the content validity by panel experts and obtaining formal approval to conduct this study, the questionnaire was piloted to assess its reliability. Ten eligible gym users were recruited through announcement at Taibah university campus. They were invited for voluntary participation to measure the reliability of the questionnaire. The participants were asked about clarity, readability, and understanding of the questionnaire. Moreover, they were asked to provide additional comments as part of developing and improving the instrument. One of the significant comments was not to collect personal data to increase the response rate of participants. Cronbach's alpha test indicated high internal reliability (Cronbach's Alpha=0.93). Participants reported that the questionnaire was clear and easy to complete. Data from this pilot study was not included in the current study.

### *Data analysis*

Data was analyzed by using SPSS version 22, (IBM, Armonk, NY United States). Frequencies and descriptive statistics including means, standard deviation, and ranges were used to describe the knowledge, awareness, beliefs and attitudes of participants about using PEAs. Chi-square analysis was used to identify the relationship between beliefs about the hazards of PEAs and use of PEAs. An independent t test analysis was conducted to identify the association between the use of PEAs and knowledge of the negative health consequences of these agents.

## RESULTS

The 316 males who participated in the study were aged between 18 and 35 years old, were fluent in the Arabic language, and had been practicing in a gym for at least 6 months. Approximately, 69% of the participants

received suggestions to use PEAs to enhance performance (**Table 1**). Most of these suggestions were provided by friends (50.7%) or a gym trainer (38.5%). About 70.6% of the participants reported that PEAs were easily accessible. Approximately 70% of the participants used PEAs during the last 6 months. Two-thirds of the participants (68.4%) used protein supplements, and 48.1% used energy drinks over the last 6 months. About 82% of the participants reported that they used more than one of the PEAs over the last six months.

Most of the participants believed that protein supplements (79.1%), and energy drinks (54.1%) helped enhance performance (**Table 2**). About two-thirds of participants (67.4%) believed that human growth hormone (hGH), testosterone (66.8%), and insulin (64.9%) would harm gym users. Of all participants, 78.8% reported having exposure to education about the risks of PEAs. Only half of the participants were aware that using testosterone hormone in males may lead to disruption of puberty (52.8%), breast tissue development (51.3%), and male pattern baldness (50.9%) (**Table 3**). Similarly, about half of participants were aware that diuretics may cause dehydration (61.1%), muscle cramps (51.2%), and a decrease in blood pressure (54.1%). Only about one-third of the participants were aware that using hGH may cause severe headaches (37.2%), and loss of vision (31.1%). About two-thirds (64.3%) reported that they strongly agreed or agreed that insulin might lead to hypoglycemia. About half of the participants were aware that using protein supplements may lead to imbalanced nutrition (43.7%), digestive problems (49.4%), and heart and kidneys disorders (49.3%). About 60 percent were aware that energy drinks might cause dependence, and 253 (80%) were aware that energy drinks might cause insomnia.

Use of protein supplements and energy drinks over the last six months was significantly associated with the beliefs about the possible hazards of these PEAs (**Table 4**). Most of the participants who used protein supplements (85.6%) and energy drinks (62.5%) over the last six months, did not believe that using these agents would cause harm. There was a significant difference in knowledge of negative health consequences of using insulin between subjects who used insulin and those who did not over the last six months (**Table 5**). Another significant difference was found in knowledge of negative health consequences of protein supplements between subjects who used supplements and those who did not.

## DISCUSSION

Most of the participants reported that friends and gym trainers were the primary source of suggestions to use

**Table 1.** Gym user attitudes on use of performance enhancing agents.

Has anyone ever suggested that you try drugs to enhance your performance or to change your appearance?	n	%
Yes	218	69.0
No	98	31.0
<b>Who suggested use of PEAs?</b>		
Friend	112	50.7
Gym trainer	85	38.5
Relative	14	6.3
Health professional	10	4.5
<b>Are PEAs easily accessible?</b>		
Yes	223	70.6
No	42	13.3
I do not know	51	16.1
<b>Have you ever used PEAs (nutritional supplements, drugs, hormones, and medications) during the last 6 months?</b>		
Yes	22	70.2
No	94	29.8
Have you used one or more of the following agents over the last six months to enhance your training performance?	Yes n (%)	No n (%)
Testosterone	36 (11.4)	280 (88.6)
Diuretics	30 (9.5)	286 (88.3)
Glucocorticosteroids	12 (3.8)	304 (96.2)
Human growth hormone	21 (6.6)	295 (93.4)
Insulin	19 (6.0)	297 (94.0)
Protein powder supplements	216 (68.4)	100 (31.6)
Energy drinks	152 (48.1)	164 (51.9)
<b>Have you used more than one of these PEAs over the last six months?</b>	<b>228 (82.2)</b>	<b>88 (27.8)</b>

