A Cross-sectional Study on Caffeine Dependency by Drinking Tea and Coffee Among Bangladeshi Students

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ABSTRACT: Too much caffeine consumption might cause physical and mental dependency on the consumer. This study examined the socio-demographic factors, knowledge, behavior and perception of Bangladeshi students about caffeine which is based on drinking tea and coffee. This questionnaire-based study included 1020 respondents from primary level to postgraduate level students. The analysis utilized frequencies, means, percentages, Pearson's chi-square (χ^2) statistic and Spearman's rank correlation coefficients. Pearson's chi-square (χ^2) statistic test was performed to determine the significance at 5% with a p-value < 0.05. Most of the students (94.8%) consume tea or coffee regularly, and 66.1% drink it daily. A total of 87.5% of students knew that tea and coffee have caffeine. Nearly two-thirds (67.1%) of the students were dependent on tea and coffee, and 35.9% experienced psycho-physiological alterations after a day without drinking those items. About 38% of students noticed side effects after consumption of tea or coffee multiple times in a day. This study also reveals that gender did not alter the knowledge or drinking behavior of tea and coffee. Tea and coffee drinking patterns were not significantly dependent upon the participants' educational qualifications.

Key words: Caffeine, tea, coffee, drinking habit, dependency.

INTRODUCTION

Caffeine, a methyl-xanthine purine alkaloid derivative, is widely consumed in food and beverages.[1,2] It is a well-known natural central nervous system (CNS) stimulant that mainly exists in tea and coffee.[3] Coffee is the largest source of caffeine, making up 54% of global caffeine consumption, while tea is right behind it at 43%.[4] Nowadays, it has turned into an available food ingredient in the various commercial beverages on the market, such as chocolate, which carries nearly 1% of the global caffeine consumption.[3,4]

Caffeine is a controlled substance.[5] Excessive intakes may cause several unwanted consequences.[5] Though the human nervous system can tolerate low to moderate amounts of caffeine, high doses may lead to adverse effects.[5] Furthermore, relatively few consumers of caffeine-containing beverages are aware of the toxicity of excessive caffeine intake.[6] The high concentration primarily causes addiction, which can lead to serious health issues such as nervous system disturbances and cardiovascular problems.[6]

Consumption patterns of caffeine may vary depending on geographic location.[4] For instance, per capita caffeine consumption is roughly three times more in the United States and Canada than it is in the rest of the world, but it is less than half that of nations that drink a lot of tea, such as the United Kingdom.[4] Asia also ranks highly due to its substantial quantity of caffeine use.[6] These trends vary even more depending on the age group, with adults favoring carbonated beverages and energy drinks mixed with coffee-flavored drinks.[3] Adolescents drink caffeine for different purposes such as studying, partying,

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driving and for quick energy.[6] Students also use caffeine for the alleviation of stress due to academic pressure, social or emotional disturbances.[7] Usually, they consume tea, coffee or a combination of these two to alleviate stress and improve their concentration and performance which may lead to addiction in their later life.[8,9]

The vast majority of students in Bangladesh regularly drink tea and coffee as a way to relax or pass the time.[10] However, excessive consumption of tea and coffee may lead to caffeine dependency with some serious side effects. Therefore, the objective of this study is to investigate the knowledge and perception of Bangladeshi students on the habit of drinking tea and coffee which is correlated with their consumption of caffeine. This study will also identify if any of the students have a caffeine dependency that is related to their withdrawal symptoms. Moreover, this study will contribute to increase students' awareness about caffeine dependency and its major side effects.

MATERIALS AND METHODS

Study design, sample size and data collection. A structured English questionnaire was prepared and an online version was generated using "Google form" to reach a maximum number of respondents (Table 1). This questionnaire-based research was carried out with the students of Bangladesh from June 2021 to July 2021. A total of 1020 respondents' data were collected via using online social media platforms such as, Facebook, WhatsApp, Imo and Viber. Students who participated in this study were from all over Bangladesh and their educational level ranged from primary to postgraduate programs. The consent of each participant was taken before the investigation and students who were not interested in participating were excluded from the study.

