

# A Cross-Sectional Study on Knowledge, Attitudes, and Practices (KAP) toward Sport Supplements and Doping Agents in the Jordanian Community

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Received October 5, 2023; Revised November 30, 2023; Accepted December 22, 2023

## Cite This Paper in the Following Citation Styles

(a): [1] Ali Qoqazeh, Ala'a Al-Bakheit, Hadeel Ghazzawi, "A Cross-Sectional Study on Knowledge, Attitudes, and Practices (KAP) toward Sport Supplements and Doping Agents in the Jordanian Community," *International Journal of Human Movement and Sports Sciences*, Vol. 12, No. 1, pp. 84 - 98, 2024. DOI: 10.13189/saj.2024.120111.

(b): Ali Qoqazeh, Ala'a Al-Bakheit, Hadeel Ghazzawi (2024). A Cross-Sectional Study on Knowledge, Attitudes, and Practices (KAP) toward Sport Supplements and Doping Agents in the Jordanian Community. *International Journal of Human Movement and Sports Sciences*, 12(1), 84 - 98. DOI: 10.13189/saj.2024.120111.

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**Abstract** Increasing the level of society's knowledge toward sports supplements and doping agents has clear benefits, including improving athletic performance and avoiding the side effects of these substances. This study used the KAP approach to determine the Jordanian community's knowledge, attitudes, and practices (KAP) toward sports supplements and doping agents. A prospective cross-sectional study based on a valid, reliable questionnaire was conducted, and 400 adult participants were recruited. The questionnaire consisted of four parts: individual characteristics, knowledge, attitudes, and practices toward supplements and doping agents. The results showed that the knowledge score was 62.00%, attitudes were 83.00%, and practices were 80.00% among the Jordanian community. The society categories that had the best knowledge scores toward sports supplements and doping agents were older adult age group 51-64 years ( $P < 0.05$ ), and nonsmoking individuals ( $P < 0.05$ ). No significant differences were found among society categories concerning attitudes score. Also the highest practice scores were the participant's monthly salary group of 500-1,000 JOD ( $P < 0.05$ ) and individuals in the southern region ( $P < 0.05$ ). This study concluded that the Jordanian community has moderate knowledge, positive attitudes, and good practices toward sports supplements and doping agents.

**Keywords** KAP, Sports Supplements, Ergogenic

Aids, Doping Agents, Sports Nutrition

## 1. Introduction

Sports supplements are products that are taken orally in pill or powder form and are intended to supply energy, replenish micronutrients, and provide building blocks for building muscle protein, enhancing adaptability and recovery [1], [2]. In sports, using dietary supplements (DS) is highly common, especially among young players, and athletes think that these supplements supply extra nutrients that are considered essential for sports performance and enhancing muscle gains [3].

Many nutrition items are promoted with the promise that they will enhance performance and optimize player wellness and functioning [4]. Sports supplements can be sold as "athletic supplements" or "nutritional supplements," and they are consumed for training and competition performance, training adaptability, and recovery, along with enhancing immune system performance [4]. Athletes' nutritional requirements should not be achieved by using athletic food products solely. Sports supplements can be used as an option when the food intake does not cover the athlete's nutritional requirements [4]. High-intensity exercise such as running

and racing walks can elevate the energy depletion and loss of some nutrients, such as water and minerals. As a result, athletes commonly use supplements, such as sports and energy beverages and protein bars or powder to prevent deficiency [1]. Regular balanced meals can replace the use of some of these supplements, for example, protein-dense recovery beverages can be effectively substituted by significantly less expensive dairy food products, such as skimmed milk [4]. However, despite their high price, sports supplements are still used, which can be attributed to the fact that they contain only the nutrients required for training, but regular food provides additional nutrients like lipids and fiber, which can upset the stomach during performance. Therefore they are not desirable during competition [4].

Nutritional supplements are commercially available over the counter and do not need a prescription [5]. Currently, there are more than 55,000 supplements already available on the market [5]. The total sales of athlete supplements reached over 50 billion dollars in 2019, and they are expected to exceed 90 billion dollars by 2023 [5]. The regulations of the Food and Drug Administration (FDA) for the sector of nutrition supplements are less strict than those governing pharmaceuticals. Therefore, the risk of contaminated or adulterated supplements with hazardous components is high [5].

Some athletes are susceptible to using other types of performance-enhancing substances (PES), such as doping agents. Doping is defined as consuming a substance or following a strategy that can improve participants' performance but might harm their health. Therefore, their use has been prohibited and considered unethical [6]. The word "doping" is often used by regulatory agencies and sporting events arranged by organizations like The World Anti-Doping Agency (WADA) and the International Olympic Committee [7]. Unfortunately, doping agents are seen as an effective strategy for achieving tremendous success in sports, whether for non-competitive or competitive training, and their use has been more common among weightlifters and bodybuilders [6].

To gain a competitive edge, some competitors use and misuse illicit substances [7]. Since the use of doping agents is increasing, especially among young people and amateur players, it has become a growing social and public health issue [1], [8]. The WADA updates the doping ingredients database annually [7]. Using unusual substances as a performance-enhancing drug can have long-term detrimental effects and aberrant body adaptations. The danger is increased if such PES are used without sufficient physician follow-up [6]. Doping is phenomenal and does not have any information drawn from clinical studies. The necessary information about doping agents comes from professionals through anti-doping inspections and governmental authorities' requests for reports about banned substances in amateur competitions [7].