**Table 2.** Gym user beliefs on the use of performance enhancing agents.

Do you think that any of the following will help gym users perform better?	Yes n (%)	No n (%)	Do not know n (%)
Testosterone	143 (45.3)	93 (29.4)	80 (25.3)
Diuretics	75 (23.7)	147 (46.5)	94 (29.7)
Glucocorticosteroids	45 (14.2)	157 (49.7)	114 (36.0)
Human growth hormone	138 (43.7)	105 (33.2)	73 (23.1)
Insulin	84 (26.6)	133 (42.1)	99 (31.4)
Protein powder supplements	250 (79.1)	39 (12.3)	26 (8.5)
Energy drinks	171 (54.1)	119 (37.7)	26 (8.2)
<b>Do you think that any of the following will hurt you in any way if you use them?</b>			
Testosterone	211 (66.8)	29 (9.2)	76 (24.0)
Diuretics	189 (59.8)	43 (13.6)	84 (26.6)
Glucocorticosteroids	203 (64.2)	20 (6.3)	93 (29.4)
Human growth hormone	213 (67.4)	42 (13.3)	61 (19.3)
Insulin	205 (64.9)	32 (10.1)	79 (25.0)
Protein powder supplements	84 (26.6)	203 (64.2)	29 (9.2)
Energy drinks	173 (54.7)	106 (33.5)	37 (11.7)
Exposure to education about risks of using PEAs	Yes n (%)	No n (%)	
Have you gained knowledge about the risks of PEAs from formal/informal sources (e.g., TV, internet, ..etc.)?	249 (78.8)	67 (21.2)	

**Table 3.** Gym user knowledge and awareness of negative health consequences of using performance enhancing agents (PEAs).

<b>Using testosterone hormone on males may lead to the following negative health consequences:</b>	<b>Agree or strongly agree n (%)</b>	<b>Neither agree or nor disagree n (%)</b>	<b>Disagree or strongly disagree n (%)</b>
Acne	172 (54.4)	113 (35.8)	31 (9.8)
Male pattern baldness	161 (50.9)	113 (35.8)	42 (13.3)
Liver Damage	174 (55.0)	106 (33.5)	36 (11.4)
Stunted growth and disruption of puberty	167 (52.8)	99 (31.3)	50 (15.8)
Increased aggressiveness and sexual appetite	181 (57.2)	82 (25.9)	53 (16.8)
Depression	162 (51.3)	100 (31.6)	54 (17.1)
Breast tissue development	164 (51.3)	95 (30.1)	59 (18.7)
Shrinking of the testicles	188 (59.5)	93 (29.4)	35 (11.1)
Impotence	200 (63.3)	67 (21.2)	49 (15.5)
Reduction in sperm production	187 (59.1)	75 (23.7)	54 (17.1)
<b>Using diuretics by gym users may lead to the following negative health consequences:</b>			
Dehydration	193 (61.1)	106 (33.5)	17 (5.4)
Muscle cramps	173 (51.2)	120 (38.0)	34 (10.7)
Dizziness or fainting	168(53.2)	120 (38.0)	28 (8.8)
Drop in blood pressure	171 (54.1)	121 (38.3)	24 (7.6)
Loss of coordination and balance	155 (49.0)	127 (40.2)	34 (10.7)
<b>Using human growth hormone may lead to the following negative health consequences:</b>			
Severe headaches	113 (37.2)	159 (52.3)	32 (10.5)
Loss of vision	96 (31.1)	159 (50.5)	54 (17.5)
Acromegaly (Protruding or enlarged jaw, brow, skull, hands and feet)	182 (58.3)	102 (32.7)	28 (8.9)
High blood pressure and heart failure	175 (56.5)	110 (35.5)	25 (8.0)
Diabetes and tumors	145 (46.5)	131 (42.0)	36 (11.5)
Crippling arthritis	125 (40.5)	143 (46.3)	41 (13.3)
Using Insulin may lead to:			
Low blood sugar (hypoglycaemia)	203 (64.3)	105 (33.2)	8 (2.6)
<b>Using protein powder supplements may lead to the following negative health consequences:</b>			
Imbalanced nutrition	138 (43.7)	41 (13.0)	137 (43.4)
Digestive problems	156 (49.4)	34 (10.8)	126 (39.8)
Weight gain	205 (64.8)	24 (7.6)	84 (26.6)
Heart and kidneys disorders	156 (49.3)	45 (14.2)	115 (36.4)

**Table 3. (cont.)** Gym user knowledge and awareness of negative health consequences of using performance enhancing agents.