Sample size determination. To determine this study's sample size, the prevalence of the condition of interest from existing literature was initially attempted. However, since this information was unavailable, a conservative estimate of 50% prevalence was adopted as a starting point. Based on this assumption, a sample size of approximately 385 students would have been considered appropriate through the Raosoft®.[11] However, the sample size was adjusted after considering the design effect, which corrects for the clustered nature of our sampling approach across multiple locations in Bangladesh. The design effect, calculated as 2.65, reflects the extent of clustering within the sample. So, the sample size was increased by multiplying the initial estimate of 385 by the design effect of 2.65. As a result, the final sample size was determined to be 1020, which considered the clustering present in the study design.

Validation of the study. The validation of the study was conducted. Initially, the questionnaire was reviewed by two senior public health experts and then a pilot study was carried out twice for 3 weeks before starting the original research. From the pilot study, participants' response data, the internal consistency reliability was found good by using Cronbach's alpha (0.85) and test-retest reliability using the intra-class correlation coefficient (0.73).

Study measures. In this study, the socio-demographic characteristics of the participants were differentiated into age, sex, current residence and educational levels. Along with socio-demographic categories, the questionnaire was divided into three further categories, such as knowledge, behavior and perception of tea & coffee. The questionnaire was mainly developed based on the students' socio-demographic characteristics, knowledge about caffeine, drinking tea/caffeine behavior, side effects, and physio-psychological changes related questions (perception) (Table 1).

Data analysis. As statistical tools for analysis, Microsoft Excel 2019 and the Statistical Package for Social Sciences (IBM SPSS Version 26) were utilized. The data were entered in Microsoft Excel for sorting, coding and editing. Later the Excel file was imported into the IBM SPSS Statistics 26. Pearson's chi-square (χ^2) statistic was applied to figure out the relationship between dependent and independent variables. Spearman's rank correlation coefficient was measured to evaluate the significance of the

correlated variables. The correlation was deemed to be significant at the 5% level, with a p-value of < 0.05.

Table 1. Questionnaire form of the study.

Questionnaire	Option
What is your gender?	• Male • Female
How old are you?	• <18 • 18– 23 • 24-29
What is your current educational level?	• Primary • Secondary • Higher secondary • Undergraduate • Postgraduate • Other:_____
Following which region do you live in?	• Metropolitan • Municipality • Suburb • Rural
Do you drink tea/coffee?	• Yes • No
Which one is more preferable to you between tea and coffee?	• Coffee • Tea • Both • None
Is drinking tea or coffee a part of your daily routine?	• Yes • No
How many cups of tea/coffee on average do you consume daily?	• 1 • 2 • 3 • 4 • 5 or more
Do you know that tea or coffee contains caffeine?	• Yes • No • May be
Caffeine is a central nervous system (CNS) stimulant.	• Yes • No • May be • I don't know
Have you experienced any types of side effects after taking tea or coffee multiple times a day?	• Yes • No
If you don't take tea or coffee in a day, do you experience any psycho-physiological change?	• Yes • No
Do you classify yourself as a tea/coffee addict?	• Yes • No
Do you think that tea/coffee addiction or withdrawal problems are psychological disorders?	• Yes • No • May be • I don't know

Ethical clearance. The study was carried out in accordance with the Helsinki Declaration (World Medical Association).[12] It was solely online questionnaire-based research that had no risk of harm to humans or animals and was not part of any clinical research. So, there was no need to take ethical approval. However, the consent of each respondent was taken in writing before participating in the research. The participant's personal information was kept confidential.

RESULTS AND DISCUSSION

Socio-demographic characteristics. In a total of 1020 respondents, both genders were nearly the same in frequency (51.6% male vs. 48.4% female). The age of the respondents was categorized into several groups. The majority (70%) belonged to the age group 18-23 years, while >23 years had the least frequency (7.5%) and <18 years were only in 22.5% (Table 2). Most of the respondents (68.6%) reported themselves to be an inhabitant of a metropolis, while the least (4.8%) was recorded from the suburbs area and 19.6% were from municipal. However, only 7% of the participants in this study were inhabitants of rural areas. The data analysis revealed that most respondents (60.9%) belonged to the undergraduate level, followed by higher secondary (21.6%) and secondary (12.7%), while the least were primary (0.8%) students (Table 2).

Table 2. Socio-demographic characteristics of the respondents (n=1020).

