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Original Article

Patterns of Caffeine Consumption in Western Province of Saudi Arabia

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ABSTRACT

Introduction: Caffeine is the most consumed psychoactive drug worldwide. Nowadays, the introduction of many caffeine-containing products, along with changes in the consumption patterns of both natural and synthetic sources of caffeine, has drawn the attention of health researchers. Information regarding consumption patterns of coffee and caffeinated products among the Saudi population, particularly in different regions, remains unclear**.** Thus, this study aims to identify the amount and sources of caffeine consumed by the Saudi population and explore its relationship with the consumption patterns. **Patients and Methods:** This cross-sectional study used an online self-administered questionnaire, including adults who live in the western province of Saudi Arabia and use caffeine products. A 15-item questionnaire was distributed via social media platforms between 1 June and 31 August 2021. Descriptive statistics were used to describe the participants' characteristics, and categorical variables were reported as frequencies and percentages. Chi-square test was used to test the difference between variables. **Results:** In total, 1,036 participants were included in the study. Females represented 80% of the participants included, and nearly half of participants (58%) received an undergraduate education. Concerning caffeine sources, most participants consumed coffee and tea (97%), followed by OTC medications containing caffeine (21%), energy drinks (17%) and other, such as soft drinks and chocolate (4%). Regarding drinking habits, most participants (89%) replied that they drink coffee/tea only, whereas 8% drink it with sweets and cakes and the rest (3%) have it either with water, fruit or a cigarette. Concerning adverse effects of caffeine intake, most participants experienced sleep disturbance (67%), headache (60%), arrythmia (51%) and stress and anxiety (40%). Sex showed a significant relation with OTC medications containing caffeine (p = 0.025) and adverse effects related to caffeine intake (p = 0.002). **Conclusion:** The present study provides useful data for multiple stakeholders in Saudi Arabia regarding caffeine consumption. Measures should be implemented to ensure safe caffeine consumption to avoid the occurrence of secondary events associated with a lack of knowledge related to its usage.

Keywords: caffeine intake, caffeinated products, consumption pattern, caffeine sources, caffeine awareness, Saudi Arabia.

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INTRODUCTION

Caffeine is the most consumed psychoactive drug worldwide.[1] Nowadays, the introduction of many caffeine-containing products, along with changes in the consumption patterns of both natural and synthetic sources of caffeine, has drawn the attention of health researchers to the overall consumption of caffeine and its potential growing effects on behaviour and physiology.[2] Natural sources of caffeine include coffee, tea and chocolate, while synthetic sources include energy drinks, soda and over-the-counter (OTC) medications containing caffeine.[3]

In general, adults consume caffeine from coffee and tea, both of which have natural caffeine in their leaves or beans.[4] Energy drinks and chocolate also include caffeine from natural products, such as extracts from guarana leaves. However, the amount of caffeine in chocolate changes according to the percentage of cocoa included, and synthetic caffeine is added to soda, energy drinks and OTC medications.[5-6] Caffeine is included in many OTC pain medications because it acts as a compliment to analgesics, in certain cases increasing the efficiency of pain relievers by up to 40%, in addition to its vasoconstricting and anti-inflammatory effects.[7-9]

For healthy adults, caffeine consumption is considered safe; however, caffeine intake has positive and negative effects. The positive effects include improving mood and cognitive attention, strengthening exercise performance, and boosting fat-burning and metabolism.[10] In contrast, negative

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effects occur when caffeine intake exceeds 400 mg, which is roughly the amount of caffeine in 3 to 4 cups of brewed coffee and which can lead to a condition called caffeine intoxication.[11] Symptoms include sleep disturbance, increased urination, gastric irritation, headache, irregular or rapid heartbeat and psychomotor agitation, according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5).[12-13]

Information regarding the spread of the different types of coffee and caffeinated products consumed by the Saudi population remains unclear.[14] This study aims to identify the amount and sources of caffeine consumed by the Saudi population and explore its relationship with the consumption patterns. This is to provide public health practitioners and dietitians with information on caffeine consumption, to help them understand the situation and make suitable recommendations for patients.