Using stimulants (e.g., energy drinks) may lead to the following negative health consequences:	Agree or strongly agree n (%)	Neither agree or nor disagree n (%)	Disagree or strongly disagree n (%)
Insomnia	253 (80.0)	42 (13.3)	21 (6.7)
Anxiety	244 (77.2)	39 (12.3)	33 (10.4)
Weight loss	176 (55.7)	77 (24.4)	63 (20.0)
Dependence and addiction	191 (60.5)	48 (15.2)	77 (24.4)
Dehydration	166 (52.5)	75 (23.7)	75 (23.8)
Tremors	151 (47.8)	103 (32.6)	62 (19.6)
Increased heart rate and blood pressure	250 (79.1)	42(13.3)	24 (7.6)
Increased risk of stroke, heart attack, and cardiac arrhythmia	210 (66.5)	72 (22.8)	34 (10.7)

**Table 4.** Relationship between gym user beliefs about hazards of performance enhancing agents and use over the last six months.

Gym users believe that the following PEAs are: harmful (Yes) / none harmful (No)		Used the following agent over the last six months		Chi square test statistic	P value
		Yes n (%)	No n (%)		
Testosterone	Yes	25 (69.4)	186 (66.4)	0.13	.85
	No	11 (30.6)	94 (33.6)		
Diuretics	Yes	15 (50.0)	174 (60.8)	1.33	.33
	No	15 (50.0)	112 (39.2)		
Glucocorticosteroids	Yes	8 (66.7)	195 (64.1)	0.03	.99
	No	4 (33.3)	109 (35.9)		
Human growth hormone	Yes	14 (66.7)	199 (67.5)	0.06	.99
	No	7 (33.3)	96 (32.5)		
Insulin	Yes	14 (73.7)	191 (64.3)	0.69	.47
	No	5 (26.3)	106 (35.7)		
Protein powder supplements	Yes	31 (14.4)	53 (53.0)	52.3	<.001
	No	185 (85.6)	47 (47.0)		
Energy drinks	Yes	57 (37.5)	116 (70.7)	35.2	<.001
	No	95 (62.5)	48 (29.3)		

2 by 2 cross tabulations, degrees of freedom=3.

PEAs. In addition, they reported easy access to PEAs in Saudi Arabia. These findings are consistent with previous studies in Saudi Arabia,<sup>11,13,16,17,22</sup> and other Arab countries such as Jordan.<sup>23</sup> Lack of regulation of PEAs, particularly AAS, is generally common in the majority of Arab countries.<sup>24</sup> In this study, more than two-thirds of the participants reported using one or more PEAs to enhance performance and body image. These findings were similar to previous Saudi study.<sup>13</sup> Many Saudi gym users consume a range of PEAs that increase muscle growth, reduce body fat, and increase physical endurance.<sup>11,12,25-27</sup> The high intake of PEAs among the participants (70.2%) in this study is higher than in previous Saudi reports<sup>13</sup> and similar to a Kuwaiti study (58%).<sup>26</sup> A study in the United States by Hildebrandt et al<sup>28</sup> indicated that 94% of PEAs users regularly took at least one AAS and testosterone use was most common (90.3%). PEA use is risky, especially since most users take these agents over-the-counter without medical supervision or even dietary counseling.<sup>5,7,24</sup>

Each type of PEA varies in negative side effects and complications; however, there are similar and overlapping side effects based on the nature of these agents.<sup>29,30</sup> For example, the negative side effects of AAS include high blood pressure, liver and heart prob-

lems, and growth of breast tissue, hair loss, shrinking testicles and prostate problems.<sup>7,29,31-33</sup>

Despite knowing the negative side effects of PEAs,<sup>7,31,33</sup> participants had a knowledge deficit about the possible harms of PEAs. Sometimes knowledge was not enough to stop them from consuming some agents. At the same time, knowledge and awareness of possible negative side effects and health hazards of all types of PEAs was slightly better than in other similar studies in Saudi Arabia,<sup>12</sup> and other parts of the Arab world.<sup>6,24,25</sup> Jabari et al (2016) reported that only 40% of Saudi gym users had complete knowledge of the harmful side effects of AAS.<sup>12</sup> About half of AAS users had knowledge deficits about hazards of AAS in a Kuwaiti study.<sup>25</sup> In a previous Emirati study, the participants were unaware of the side effects of AAS.<sup>6</sup> Moreover, a knowledge deficit on the effects of PEAs also existed in other populations including Australian,<sup>34</sup> Swedish,<sup>35</sup> and Americans.<sup>36</sup>

The finding that participants did not believe in harmful effects was similar to a previous Kuwaiti study.<sup>25</sup> The most important contributing factor for using AAS among male gym users in Kuwait was the perceived need to achieve the goals in enhancing sport performance and bodybuilding. Despite beliefs about the

**Table 5.** Relationship between gym user knowledge and awareness of negative health consequences and use of performance enhancing agents.