Socio-demographic characteristics		Frequency	Percentage (%)
Age	18 years or below	229	22.5
	Between 18-23 years	714	70
	Above 23 years	77	7.5
Gender	Male	526	51.6
	Female	494	48.4
Current Residence	Metropolitan	700	68.6
	Municipality	200	19.6
	Suburb	49	4.8
	Rural	71	7
Educational Level	Primary	8	0.8
	Secondary	130	12.7
	Higher secondary	220	21.6
	Undergraduate	621	60.9

Knowledge, behavior and perceptional patterns of the respondents. In the questionnaire form, most of the respondents answered correctly the two knowledge-based questions, "Do you know tea

or coffee contains caffeine?" and "Do you know caffeine is a central nervous system (CNS) stimulant?" (92.7% and 86.5%, respectively). In contrast, more than half of the respondents correctly answered another knowledge-related question, "Do you know tea or coffee addiction is a psychological disorder" (53.8% correct vs. 46.1% incorrect). The behavioral assessment showed that most students were tea or coffee consumers (94.8%), while they preferred tea, coffee or both in near frequencies (33%, 27.8% and 35.5%, respectively). Most of them (66%) drink tea or coffee as a part of their daily routine. Among the respondents, 45.5% population took at least 1 cup of tea or coffee, followed by 2 cups (35%), 3 cups (11.6%), 4 cups (4.5%) and 5 cups or more (3.4%). A considerable number of respondents were not regular consumers of tea or coffee (30.8%). The result of the perception section revealed that most participants were free from any side effects or physio-psychological effects (61.6% and 64.1%, respectively), while two-thirds of them did not consider themselves tea or coffee addicts. (67.1%) (Table 3).

Table 3. Knowledge, behavior and perception of the respondents (n=1020).

Aspect	Related questions	Response	Frequency	Percentage (%)
Knowledge	Tea or coffee contains caffeine	Yes	946	92.745
		No	74	7.255
	Caffeine is a central nervous system (CNS) stimulant	Yes	883	86.569
		No	137	13.431
	Tea or coffee addiction is a psychological disorder	Yes	549	53.824
		No	471	46.176
Behavior	Tea or coffee consumer	Yes	967	94.8
		No	53	5.2
	Preference between tea and coffee	Tea	337	33
		Coffee	280	27.5
		Both	365	35.8
		None	38	3.7
	Drink tea or coffee as a part of daily routine	Yes	674	66.1
		No	346	33.9
	Average daily consumption of tea or coffee (cups)	1	464	45.5
		2	357	35
		3	118	11.6
		4	46	4.5
		5 or more	35	3.4
		Nothing	314	30.8
Perception	Side effects experienced after taking tea or coffee multiple times in a day	Yes	392	38.4
		No	628	61.6
	Physio-psychological changes experienced if tea or coffee is not taken in a day	Yes	366	35.9
		No	654	64.1
	Tea or coffee addict	Yes	336	32.9
		No	684	67.1

Strength and association between socio-demographic characteristics and the knowledge, behavior & perceptions regarding caffeine consumption. Analysis revealed that the age variable was significantly associated ($p < 0.05$) with the knowledge-based questions, "Do you know tea or

coffee contains caffeine?" and "Do you know caffeine is a central nervous system (CNS) stimulant?" (Table 4). In contrast, another question "Do you know tea or coffee addiction can lead to a psychological disorder" was statistically insignificant (p-value > 0.05) in respect to age (Table 4). The association between the gender variable and the two knowledge questions, including "Do you know tea or coffee contains caffeine?" and "Do you know tea or coffee addiction can lead to a psychological disorder?" were also significant (p-value < 0.05) (Table 4). However, the second question "Do you know that caffeine is a central nervous system (CNS) stimulant?" was significant in the respect of gender at a 5% significance level (p-value > 0.05). Simultaneously, the "current residence" of the students was associated with the first two knowledge questions,

"Do you know tea or coffee contains caffeine?" and "Do you know caffeine is a central nervous system (CNS) stimulant?", while insignificant with the third question, "Do you know tea or coffee addiction can lead to a psychological disorder?" (p-value > 0.05) (Table 4). The "educational qualification of the students" was significantly correlated with the first two knowledge questions, "Do you know tea or coffee contains caffeine?" and "Do you know caffeine is a central nervous system (CNS) stimulant?" of the knowledge category (Table 4). However, there was a lack of association between the educational qualification of the students and the third question of knowledge, "Do you know tea or coffee addiction can lead to a psychological disorder?" (p-value > 0.05) (Table 4).