MATERIALS AND METHODS

Ethical Approval

The study was approved by the Biomedical Research Ethics Committee, Faculty of Medicine, Umm Al-Qura University, Makkah, Saudi Arabia. Approval number: HAPO-02-K-012-2021-04-670, in accordance with the Declaration of Helsinki.

Study Design

This study was a cross sectional study design using a self-administered questionnaire and participants were males and females aged ≥18 years who live in the western province of Saudi Arabia and use caffeine products. They were randomly approached by sending the electronic questionnaire over a period of three months (1 June to 31 August 2021) to reach the highest number of participants using caffeine products. In the electronic questionnaire, the purpose of the research was explained to participants. Also, they were informed that their participation is voluntary.

Questionnaire Tool

The questionnaire was designed in English and translated into Arabic by proficient speakers of both languages. A pilot study of 10 participants was performed to confirm the reliability and validity of the questionnaire. Content validities were done to clarify all questions. The questionnaire was then reviewed by experts who provided their feedback and opinion for developing/improving the questionnaire to ensure test reliability. Feedback and suggestions were incorporated into the final questionnaire, which contained 15 questions and was designed using an online cloud-based questionnaire development software (Google Forms). The questionnaire was divided into four main parts: the first part included sociodemographic information, including gender, age, education level and history of chronic diseases. The second part included the sources of caffeine: coffee and tea, energy drinks, OTC medications containing caffeine, soft drinks, and chocolates. The third and fourth parts included the amount and the adverse effects related to caffeine intake.

Sample Size and Data Collection

The sample size was calculated using Slovin's formula, with a population size of 930 participants in SA from a recently published study by Alfawaz *et al.* 2020, with a confidence interval (CI) of 0.90, and margin of error of 5%.[15] Social media channels were used to distribute the questionnaire. All responses to the questionnaire were downloaded from the Google Forms website and held on a secure server. We received a complete case analysis of the answers provided by respondents who completed all 15 questions from the four-part survey. Participants who provided incomplete responses to the questionnaire were excluded. The data were collected from the spreadsheets provided by Google Forms and transferred to Microsoft Excel.

Statistical Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL, USA), All categorical variables were presented as frequencies and percentages (%). A Pearson Chi Square test was used to test the differences between variables. Statistical significance was determined at a p-value of <0.05.

RESULTS

Demographic Characteristics of the Participants

In total, 1,046 questionnaires were collected, of which 10 were excluded because of incomplete responses, giving a response rate of 99%. Consequently, 1,036 questionnaires were included in this study. The participants' demographic characteristics are shown in Table 1. Females represent 80% of the participants included in the study. In terms of age groups, participants belonging to the 26–40-year age group comprised the highest percentage (55%), followed by 18–25-year group (30%) and lastly the over 40-year group (15%). While most participants (58%) received an undergraduate education, 15% received only basic education (including elementary, intermediate, and high school education). Caffeine intake in the morning showed the highest percentage (99%), followed by afternoon (97%) and evening (92%). As shown in Figure 1, concerning caffeine sources, most participants consumed coffee and tea (97%), followed by OTC medication containing caffeine (21%), energy drinks (17%) and others, such as soft drinks and chocolates (0.3%). Only 4% of participants had a history of chronic diseases, including diabetes, asthma, hypertension, thyroid disorders, and others.

Table 1: Demographic characteristics of participants.