Doping is a form of cheating. Each sport has unique critical elements of athletic performance: skill, strength, endurance, and recovery. Doping agents manipulate these elements to achieve powerful and successful performances. For example, hemoglobin boosting improves the capability of training tissues to use oxygen, and therefore it is considered effective in sports that demand endurance. Androgen doping agents, another example, are used for games that require massive power due to their influence on boosting muscle development and strength. Growth hormone is another doping agent which may also improve performance in some sports requiring vigorous training by accelerating tissue healing after injury [9]. Most doping (90%) is a medical substance often used in health care; they're not drugs synthesized for athletes as it is commonly believed [7]. Diuretics, boosters, and hormonal drugs are all on the WADA's list of illegal substances [1].

In Jordan, it was noticed that sports supplements and doping agents are used by people who lack enough knowledge. They use them to improve performance, maximize energy, and improve body shape without looking at their health side effects. Also, it was noticed that the use of these agents was without medical approval. Instead, people relied on information from social media or advice from gym coaches who had no scientific background or knowledge. In addition, it was noticed that hormones, such as testosterone and growth hormones, are sold by pharmacies without a prescription or restrictions. According to the Jordan Food and Drug Administration (JFDA), testosterone and growth hormone are not mentioned in the controlled drugs list. Also, personal communication showed that some steroids are sold in gyms without permission. It is important to note that studies on the use and awareness of sports supplements and doping agents are limited in Jordan and that it has been noticed that the use of supplements and anabolic steroids is significantly increasing in Jordan.

This study hypothesizes that the knowledge of sports supplements and doping substances is poor, attitudes are negative, and consumption and misuse are high.

This study provided information about what individuals know, believe, and do regarding these substances. Thus, the study aimed to evaluate the knowledge, attitudes, and practices (KAP) of sports supplements and doping agents in the Jordanian community, assess the link between the individual characteristics and KAP of sports supplements and doping agents, and determine the association between KAP variables.

This study is important because it reveals the level of awareness about sports supplements and doping agents among the Jordanian community. Also, this study might draw the government's attention to the use of doping agents and sports supplements in Jordan, thereby prompting more restrictions regarding their use and registration and monitoring their sale and distribution. Furthermore, the current study provides findings and

literature for future research on KAP of sports supplements and doping agents.

## 2. Materials and Methods

A prospective cross-sectional study was conducted in Jordan from December 2022 to January 2023. The target population was given structured questionnaires randomly delivered online using convenience sampling. The inclusion criteria for the participants are that individuals can read and write in Arabic, Jordanians live in Jordan and are male and female aged between 18 and 64 years old. The exclusion criteria are age less than 18 years old and above 64 years old and the individual did not approve the consent.

### 2.1. Participants

The estimated number of subjects in our survey was 400 individuals. One sample proportion with 95% confidence intervals ( $\alpha$ ) was used, assuming response rate ( $p$ ) to be 50%, and 5% margin of error ( $e$ ). The formula:  $n = z^2 * p * (1 - p) / e^2$  was used to calculate the sample size ( $n$ ). Where:  $p$  = proportion (expressed as a decimal),  $z = 1.96$  with a confidence level ( $\alpha$ ) of 95%,  $e$  = margin of error.  $z = 1.96$ ,  $p = 0.5$ ,  $e = 0.05$   $n = 1.96^2 * 0.5 * (1 - 0.5) / 0.05^2 = 384.16$ . This study aims to include 400 participants.

### 2.2. Questionnaire

The validated questionnaire was used to determine and evaluate the Jordanian community's knowledge, attitudes, and practices (KAP) toward sports supplements and doping substances. The information in this study was collected using a modified questionnaire. The questionnaire was constructed based on previous studies [6], [10], [11], [12], adopted, and modified according to the study criteria, and the target audience for this study (i.e., Jordanian population).

The questionnaire was divided into four sections.

Section 1 collected information about the participant's characteristics and lifestyle factors, including age, sex, educational level, household income, region, smoking, and medical conditions. Section 2 contained "yes" and "no" questions about knowledge (nine questions) regarding sports supplements and doping substances. This part collected information about the contamination of sports supplements, the information on the food label, the classification of sports supplements, consequences due to positive doping tests, food-drug interaction, the safety of sports supplements, anti-doping agencies, and the role of JFDA in ensuring the safety of sports supplements. Section 3 contains ten questions about attitudes toward using sports products and doping substances. This part collected information about the benefits and importance of sports supplements and doping agents, the risks of sports

supplements and doping agents, and the beliefs about the approved sources of knowledge. The respondents were asked to evaluate their attitudes and beliefs toward the questions using a 3-point Likert type scale (agree, neutral, and disagree). Finally, section 4 contains "yes" and "no" questions about practices (seven questions) toward sports products and doping substances. This part collected information about the prevalence of sports supplements and doping agents, reading the nutrition facts, asking about the side effects, and the effectiveness of friends/relatives and coaches on usage decisions.

The validity and reliability of the questionnaire were evaluated. First, the content was validated by experts, in which five academic nutrition researchers were asked to review the questionnaire and determine whether the questionnaire was straightforward or not and if they had any modifications or suggestions to make it more transparent. Second, a pilot study was conducted, where 50 participants who had the same characteristics as the study subjects were asked to fill out the questionnaire and answer whether the questionnaire was straightforward or not and if there were any suggestions or modifications needed. Accordingly, the questionnaire was revised and modified. Finally, the reliability of the questionnaire was assessed using Cronbach's alpha, which measures internal consistency. Cronbach's Alpha was 0.85, 0.85, and 0.83 for the knowledge, attitudes, and practices sections, respectively.