Table 4. Association and strength between socio-demographic characteristics and the knowledge, behavior & perceptions regarding caffeine consumption.

Socio-demographic characteristic	Statistical tools and results	Knowledge, behavior and perceptions regarding caffeine consumption									
		Knowledge			Behavior				Perceptions		
		Tea or coffee contains caffeine	Caffeine is a central nervous system (CNS) stimulant	Tea or coffee addiction is a psychological disorder	Tea or coffee consumer	Preference between tea and coffee	Drinks tea or coffee as a part of daily routine	Average daily consumption of tea or coffee (cups)	Side effects experienced after taking tea or coffee multiple times in a day	Physio-psychological changes experienced if tea or coffee is not taken in a day	Tea or coffee addict
Age	Spearman rank correlation coefficient (r)	-0.140	-0.122	-0.015	-0.038	0.050	-0.061	0.174	-0.056	-0.092	-0.124
	χ^2-statistic	22.681	17.959	1.846	3.628	13.076	3.803	32.612	5.592	8.597	15.867
	df	2	2	2	2	6	2	8	2	2	2
	p-value	0.000	0.000	0.397	0.163	0.042	0.149	0.000	0.061	0.014	0.000
Sex	Spearman rank correlation coefficient (r)	0.097	0.019	0.067	0.006	0.051	0.044	0.000	0.118	0.167	0.114
	χ^2-statistic	9.617	0.379	4.625	0.36	2.817	1.958	2.485	14.096	28.320	13.215
	df	1	1	1	1	3	1	4	1	1	1
	p-value	0.002	0.538	0.032	0.850	0.421	0.162	0.647	0.000	0.000	0.000
Current residence	Spearman rank correlation coefficient (r)	0.060	0.131	0.016	0.013	0.038	0.058	-0.029	0.009	0.044	0.034
	χ^2-statistic	28.019	44.945	3.748	3.258	26.064	12.646	18.951	0.814	5.198	4.845
	df	3	3	3	3	9	3	12	3	3	3
	p-value	0.000	0.000	0.290	0.354	0.002	0.005	0.090	0.846	0.158	0.183
Educational level	Spearman rank correlation coefficient (r)	-0.205	-0.189	-0.026	-0.022	0.014	-0.045	0.154	-0.057	-0.062	-0.116
	χ^2-statistic	69.119	67.265	7.953	2.259	29.886	6.448	40.225	5.865	12.603	16.353
	df	4	4	4	4	12	4	16	4	4	4
	p-value	0.000	0.000	0.093	0.688	0.003	0.168	0.001	0.209	0.013	0.003

Except for "Do you consume tea or coffee?" and "Do you drink tea or coffee as a part of your daily routine?" respectively, the age variable was statistically correlated with the behavior questions at the 5% significance level (Table 4). In contrast, none of the behavior questions were significantly associated with the gender variable. The "current residency of the students" variable was related to the questions of the behavior category, "Any preference between tea and coffee?" and "Do you drink tea or coffee as a part of your daily routine?", with p-values of 0.002 and 0.005, respectively. At a 5% level of significance, the educational level variable was significantly correlated with behavior categories concerning the second and fourth behavior questions "Any preference between tea and coffee?" and "Any preference between tea and coffee?" (Table 4). In perception categories, except for the, "Do you experience any side effects after taking tea or coffee multiple times in a day?", age was statistically significant with the rest of the two questions, "Have you experienced any physio-psychological change if tea or coffee is not taken in a day?" and "Any addiction for tea or coffee?" ($p < 0.05$). However, the gender variable was associated with all the perception-based questions. Furthermore, none of the perception-based questions was associated with the current residence variable (p-value > 0.05). The educational level variable was significant ($p < 0.05$) with the second and third perception category questions, "Have you experienced any physio-psychological change if tea or coffee is not taken in a

day?" and "Any addiction to tea or coffee?". The educational level had a weak negative correlation with the knowledge regarding the first question, "Do you experience any side effects after taking tea or coffee multiple times in a day?". Except for this, all other correlations were negligible (Table 4).