Parameters	Frequency (%)
Number	1,036
Age (years)	
18–25	310 (30%)
26–40	571 (55%)
Over 40	155 (15%)
Gender	
Females	833 (80%)
Males	203 (20%)
Education level	
Basic	155 (15%)
Undergraduate	879 (85%)
Postgraduate	2 (0.1%)
Times of caffeine intake	
Morning	1,034 (99%)
Afternoon	1,000(97%)
Evening	961 (92%)
Sources of caffeine intake	
Coffee and Tea	1,000 (97%)
Energy drinks	181 (17%)
OTC medications containing caffeine	217 (21%)
Others	4 (0.3%)
History of chronic diseases	38 (4%)

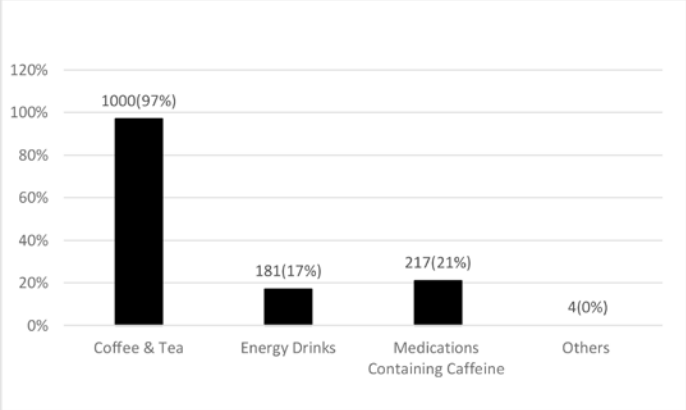

Figure 1: Sources of caffeine intake.

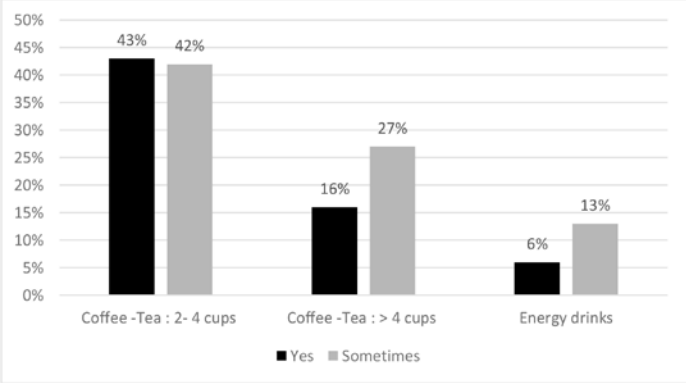

Figure S1: Caffeine Drinking frequency (daily) for the commonly used caffeine sources (coffee, tea, and energy drinks).

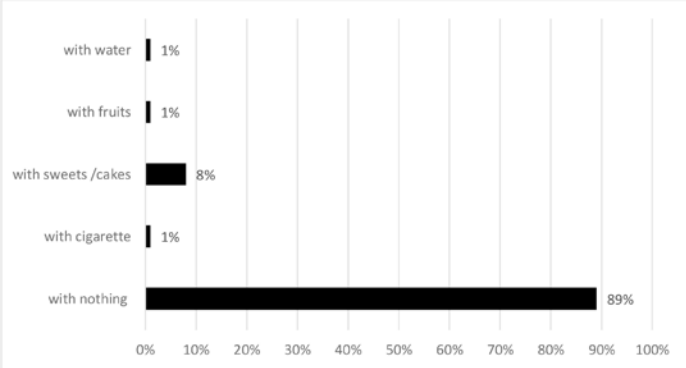

Figure S2: Caffeine Drinking habits.

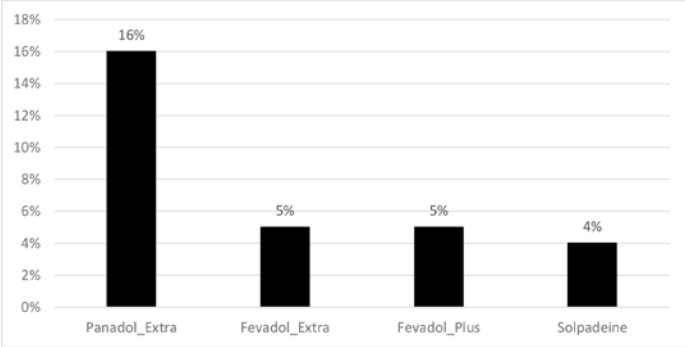

Figure S3: Participants used OTC medications containing caffeine.