### 2.3. Statistical Analysis

Recruited study data of the knowledge, practice, and attitude (KAP) responses were analyzed using the SPSS, Version 25.0 (SPSS Inc., Chicago, IL, USA). The frequencies and percentages illustrate categorical variables of the participants' characteristics. Binary and nominal logistic regression determined the factors associated with the participants' knowledge, practice, and attitude toward sports supplements and doping agents. Results are presented as  $p$ -values, odds ratios (OR) and 95% confidence intervals (CI). The significant level ( $P < 0.05$ ) was considered. The Pearson correlation test examined the association between the KAP to each other. Results are presented as Pearson correlation coefficient. The significant level ( $P < 0.01$ ) was considered.

## 3. Results

This cross-sectional study was conducted in Jordan based on a questionnaire, and their responses about KAP of sports supplements and doping agents were collected from 400 participants using convenience sampling.

A total of 400 participants' responses were included in the study's analysis. Table 1 illustrates the characteristics of the participants. Most of the participants (90%) were under the age of 50 yrs. More than half of the study participants were female. The majority had academic

qualifications of diploma, bachelor's degree, higher diploma, master's degree, or PhD. However, the majority of them had a monthly income equal to or lower than 1,000 JD, and about 70% of them lived in the central region of Jordan. Most of the study participants were nonsmokers, with a percentage of 61.75%. Also, 80% of them were not users of chronic medications.

Most participants generally possess moderate knowledge, good attitudes, and good practices towards sports supplements and doping agents (Table 2).

The KAP mean score was evaluated based on a

previous study [13]; Knowledge and practice scores are classified into three groups. Group 1 has a score value of over 74% and is considered good. Group 2 represents percent values of 40-74% and is considered moderate. Group 3 represents score values below 40% and is considered low. For attitude scores, group 1 represents score values above 74% and is considered positive. Group 2 represents a score value of 40-74% and is considered neutral, while group 3 represents a score value below 40% and is considered negative.

**Table 1.** Study participants' characteristics

Variables	Categories	N (%)
Age (Years)	18-30	163 (40.75%)
	31-50	197 (49.25%)
	51-64	40(10.00%)
Sex	Male	174 (43.50%)
	Female	226 (56.50%)
Education level	High school or below	45 (11.25%)
	Academic qualification *	355 (88.75%)
Monthly income (JOD)	< 500 JOD	163 (40.75%)
	500-1000 JOD	162 (40.50%)
	> 1,000 JOD	75 (18.75%)
Region	Northern	65 (16.25%)
	Central	312 (78.00%)
	Southern	23 (05.75%)
Smoking	No	247 (61.75%)
	Yes	153 (38.25%)
Chronic medication uses	No	316 (79%)
	Yes	84 (21%)

\* Academic qualification: diploma, bachelor's degree, higher diploma, master's degree, or PhD.

**Table 2.** The frequency and score of the KAP response.

KAP Domain	Score Categories #	N (%) *
Knowledge	Poor knowledge (< 40)	19 (04.75%)
	Moderate knowledge (40-74)	288 (72.00%)
	Good knowledge (>74)	93 (23.25%)
Attitudes	Negative attitudes (< 40)	00.00 (00.00%)
	Neutral attitudes (40-74)	60 (15.00%)
	Positive attitudes (>74)	340 (85.00%)
Practices	Poor practices (< 40)	10 (02.50%)
	Moderate practices (40-74)	179 (44.75%)
	Good practices (> 74)	211 (52.75%)

\* N: total number of participants, N = 400; %: percentage of participants.

The number, percentage, and score of responses to KAP questions are illustrated in Table 3. The questions that showed good knowledge according to the response score were: sports supplements may contain banned substances (75.00%), the consequences of positive doping agents on athletes (91.50%), possible food-drug interaction between sports supplements and some medications (91.75%), the importance of drinking water when sports supplements are used (76.00%), and the role of the JFDA in the sports supplements' safety in the Jordan market (89.75%). One question showed moderate knowledge regarding hormones being categorized as sports supplements (47.50%). However, some of the questions showed poor knowledge, such as whether sports supplements undergo the integral process of content authorization and integrity tests before marketing (23.75%), whether the US-FDA is responsible for doping agents' control (29.50%), and whether the label information mentions all ingredients inside the products (34.50%).

The questions, which showed positive attitudes according to the response scores were the effectiveness of some sports supplements to enhance body shape (build muscle, lose fat) (87.00%), the effectiveness of some sports supplements to enhance physical performance during exercise (90.00%), the dangers and side effects of sports supplements (87.00%), the dangers and side effects of doping agents (94.00%), the effectiveness of anabolic

steroids to speed up the result of building muscle and losing fat (81.00%), the effectiveness of anabolic steroids to improve physical performance during exercise (85.00%), sports supplements are crucial to athletes even though diet is adequate for energy and nutrients (79.00%), the importance of using sports supplements under a nutritionist's supervision (86.00%), and sports supplements are considered important for all sport types (76.00%). The question that showed moderate attitudes was whether the coach's body shape and achievements are evidence of his/her possession of sufficient information (66.00%), as seen in Table 3.