Association and strength between behavior and perceptions regarding caffeine consumption. At a 5% level of significance, the third and fourth questions, "Do you drink tea or coffee as a part of your daily routine?" and "Any preference between tea and coffee?" of the behavior category were not statistically related to the first question of the perception category "Do you experience any side effects after taking tea or coffee multiple times in a day?" (Table 5). At the same time, they were significantly associated with the second question, "Have you experienced any physio-psychological change if tea or coffee is not taken in a day?" of the perception category (Table 5). From the analysis, it is clear that drinking tea or coffee as a part of daily routine positively correlates with physio-psychological changes experienced if tea or coffee is not taken in a day. In contrast, there is no correlation with side effects experienced after taking tea or coffee multiple times daily. On the other hand, the average daily consumption of tea or coffee (cups) is negatively correlated with physio-psychological changes experienced if tea or coffee is not taken in a day. In contrast, there is no correlation with side effects experienced after taking tea or coffee multiple times daily (Table 5).

Table 5. Association and strength between behavior and perceptions regarding caffeine consumption.

Behavior	Statistical tools and results	Perception	
		Side effects experienced after taking tea or coffee multiple times in a day	Physio-psychological changes experienced if tea or coffee is not taken in a day
Drinks tea or coffee as a part of daily routine	Spearman rank correlation coefficient (r)	-0.004	0.428
	χ^2-statistic	0.020	186.903
	Df	1	1
	p-value	0.889	0.000
Average daily consumption of tea or coffee (cups)	Spearman rank correlation coefficient (r)	-0.027	-0.442
	χ^2-statistic	1.718	202.324
	Df	4	4
	p-value	0.787	0.000

As the investigation was conducted over the phone and online media, the results revealed that urban youth were more engaged in online social media than those from other socio-demographic groups. The male-to-female ratio was nearly equal, showing that both sexes were equally involved in mobile and online activities. Students <18 years may have fewer opportunities to connect to the internet whereas students >23 years were likely less accessible via the internet (Table 2).

By correctly answering the knowledge-based questions, the outcome demonstrates that the majority of Bangladeshi students may have a basic understanding of tea or coffee as a caffeine source as well as its pharmacological activity. However, many of the respondents were unaware of the psychological risks that are associated with caffeine consumption. The results also revealed that tea, coffee and a combination of the two are very popular among Bangladeshi students, while tea is a little bit more popular than coffee. This finding pattern is nearly the same as in a previous study, where the majority of the population chose tea (83.7%), followed by coffee (14.7%) and a few (1.6%) took both tea and coffee.[13] Kabir *et al*. mentioned in their study that the food style of Bangladeshi students depends on their campus environment, living, social influences, educational work, food costs and supply as well as their ambient environment.[10] Drinking tea and coffee is not an exception to that. The study showed that for various surrounding factors such as educational level, residency, age and sex, the popularity of tea and coffee may vary from person to person.

As a student's life is very tough, the students feel stress that may originate from a variety of sources, including academic pressures, personal lives and the environment. Undergraduate students, in particular, require regular caffeine intake to cope with academic, mental and emotional stress.[14] Furthermore, the depression, stress and anxiety level of the students also significantly increased during examination time.[15] Champlin *et al*.[14] and Majori *et al*.[16] indicated in their studies that energy drinks and tea are the first

options for students to improve concentration and feel less weary during the exam period. It may be the reason why a huge number of students in Bangladesh consume caffeine-containing drinks such as, tea or coffee.

Caffeine may assist students to deal with stress and perform efficiently because of the harried and weary life in the metropolis.[17,18] Some people may become addicted to excessive consumption as well as build a tolerance to it over time. Rajaseharan *et al*. stated in their study that consumption within a limited range of caffeine has no detrimental consequences, while extended intake may cause addiction.[19] Another two studies' results revealed that caffeine intake should be recommended up to 4 cups per day (a cup of coffee can contain 80-175 mg of caffeine).[20,21] So, those students who drink 5 or more cups may develop caffeine addiction and withdrawal symptoms. However, using within the recommended range, the regular consumer may have experienced beneficial effects of the caffeine such as better reaction time, wakefulness, focus and motor coordination.[22,23] They may also get some benefits because moderate intake of caffeine has no association with harmful events. Furthermore, it may be beneficial for cardiovascular diseases such as arrhythmias, coronary artery disease and heart failure.[24]