Knowledge about risks of using PEAs	Subjects using the following agent over the last six months		t test statistic	P value
	Yes mean (SD)	No mean (SD)		
Total score of knowledge about negative health consequences of using testosterone	35.97 (10.31)	36.52 (8.32)	0.36	.72
Total score of knowledge about negative health consequences of using diuretics	18.83 (5.65)	18.58 (4.53)	- 0.24	.81
Total score of knowledge about negative health consequences of using human growth hormone	21.57 (5.77)	20.51 (5.47)	- 0.85	.39
Total score of knowledge about negative health consequences of using insulin	12.58 (2.63)	11.15 (2.44)	- 2.45	.015
Total score of knowledge about negative health consequences of using protein powder supplements	12.04 (4.62)	13.37 (4.55)	2.38	.018
Total score of knowledge about negative health consequences of using energy drinks	15.08 (4.20)	15.71 (2.22)	1.48	.14

Degrees of freedom for each test=314

harms of using AAS, they did not consider the harm as the most influencing factor in deciding to use ASS or not.<sup>25</sup>

The findings of this study confirmed that the high prevalence of protein supplement and energy drink use may be influenced by the beliefs of no health hazards of these PEAs. Improving gym users perceived self-efficacy by enhancing their knowledge and awareness of the negative effects of PEAs could be helpful to reduce PEAs consumption.<sup>8,37,38</sup> Therefore, establishing properly structured health education programs as well as providing cognitive behavioral therapy are recommended to reduce the unregulated use of PEAs.<sup>8,37</sup>

Participants who had more awareness of the negative health consequences of insulin were more likely to use it. This finding indicated that regardless of knowledge about health hazards of insulin, the gym users in this study insisted on using insulin to enhance body image/ performance. This finding is similar to that from previous Australian<sup>34</sup> and American<sup>36</sup> studies where the participants declared that they would take PEAs to enhance sport performance and body image, despite health hazards or complications or even shortened life.<sup>36</sup> Many scientists have stated that use of supplements and PEAs for sports is a serious medical and behavioral concern because of possible health hazards, particularly for adolescents and young adults. In addition to the health hazards and complications, PEA use may eventually act as a gateway to use of illegal substances.<sup>34,39,40</sup> This again confirms that knowledge alone is not enough if it does not change beliefs about harm. Therefore, preventive health education for gym users are needed.

Research towards preventing use of PEAs might involve use of self-efficacy theory.<sup>37</sup> Advice on healthy sport practices—nutrition, and maintaining fluid balance may help gym users achieve desired goals without risk. A combination of traditional cognitive approaches and affective education programs are recommended to prevent use of PEAs.<sup>41</sup> Use of social and mass media are also recommended to enhance knowledge of the health hazards of PEAs. We also recommend that involvement of gym instructors and trainers in proper health education programs to influence gym

users against the use of PEAs, and to encourage gym users to use healthy and safe alternatives to achieving fitness-related goals. Likewise, using gym trainers as a role model will be helpful.<sup>38</sup> Another important factor is the significant influence of others such as family, peers, and friends in providing social support to help gym users in taking a decision to stop using PEAs. Health professionals can provide supportive counseling and motivational interviewing intervention during clinical examination of adolescents in primary health care institutions, or during school visits as well as community education programs.<sup>7,42</sup> The availability and easy accessibility of healthy drinks such as milk and natural juices at gym centers instead of unhealthy drinks such as energy drinks are very important to decrease the use of unhealthy choices. In addition, proper regulation of PEAs and untested nutritional supplements must be considered in relation to the availability, sales, marketing and supply to gym users.<sup>7,43,44</sup> This issue must be examined carefully by the Saudi Food and Drug Authority.

The cross-sectional design prevented identification of causality between outcome and independent variables related to the use of PEAs and beliefs and knowledge of the health hazards. Moreover, convenience sampling limited the generalizability of the finding to all regions of Saudi Arabia. Further experimental and longitudinal studies are needed to examine the effectiveness of interventions in quitting or preventing use of PEAs among gym users in Saudi Arabia.

#### **Conflict of interest**

*The authors declare no conflicts of interest.*

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