Table 3 showed that in the questions that revealed good practices, 13.75% of participants took sports supplements, and 1.75% took doping agents. More than half of the participants (62.75%) cared and asked about the possible side effects of sports supplements, interaction with medicine, and the possibility of patients taking sports supplements. Also most of the participants (59.25%) cared and asked about the side effects of doping agents, interaction with medicine, and the possibility of patients taking doping agents. Most of the participants (88.25%) used to read the nutritional labels and ingredients before taking any products. The impact of coaches and relatives/friends on the tendency to administer sports supplements or steroid hormones was 23.5% and 12.25, respectively.

**Table 3.** KAP questions, responses, and scores of the participants

KAP	questions	Participant response	N (%) *	Response score #
Knowledge	1	No	100 (25.00%)	75
		Yes	300 (75.00%)	
	2	No	34 (08.50%)	92
		Yes	366 (91.50%)	
	3	No	33 (08.25%)	92
		Yes	367 (91.75%)	
	4	No	96 (24.00%)	76
		Yes	304 (76.00%)	
	5	No	95 (23.75%)	24
		Yes	305 (76.25%)	
	6	No	41 (10.25%)	90
		Yes	359 (89.75%)	
	7	No	118 (29.50%)	30
		Yes	282 (70.50%)	
	8	No	138 (34.50%)	35
		Yes	262 (65.50%)	
	9	No	190 (47.50%)	48
		Yes	210 (52.50%)	
Average score	-	-	-	62

Table 3. Continued

Attitudes	1	Disagree	28 (07.00%)	87
		Neutral	105 (26.25%)	
		Agree	267 (66.75%)	
	2	Disagree	21 (05.25%)	90
		Neutral	73 (18.25%)	
		Agree	306 (76.50%)	
	3	Disagree	28 (07.00%)	87
		Neutral	100 (25.00%)	
		Agree	272 (68.00%)	
	4	Disagree	141 (35.25%)	66
		Neutral	121 (30.25%)	
		Agree	138 (34.50%)	
	5	Disagree	12 (03.00%)	94
		Neutral	41 (10.25%)	
		Agree	347 (86.75%)	
	6	Disagree	49 (12.25%)	81
		Neutral	126 (31.50%)	
		Agree	225 (56.25%)	
	7	Disagree	41 (10.25%)	85
		Neutral	99 (24.75%)	
		Agree	260 (65.00%)	
	8	Disagree	73 (18.25%)	79
		Neutral	103 (25.75%)	
		Agree	224 (56.00%)	
	9	Disagree	35 (08.75%)	86
		Neutral	102 (25.50%)	
		Agree	263 (65.75%)	
	10	Disagree	54 (13.50%)	76
		Neutral	175 (43.75%)	
		Agree	171 (42.75%)	
Average score	-	-	-	83
Practices	1	No	345 (86.25%)	86
		Yes	55 (13.75%)	
	2	No	393 (98.25%)	98
		Yes	7 (01.75%)	
	3	No	149 (37.25%)	63
		Yes	251 (62.75%)	
	4	No	163 (40.75%)	59
		Yes	237 (59.25%)	
	5	No	47 (11.75%)	88
		Yes	353 (88.25%)	
	6	No	306 (76.50%)	77
		Yes	94 (23.50%)	
	7	No	351 (87.75%)	88
		Yes	49 (12.25%)	
Average score	-	-	-	80

\* N: total number of participants, N = 400; %: percentage of participants. # Data are shown as %. The response score is the score of all participants' answers per question that were classified into good, moderate, or poor responses. The indication of the question numbers is in Appendix A.

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**Table 4.** Binary and nominal Logistic regression analysis for the identified correlation between KAP and participants' categorical variables characteristics

Variables	Knowledge					Attitudes					Practices				
	Total score 5.59					Total score 24.97					Total score 5.59				
	95 % Confidence interval					95 % Confidence interval					95 % Confidence interval				
	P-value	B	odd ratio	Lower	Upper	P-value	B	odd ratio	Lower	Upper	P-value	B	odd ratio	Lower	Upper
<b>Age ()</b> (Ref=51-64)															
<b>18-30</b>	0.041*	-2.53	0.08	0.007	0.908	0.316	0.722	2.059	0.502	8.454	0.993	0.009	1.009	0.143	7.121
<b>31-50</b>	0.312	-1.217	0.296	0.028	3.131	0.749	0.223	1.249	0.319	4.899	0.221	-1.187	0.305	0.046	2.044
<b>Sex</b> (Ref=Female)															
<b>Male</b>	0.616	0.351	1.421	0.359	5.622	0.952	-0.025	0.975	0.434	2.192	0.739	-0.18	0.835	0.291	2.401
<b>Education level</b> (Ref=High school or below)															
<b>Academic qualification <sup>1</sup></b>	0.071	2.028	7.599	842	68.589	0.153	-0.983	0.374	0.097	1.443	0.233	0.974	2.647	0.535	13.11
<b>Monthly income</b> (Ref= <500 JOD)															
<b>500-1000 JOD</b>	0.949	0.059	1.061	0.227	4.951	0.932	-0.039	0.961	0.391	2.366	0.023*	1.39	4.014	1.213	13.28
<b>&gt; 1000 JOD</b>	0.216	1.182	15.937	0.501	21.21	0.949	0.036	1.512	0.341	3.149	0.541	-0.447	0.993	0.153	2.679
<b>Region</b> (Ref=Northern <sup>2</sup> )															
<b>Central <sup>3</sup></b>	0.006*	2.769	3.261	2.235	113.6	0.458	0.414	1.036	0.508	4.499	0.992	-0.007	0.639	0.243	4.058
<b>Southern <sup>4</sup></b>	0.458	1.381	3.977	0.104	151.9	0.665	0.458	1.58	0.199	12.52	0.018*	3.842	46.61	1.958	1110
<b>Smoking</b> (Ref=No)															
<b>Yes</b>	0.001*	-2.452	0.086	0.02	0.378	0.222	0.532	1.702	0.725	3.995	0.29	0.593	1.809	0.603	5.431
<b>Medication uses</b> (Ref=No)															
<b>Yes</b>	0.291	0.901	2.462	0.462	13.12	0.221	0.636	1.889	0.682	5.23	0.925	-0.063	0.938	0.255	3.46