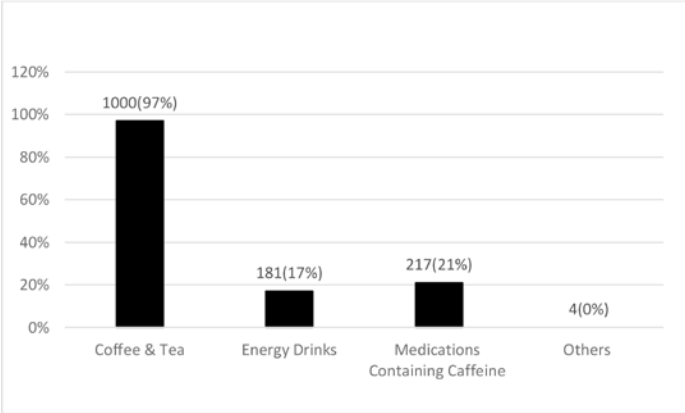

Figure 2: Participant-experienced adverse effects related to caffeine intake.

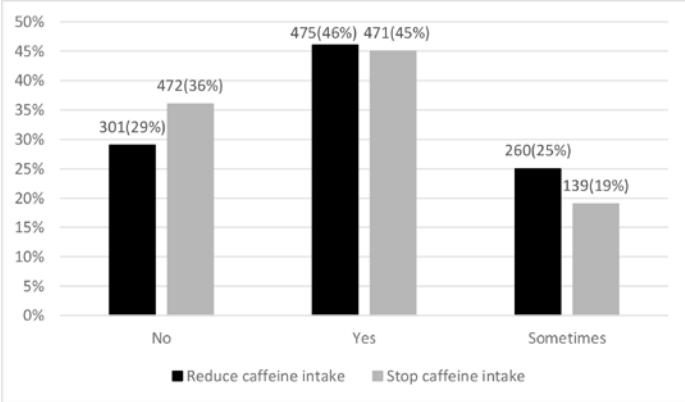

Figure 3: Participants response to the adverse effects related to caffeine intake.

Concerning caffeine consumption frequency, 43% of participants drink 2 to 4 cups of tea and coffee daily, whereas 42% drink more than four cups daily (Online Supplement Figure S1). For energy drink consumers, only 6% of participants drink them daily. Regarding drinking habits, most participants (89%) replied that they drink caffeine only, whereas 8% mentioned they have their caffeine with sweets and cakes. The rest of the participants (3%) have their caffeine either with water, fruits or a cigarette, as shown in Online Supplement Figure S2. Concerning OTC medications containing caffeine, 16% of participants used Panadol Extra, 5% used Fevadol Extra and Fevadol Plus and 4% used Solpadine, as shown in Online Supplement Figure S3.

Concerning adverse effects related to caffeine intake, most participants experienced sleep disturbance (67%, including trouble initiating or maintaining sleep), headache (60%, mainly if they do not have caffeine), arrythmia (51%, including irregular or rapid heartbeat), stress and anxiety (40%) and others (1%, such as upset stomach, nausea, and vomiting), as shown in Figure 2. In response to the adverse effects of caffeine intake, 46% of participants replied that they wanted to cease caffeine intake, while 45% wanted to reduce it, as shown in Figure 3.

As shown in Table 2, the chi square test showed a relation a between sex and taking OTC medications containing caffeine (p=0.025), also sex and adverse effects related to caffeine intake (p=0.002). Moreover,

Table 2: Relation between sex and [1] taking OTC medications containing caffeine and [2] adverse effects related to caffeine intake. Statistical significance was determined at a *p*-value of <0.05.