Though which side effects our respondents suffered were not considered in our study, according to the questionnaire, many of the individuals in our study reported experiencing side effects and psychological changes because of their tea or coffee consumption. Caffeine affects gastrointestinal motility and gastric acid output; therefore, these alterations could be linked to the gastrointestinal tract.[25] Due to a diuretic and natriuretic action, acute caffeine consumption promotes urination in patients who have been devoid of caffeine for several days.[26] They have the risk of being dehydrated. Due to tolerance, chronic users may not experience this effect.[27] Minor psycho-physiological changes in students may not necessitate a clinical diagnosis for

psychiatric problems. Mild anxiety, jitteriness, sleeplessness, increased sleep latency, and decreased coordination are some of the symptoms.[22] Those who suffer from anxiety or panic disorders may require medical attention. Some students may experience and aggravate anxiety as a result of excessive tea or coffee consumption,[28] while some people may feel less anxious once they stop drinking tea or coffee.[29] However, moderate doses of tea or coffee may be beneficial to depressed students and may reduce the risk of depression in others.[30] In general, the students might label themselves as tea or coffee addicts. Furthermore, clinical diagnosis is required in the case of caffeine addiction.

The outcomes of this study show that students' knowledge of tea or coffee, as well as its pharmacology, may improve as they get older, as there was no substantial gender bias in the knowledge-based questions (Table 4). Norton *et al.* also stated the same patterns in their study in 2011.[31] The residential area and educational level are also important to determine the student's knowledge of tea and coffee as well as caffeine. However, age, gender, place of residence and education may not have an impact on all areas of knowledge. In particular, the psychological relevance of tea or coffee requires a great deal of attention. None of the variables are significantly associated with side effects connected to tea or coffee consumption. As a result, everyone, regardless of age, gender, location or educational level, could be affected. Age, gender and place of residence may all influence how people perceive drinking tea and coffee. In this scenario, the current residence is an exception.

There were no significant association between the two question "Do you drink tea or coffee as a part of your daily routine?" and "How many cups of tea/coffee on average do you consume daily?" (Table 5). This can be explained by the findings of the study of Evans and Griffiths.[32] The regular intake of caffeine develops a tolerance; thus, the chronic consumer of tea and coffee generally does not face any such effects.[33] However, daily consumption and a higher number of cups may also lead to caffeine

dependence, as a result, physio-psychological changes might be experienced if tea or coffee is not taken in a day.[33] The significant association of "Have you experienced any physio-psychological change if tea or coffee is not taken in a day?" with the "Do you drink tea or coffee as a part of your daily routine?" and "How many cups of tea/coffee on average do you consume daily?" –can be explained by their findings.

To the best of our knowledge, this study is one of the few that offers perspective on the knowledge, behavior and perception of caffeine consumption among Bangladeshi students. The study form was disseminated to the entire Bangladesh. According to the findings of this study, students in Bangladesh may consume tea and caffeine in moderation and should be aware of the negative consequences of excessive caffeine use.

Although this study provides precise data on caffeine knowledge, behavior and perception among Bangladeshi students based on tea and coffee intake, it has several drawbacks. Because it is an online investigation, students who are uncomfortable with the internet may choose to skip it. Furthermore, the students' knowledge, behavior and perception levels were self-perspective data that may be skewed. Cross-sectional research cannot prove causality. Finally, each of this information was related to the individual providing it and it might have been influenced by the social desirability of a person.

CONCLUSION

In Bangladesh, students consume caffeine-containing drinks like coffee and tea in significant amounts, but they mainly prefer tea over coffee. With excessive caffeine intake, students may also have the risk of developing a caffeine dependency, which could exacerbate the symptoms of caffeine withdrawal. Students may have a decent understanding of the general facts and possible negative effects of caffeine in tea and coffee, but the present results showed that students lack an accurate perception of caffeine dependency and withdrawal symptoms. Additional studies are required to determine whether more participants are addicted to

tea and coffee. Therefore, there must be a link between caffeine consumption and the drinking of tea and coffee. However, further clinical study is required to confirm the findings of the study.

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DISCLOSURE STATEMENT

The authors declare that there is no conflict of interest.

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