<sup>1</sup>Academic qualification: diploma, bachelor's degree, higher diploma, master's degree, PhD.

\* P-value considered significant  $\leq 0.05$ , based on the logistic regression test.

Table 4 shows the correlation between knowledge and participants' categorical variables. There were statistically significant differences between age categories; the age group 51-64 yrs had a higher knowledge score ( $P < 0.05$ ). Similarly, there were significant differences between region categories; the participants who lived in the central area had a knowledge score higher than the northern region ( $P < 0.05$ ). The smoking categories of participants showed significant differences concerning knowledge; the non-smoking participants had higher knowledge ( $P < 0.05$ ). The correlation between attitudes and participants' categorical variables is illustrated in Table 4. There were no statistically significant differences between the study categories of variables ( $P > 0.05$ ).

The correlation between the practices and participants' categorical variables is illustrated in Table 4. There were significant differences between the study categories of monthly salary of 500-1,000 JOD compared to  $< 500$  JOD ( $P < 0.05$ ). In addition, the practice scores of the participants from the center of Jordan was significantly different from the ones from the south area ( $P < 0.05$ ). Thus, the highest scores of practices among variable categories were reported to 500-1,000 JOD monthly income and the southern region.

The model of knowledge, attitudes, and practices (a theory in the social psychology field) indicates that an increase in knowledge enhances attitudes and consequently enhances practices [14]. As mentioned below in Table 5, there was a significant positive correlation between knowledge, practice, and attitude of the participants which was tested by Pearson correlation at ( $P < 0.01$ ).

**Table 5.** Pearson correlation coefficient between knowledge, practice, and attitude of the participants

Scores	Knowledge	Attitudes	Practices
Knowledge	1	0.135*	0.144*
Attitudes	0.135*	1	0.150*
Practices	0.144*	0.150*	1

\* P-value considered significant at  $P < 0.01$ .

## 4. Discussion

The consumption of sports supplements and doping agents is popular and widespread, so communities need to be aware of their benefits, side effects, and potential risks. Sports supplements are considered part of DS and are therefore essential in a few situations or maybe part of a healthy and balanced diet amongst a segment of society, such as athletes. However, doping agents are not classified as DS, and sports organizations have banned them. Many doping agents have dangerous side effects and are illegal. Therefore, this study aimed to investigate KAP of sports supplements and doping agents in the Jordanian community.

The findings of our study were that the knowledge score was 62.00%, the attitude score was 83.00%, and the practice score was 80.00%. The study findings revealed that Jordanians have moderate knowledge, positive attitudes, and good practices toward sports supplements and doping agents. In addition, knowledge scores were significantly associated with 51-64 yrs of age ( $P < 0.05$ ) and residence in the central region of Jordan ( $P < 0.05$ ). Also, nonsmoker participants significantly correlated to knowledge of sports supplements and doping agents ( $P < 0.05$ ). A good practice score was correlated to the participant's monthly salary, where a monthly salary of 500-1000 JOD was positively correlated with practice score ( $P < 0.05$ ). A good practice score was also associated with the residence place, where participants living in the southern region showed good practices ( $P < 0.05$ ).

The result of this research deviated from its assumptions and objectives for several reasons, including evolving knowledge and awareness among the Jordanian community resulting from previous awareness efforts. Also, the cross-sectional study doesn't follow people or measure how factors change over time; cross-sectional studies only assess the community at a certain point in time and can't show cause-and-effect relationships. Furthermore, as the questionnaire was self-reported, some information may be inaccurate. For example, the estimated prevalence of DS and doping agents may be misreported, either on purpose or due to misconceptions.

Based on our results, the knowledge of the participants toward sports supplements and doping agents was shown to be moderate. This result is supported by some studies conducted recently in Jordan. A study conducted in four main cities in Jordan (Amman, Zarqa, Irbid, and Mafraq) found that 80% of individuals were familiar with DS [15]. Also, studies on gym members revealed nearly two-thirds of DS consumers had enough knowledge about their supplements [16]. On the other hand, a study in Spain of footballers also showed a significant lack of understanding regarding doping agents [17]. In Saudi Arabia, a study revealed that most gymnasts had poor knowledge about AAS [18]. A cross-sectional survey conducted among university students in Jordan found that knowledge about DS was associated with inaccurate information [19]. Ghazzawi et al. [20] illustrated that only 13.65% of Jordan University students had a good knowledge of DS. Also, our study findings showed positive attitudes toward sports supplements and doping agents in contrast to other published studies. For example, a study on doping substances involving sportspeople and college students showed that around one-third of students misused AAS due to poor beliefs [21]. Another international study of four countries (Serbia, Germany, Japan, and Croatia) and athletes competing in 18 sports found that just 18.4% of sportspeople thought the DS was not essential, and just 14.5% thought it was risky [22]. Regarding the practice score, the study's findings showed