No		Taking OTC medications containing caffeine			Total
		Yes	Sometime		
Sex	Male	156	8	39	203
	Female	693	40	100	833
Pearson Chi-Square	Value (7.382[a])	df (2)		*p*=0.025	

No		Adverse effects related to caffeine intake		Total
		Yes		
Sex	Male	86	117	203
	Female	259	574	833
Pearson Chi-Square	Value (9.337[b])	df (1)	*p*=0.002	

Table S1: Relation between educational level and [1] taking OTC medications containing caffeine, [2] adverse effects related to caffeine intake. Statistical significance was determined at a *p*-value <0.05.

No		Taking OTC medications containing caffeine			Total
		Yes	Sometime		
Educational level	Basic education	122	15	18	155
	Undergraduate	725	33	121	879
	Postgraduate	2	0	0	2
Pearson Chi-Square		*P*=0.025			

No		Adverse effects related to caffeine intake		Total
		Yes		
Educational level	Basic education	38	117	155
	Undergraduate	305	574	879
	Postgraduate	2	0	2
Pearson Chi-Square		*P*=0.006		

concerning education level, there was also a relation between education level and taking OTC medications containing caffeine (*p*-value = 0.025) and adverse effects related to caffeine intake (*p*-value = 0.006). However, there was no relation between age and taking OTC medications containing caffeine (*p*-value = 0.09) and adverse effects related to caffeine intake (*p*-value = 0.265), as shown in Online Supplement Tables S1–S2.

DISCUSSION

Several studies have been presented from various regions in Saudi Arabia regarding caffeine, but there remain limited studies available from western province of this country regarding consumption patterns.[15-18] A number of cross-sectional studies showed that females in Saudi Ariba prefer and consume more caffeine (mainly Arabic coffee) than males which is similar to our results where females represent (80%) of the participants.[14,16] On the other hand, undergraduate students represent most of the participants in our study (85%), and they may be at an increased risk of excessive caffeine consumption due to seeking

Table S2: Relation between age and [1] taking OTC medications containing caffeine, [2] adverse effects related to caffeine intake. Statistical significance was determined at a *p*-value <0.05.

No		Taking OTC medications containing caffeine			Total
		Yes	Sometime		
Age (years)	18-25	262	13	35	310
	26-40	460	23	88	571
	>40	127	12	16	155
Pearson Chi-Square		*P*=0.09			

No		Adverse effects related to caffeine intake		Total
		Yes		
Age (years)	18-25	92	218	310
	26-40	200	371	571
	>40	53	102	155
Pearson Chi-Square		*P*=0.265		

The Questionnaire

1.	Age:	o 18–25
2.	Gender:	o 26–40
3.	Education level:	o >40
		o Male
		o Female
		o Basic
		o Undergraduate
		o Postgraduate
4.	Do you suffer from chronic diseases?	o No
		o Asthma
		o Joint problems
		o Diabetes
		o Hypertension
		o Inflammatory bowel disease
		o Hyperlipidaemia
		o Thyroid problems
		o Anaemia
		o Other (Please specify) _____
5.	I use the following caffeine source(s):	o Coffee and tea
6.	(Select all that apply)	o Energy drinks
		o OTC medication containing caffeine
		o Soft drinks
		o Chocolates
7.	I use the following type(s) of OTC medication containing caffeine:	o Panadol Extra
		o Fevadol Extra
		o Fevadol Plus
		o Solpadine
		o Other (Please specify) _____
8.	My first cup of coffee/tea will be in the	o Morning
		o Afternoon
		o Evening

continued...