a good practice score. Table 3 illustrates that the prevalence of sports supplements and doping agents among the Jordanian community was 13.8% and 1.8%, respectively. However, some of the studies did not agree with our findings. Internationally, in a study on Brazilian bodybuilders, it was found that 77% of the participants acknowledged using DS and ergogenic aids in the past [23]. Another study in Turkey showed that 19.5% of students admitted using nutritional ergogenic aids [24]. A study showed that banned drugs were used by 83.3% of the study participants among Spanish bodybuilders [25]. Another study showed that 11.1% of gym members reported using PES [26]. A study in Saudi Arabia found that 24.50% used AAS among gymnasts [18]. Another Saudi study, which included 20 gyms in Riyadh, found that the percentage of AAS use was 29.3% [27]. A study in Riyadh revealed that nearly 50% of individuals used protein supplements [28]. A study in Lebanon showed that the usage of DS among Lebanese athletes was 74%, with 50% primarily using sports supplements [29]. A study in Jordan found that 4.2% of college students used doping agents, whereas 26% of sportspeople used doping agents [21]. Another Jordanian study showed that the prevalence of consuming anabolic steroids and enhancers was 19.75% [30]. A recent study determining the prevalence of the use of DS among gym clients in Amman found that 78% of participants used DS [16]. A study that involved healthcare and non-healthcare professionals in Jordan showed that 6.1% of the population had used doping substances [6]. A survey was also conducted on 111 elite competitors and their trainers. It was found that the proportion of elite athletes that utilized DS was roughly 41.6%, which is generally high [31]. In another study that involved Jordanian students at universities found that more than 60.9% of students took DS [13]. The only study that supports our findings on the prevalence of doping agents is a study that revealed that illegal substance usage affected 1-5% of the population in the United States [1].

The explanation of the lower prevalence of sports supplements in the present study and differences in the practices from other studies can be attributed to different factors. The current study involves all Jordanian communities. Several points demonstrate the low prevalence of DS in the study. First, this study investigated specific types of DS, sports supplements, which are more prevalent among athletes. Second, the price of sports supplements and doping agents is higher than that of other vitamins, minerals, and herbs. DS are more available on the market, especially in pharmacies. Finally, the average income among Jordanians is low. Also, good knowledge and attitudes are correlated with good practices.

Table 3 showed that the participants in this study knew that sports supplements may contain prohibited substances and that there were consequences for positive doping tests. This is similar to a study which found that commercially

available supplements may contain pollutants or unreported components that may cause unintentional anti-doping regulation breaches [32]. According to a study conducted in Australia, 13 out of 67 supplements included stimulants or anabolic steroids, which are prohibited in sports supplements [33], while a study in Brazil found that whey protein samples from different brands of sports supplements contained prohibited substances, such as diuretics (conivaptan and politiazide) and stimulating substances, such as benfluorex [34]. In addition, a possible danger of inadvertent doping existed for more than 28% of the examined DS [35].

Sports supplements such as protein powders, vitamins, minerals, caffeine, piperine, glucosamine, and chondroitin may interact with some nutrients and medications inside the body. The findings of this study revealed that 91.75% of the participants said that sports supplements may interact with some medications, table 3. A study found that caffeine increased the availability of theophylline, which is an asthma drug, and increased the effectiveness, causing side effects such as difficulty in breathing, decrease in urine output and vision changes [36]. Another study found that Allegra's efficacy (antihistamine) was increased by piperine. Also, chelation reactions between the mineral calcium and antibiotics, such as tetracycline and ciprofloxacin, lowered mineral and medication absorption [37]. According to a case study, glucosamine and chondroitin increased the effects of warfarin raising the danger of bleeding [38].

The Jordanian entity authorized to enforce anti-doping regulations and fight against doping is Jordan Anti-Doping Organization (JADO), which promotes a doping-free lifestyle. The participants of this study revealed poor knowledge, with 29.50% knowing that the FDA is not responsible for anti-doping control around the world, table 3. Another research study concluded that young athletes were unfamiliar with WADA regulations [22]. In a study in Jordan, 85% of the participants said they did not know about JADO [6]. Also, the score of knowledge in this study was more than the score shown in previous studies in this area; KAP studies of sports supplements and doping agents, but this could be interpreted by the study population. The current study involved Jordanian communities from many areas with diverse individual characteristics and different environments, unlike other studies. The previous studies examined DS in general, but this study examined a specific type of DS: sports supplements and doping agents, which are different kinds of performance enhancers.

Table 3 showed that the majority of the participants in this study believed that sports supplements and doping agents were used to improve body shape and performance. This result agreed with other studies. In one study, athletes acknowledged that the main reason for using sports supplements was to improve sports performance [22]. The use of doping agents was primarily motivated by the desire to improve physical performance according

to another study in Jordan [6].