9.	I drink 2–4 cups of coffee/tea per day.	o Yes o Sometimes o No
10.	I drink more than 4 cups of coffee/tea per day.	o Yes o Sometimes o No
11.	I drink energy drinks daily.	o Yes o Sometimes o No
12.	I take OTC medications containing caffeine.	o Yes o Sometimes o No
13.	I have my caffeine (coffee and/or tea) with:	o Nothing o Sweets and cakes o Water o A cigarette o Fruit o Other (Please specify) _____
14.	I experienced the following adverse effect(s) related to caffeine intake:	o Headache o Sleep disturbance o Stress and anxiety o Irregular or rapid heartbeat o Upset stomach o Nausea and vomiting o Other (Please specify) _____
15.	I have tried to reduce my caffeine intake.	o Yes o Sometimes o No
16.	I have tried to stop my caffeine intake.	o Yes o Sometimes o No

caffeinated products with well-known wakefulness effects and cognitive benefits. Moreover, a Saudi study aimed to investigate the prevalence, trends and predictors of coffee consumption among Saudi undergraduate female students, and it showed that prolonged study under stressful conditions, such as exams, and improved academic performance were two main reasons for the elevated coffee consumption.[15,19] Another study showed that most students (99.1%) regularly consumed caffeinated products, mainly chocolate, coffee, and tea, with coffee, tea and energy drinks contributing most to total caffeine intake, like our study.[20]

In Saudi Arabia, Arabic coffee (Gahwa) and tea are commonly practised by Saudi citizens and served daily in all local social settings and meetings.[21] Serving Gahwa in Saudi Arabia is a local custom and sign of hospitality and generosity. In our study, coffee and tea were the most common (97%) sources of caffeine consumed. However, OTC medications containing caffeine were the second-most commonly consumed (21%), as caffeinated OTC medications, whether alone or in combination with other treatments, are commonly used by patients for headache and pain treatment.[22-23] They play an important role in pain adjustment through their action on the adenosine receptors, which are involved in nociception, a neural feedback that allows the central nervous system (CNS) to detect and avoid noxious and potentially damaging stimuli in both active and passive settings.[24-25] As might be expected with OTC preparations, tolerability is good for most patients, and side effects are predictable and mostly mild and temporary.[26]

On the other hand, the use energy drinks, consumed by 17% of participants in our study, has been increasing dramatically in the last two decades, and Saudi Arabia is not an exception. Companies are actively pushing advertising, sponsorship of sporting events and massive subsidies to retailers that sell them.[27] They are ingested extensively among Saudis, especially adolescents and college students, due to the strong marketing of their overvalued ability to boost energy, improve physical performance, increase alertness and wakefulness, and elevate mood.[28]

Furthermore, regarding OTC medications containing caffeine, paracetamol–caffeine preparations, mainly including Panadol Extra and Fevadol Extra, are the most commonly used analgesics and antipyretics worldwide, and they are generally available OTC in the UK and Australia.[29] Even though its mechanism of action is inadequately understood, paracetamol is still popular because of its tolerability and safety when administered at recommended doses.[22] In our study, Panadol Extra was the most used OTC medication (16%), and this is because consumers, including Saudis, seek information about OTC medicines from different sources (which often recommend paracetamol), including health care professionals, the internet, medicine labels and information leaflets.[30-31] Thus, written paracetamol (especially Panadol Extra) information plays a significant role due to its OTC availability.[30]

A systemic review of randomised controlled trials showed that caffeine mainly increased sleep latency, decreased total sleep time and sleep efficiency and induced poor sleep quality.[32] In our study, sleep disturbance was the most reported side effect (67%), and it is well-known to be caused by caffeine. As caffeine is a methylxanthines derivative, it blocks the inhibitory effect of adenosine in the CNS, resulting in increased wakefulness.[33] As known, Saudi Arabia has a warm, dry desert climate with significantly high temperatures in most of the country.[34] Therefore, most people tend to go out in the late afternoon or evening to meet friends or gather with family. Interestingly, a clinical study indicated that caffeine taken six hours before bedtime has significant disruptive effects on sleep, and sleep hygiene recommendations must be considered, including stopping caffeine intake a minimum of six hours prior to bedtime.[35]

In our study, there was a significant between sex and OTC medications containing caffeine and side effects related to caffeine consumption. Because most of our participants are females and they tend to use caffeinated OTC analgesics to treat their dysmenorrhea, females reported greater OTC analgesic use than men.[36-37] However, there is an insufficient understanding of their potential effects on reproductive function, and their related side effects have not been investigated.[38] A cross-sectional survey reported that 40% usage of OTC medications among pregnant women is worrying, and it called for the need to educate, advise and increase awareness among women regarding the side effects of OTC drug usage.[39] Another study showed that OTC analgesics were the most consumed OTC drugs (49.1%), especially in women, children and individuals of a low–medium socioeconomic status.[40]

A few limitations should be considered when reading the results of this study. First, our study may not be representative because of the study design (online survey), however, we included a large population and we used common social media platforms. Second, due to its cross-sectional nature, no possible causation can be obtained from this study. Third, the questionnaires did not reference the size of a cup of coffee, which might have led to a misclassification of mean cup intake. Despite these limitations, our study has many strengths. To our knowledge, the present study is a novel contribution to the literature in observing patterns of caffeine consumption in the western province of Saudi Arabia. In addition, the inclusion of caffeinated products is a strength of this study, as it is essential to determining the contribution of several caffeinated

products to total caffeine consumption to identify which products might need special consideration to minimise caffeine-related risk. Additional research will be needed to continue to monitor caffeine consumption trends among Saudi adolescents and adults and their long-term adverse effects.

CONCLUSION

The present study provides useful data for multiple stakeholders in Saudi Arabia (e.g., the scientific community, health professionals and consumers) regarding caffeine consumption. Adverse effects associated with excessive caffeine consumption combined with the increasing number and availability of caffeine-containing products are causes for concern. Measures to educate individuals and boost public awareness should be implemented to ensure safe caffeine consumption to avoid the occurrence of secondary events related to the lack of knowledge related to its usage.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

OTC: Over-the-counter; **DSM-5:** Diagnostic and Statistical Manual of Mental Disorders, fifth edition; **CNS:** Central nervous system

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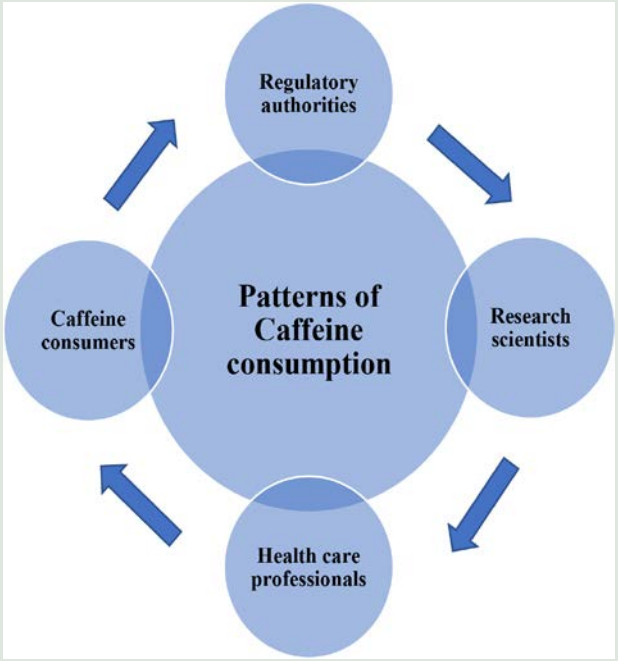
GRAPHICAL ABSTRACT



SUMMARY

Information regarding the spread of the different types of caffeinated products consumed by the Saudi population remains unclear. Natural sources of caffeine include coffee, tea and chocolate, while synthetic sources include energy drinks, soda and over-the-counter medications containing caffeine. The present study provides useful data for multiple stakeholders in Saudi Arabia (e.g., the scientific community, health professionals and consumers) regarding caffeine consumption. Measures to educate individuals and boost public awareness should be implemented to ensure safe caffeine consumption to avoid the occurrence of secondary events related to the lack of knowledge related to its usage.

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