The participants thought that sports supplements and doping agents had side effects and were unsafe for health, table 3. This result might be supported by a recent article that compiled the latest information from about 30 articles, which found that the irregular use of some of these supplements or using them at high doses can cause side effects, such as itching, paresthesia, bleeding, appetite impairment, gastrointestinal discomfort, diarrhea, nausea, dizziness, gastric cancer, and high blood urea nitrogen levels, which affect lymphocytes and monocytes and cause greater increased blood creatinine. In addition, when they consume together, there may be unexpected interactions [39]. The studies prove that doping substances can cause a wide range of harmful side effects including liver cirrhosis, kidney failure, pancreas damage, cardiovascular and brain damage, and a high risk of developing cancers in the intestine, liver, pancreas, brain, and bones. Also, doping agents were associated with mood swings and metabolic disorders, such as diabetes mellitus and growth changes [7], as well as unexpected death [35].

Table 3 showed that participants have moderate attitudes towards their beliefs about the coach's body shape as evidence of his possession of sufficient information. This result, in agreement with a review of 16 studies completed in the United States revealed that coaches and trainers were identified as significant knowledge sources for the DS in eight of these publications (50%) [40]. For example, in a study by Jovanov et al. [22] revealed that the primary source of information regarding the use of sports supplements was trainers. The coaches in sports gyms provide recommendations on foods and supplements to enhance athletic strength, power, and performance [41]. However, it is recommended that DS be consumed based on the recommendations from sports nutrition experts [42]. In developed countries, athletes depend more on dietitians concerning nutritional information [22]. Another study found that most coaches (74%) were the source of information for the use of sports supplements [29]. Another study showed that most participants obtained information from athletic coaches [16].

Most of the population (88.4%) in this study acknowledged that they read the nutritional label and ingredients. That is similar to a Jordanian study in 2022 that found that nearly two-thirds (66.2%) of DS consumers paid attention to the nutritional content of these supplements [16]. Another study conducted in Lebanon revealed that 69% of athletes did not read the nutrition facts.

In our findings, the score of practice among participants was significantly correlated to knowledge and attitude (P-value = 0.004), (P-value = 0.003), respectively. In addition, the score of attitudes was associated significantly with knowledge (P-value = 0.007). It is concluded that there are significant correlations among the

KAP variables. These findings are similar to those supported by Emiru et al. [43] revealed a significant positive linear correlation between knowledge-attitude, knowledge-practice, and attitude-practice. A study showed that the knowledge of individuals who use anabolic-androgenic steroids strongly correlated with practices [44]. According to another research study, it was found that there was a negative relationship between the use of sports supplements and knowledge, which means an increase in knowledge improves practices [3]. However, our findings disagree with those of Amawi et al. [14], which indicate that there was no significant correlation between knowledge and attitudes, or between attitudes and practices. The positive linear correlations among KAP reinforce that more knowledge can lead to more positive attitudes and, as a result, to better practices [45].

High scores about the knowledge, attitude, and practice of sports supplements and doping agents can have various clinical implications. First, some of these implications include improved population outcomes. Individuals with a good understanding of sports supplements and doping agents make informed decisions about their use and can provide sound advice and guidance to others. This can help individuals who want to enhance their health outcomes. In addition, individual safety is enhanced. Individuals who understand sports supplements and doping agents can avoid risky substances. They can also help others identify the benefits, interactions, and side effects. Also, there is improved compliance with institutions and organizations, such as the FDA and JFDA working to minimize the use of sports supplements, especially those from unreliable sources. Institutions, such as WADA and JADO are recognized for their work to ban the use of doping agents and enhance fair competition. Finally, sports performance has improved. Knowing the appropriate use of sports supplements can help athletes improve their performance and obtain their goals safely and legally.

## 5. Conclusions

The current study found that the Jordanian community has sufficient knowledge, positive attitudes, and good practices toward sports supplements and doping agents. The knowledge of sports supplements and doping agents was significantly correlated with age and smoking status while the practice was affected by the monthly salary and living region of the participants. The attitudes toward sports supplements and doping agents were not statistically significant with participant characteristic variables. There are significant correlations between the KAP variables (knowledge, attitudes, and practices).

## Limitations

This cross-sectional study has some limitations that should be considered to enhance our results' applicability. First, the study's cross-sectional design cannot draw a causal conclusion because it doesn't follow people or measure how factors change over time; cross-sectional studies only assess the community at a certain point in time and can't show cause-and-effect relationships. Second, as the questionnaire was self-reported, some information may be inaccurate. For example, the estimated prevalence of DS and doping agents may be misreported, either on purpose or due to misconceptions. Furthermore, there was a lack of data gathered regarding the nutrient sufficiency of the athletes' diets, which could correlate with the utilization of supplements among athletes. Also, our questionnaire could not detect male users of doping agents, possibly due to the fear of consequences for athletes when they are taken. Also, the study included all people aged between 18 and 64 years old, including those with health problems.

## **Acknowledgements**

The authors would like to thank the Deanship of Scientific Research at Al- Balqa' Applied University for supporting this research. In addition, they would like to thank the College of Agriculture at Al- Balqa' Applied

University for the participation of their faculty members in enriching this manuscript.

## **Funding**

This research received no external funding.

## **Institutional Review Board Statement**

The Ethical approval number (745/1/3/26) was obtained from the Institutional Review Board (IRB) at Al-Balqa Applied University (BAU).

## **Informed Consent Statement**

Before the start of the study, participants completed a consent form which contained a brief description of the study and its aims. Participants could ignore the link if they did not decide to participate in the study.

## **Conflicts of Interest**

The authors declare no conflict of interest.

## Appendix A: Questionnaire Form in English

KAP	Question NO.	Questions
Knowledge (Yes, No)	1	Sports supplements may contain legally prohibited substances.
	2	Upon examination, a prohibited substance in the athlete's body leads to consequences for athletes.
	3	Sports supplements may interact with some medications
	4	Drinking water in appropriate quantities reduces the side effects of taking sports supplements.
	5	Do sports supplements undergo content authorization and integrity tests before marketing?
	6	The Jordanian Food and Drug Administration (JFDA) is responsible for the safety of sports supplements before distributing and selling them to the markets.
	7	US-FDA is responsible for doping control around the world.
	8	The fact label mentions all the ingredients inside the supplement's products.
	9	Hormones (prohibited substances) are classified as sports supplements.
Attitudes (Agree, Neutral, Disagree)	1	Do you think some sports supplements improve body shape (build muscle and lose fat)?
	2	Do you think some sports supplements improve physical performance during exercise?
	3	Would sports supplements be dangerous to your health?
	4	Do you think the coach's body shape and achievements are evidence of his possession of sufficient information?
	5	Do you think doping agents are dangerous to your health?
	6	Do you think that anabolic steroids speed up the result of building muscle and losing fat?
	7	In your opinion, do anabolic steroids improve the physical performance of athletes?
	8	In your opinion, are supplements necessary even if the diet is sufficient to meet nutritional needs?
	9	Do you think sports supplements should be taken under the supervision of a nutritionist?
	10	Do you think sports supplements are necessary for all types of sports?
Practices (Yes, No)	1	Do you take any athlete supplements
	2	Do you take any doping substances (steroid hormones)
	3	Have you ever asked about the side effects of supplements, their interaction with medications, or their suitability for certain diseases
	4	Have you ever asked about the side effects of doping substances, their interaction with medications, or their suitability for certain diseases
	5	Do you read the nutritional and ingredient information labels for any products
	6	Would you take sports supplements or steroid hormones if your coach encouraged you to use them
	7	Would you take sports supplements or steroid hormones if you had friends/relatives who took them

## Appendix B: Questionnaire Form in Arabic

السؤال	رقم السؤال	KAP
هل يمكن أن تحتوي المكملات الرياضية على مواد محظورة قانونياً	1	المعرفة (نعم / لا)
يؤدي وجود مادة محظورة في جسم الرياضي عند الفحص إلى عقوبات على الرياضيين	2	
هل يمكن أن تتفاعل المكملات الرياضية مع بعض الأدوية	3	
شرب الماء بكميات مناسبة يقلل من الآثار الجانبية لتناول المكملات الرياضية	4	
تخضع المكملات الرياضية للتأكد من مطابقة المحتوى وسلامتها قبل توزيعها للأسواق	5	
إدارة الغذاء والدواء الأردنية هي المسؤولة عن سلامة المكملات الرياضية قبل عملية توزيعها وبيعها للأسواق	6	
إدارة الغذاء والدواء الأمريكية هي المسؤولة عن مكافحة المنشطات في جميع أنحاء العالم	7	
يذكر ملصق المعلومات الغذائية الموجود على المنتج جميع المكونات الموجودة بالفعل داخل المكملات	8	
تصنف الهرمونات (المواد المحظورة) كمكملات رياضية	9	
برأيك هل تعمل بعض المكملات الرياضية على تحسين شكل الجسم (بناء العضلات وفقدان الدهون)؟	1	الموقف (موافق، محايد، غير موافق)
برأيك هل تعمل بعض المكملات الرياضية على تحسين الأداء البدني أثناء التمرين؟	2	
هل تعتقد أن المكملات الرياضية قد تشكل خطورة على صحتك؟	3	
هل تعتقد أن شكل جسم المدرب وإنجازاته الرياضية دليل على حيازته لمعلومات كافية عن مكملات الرياضيين والمنشطات؟	4	
هل تعتقد أن المواد المنشطة (الهرمونات) قد تشكل خطراً على صحتك؟	5	
هل تعتقد أن المنشطات تؤدي إلى تسريع نتيجة بناء العضلات وفقدان الدهون؟	6	
برأيك هل تؤدي المنشطات إلى تحسين الأداء البدني للرياضيين؟	7	
برأيك هل تعتبر المكملات ضرورية حتى لو كان النظام الغذائي كافياً لتلبية الاحتياجات الغذائية؟	8	
برأيك هل يجب تناول المكملات الرياضية تحت إشراف أخصائي التغذية؟	9	
برأيك هل المكملات الرياضية ضرورية لجميع أنواع الرياضات؟	10	
هل تتناول أي من مكملات الرياضيين؟	1	الممارسة (نعم / لا)
هل تتناول أي من المنشطات (الهرمونات)؟	2	
هل سألت من قبل عن الآثار الجانبية للمكملات ، أو تفاعلها مع الأدوية ، أو مدى ملاءمتها لأمراض معينة؟	3	
هل سألت من قبل عن الآثار الجانبية للمكملات ، أو تفاعلها مع الأدوية ، أو مدى ملاءمتها لأمراض معينة؟	4	
هل تقرأ ملصق المعلومات الغذائية والمكونات لأي من المنتجات؟	5	
هل ستتناول المكملات الرياضية أو المنشطات والهرمونات إذا شجعتك مدربك على استخدامها؟	6	
هل ستتناول المكملات الرياضية أو المنشطات والهرمونات إذا كان لديك أصدقاء/أقارب يتناولونها؟	7	

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