



The Relationship Between Caffeine Consumption and Depression, Anxiety, Stress Level and Sleep Quality in Medical Students

Tıp Fakültesi Öğrencilerinde Kafein Kullanımıyla Depresyon, Anksiyete, Stres Düzeyi ve Uyku Kalitesi Arasındaki İlişki

İrem Akova, Elif Nur Duman, Ayça Elçim Sahar, Ergün Haldun Sümer

Sivas Cumhuriyet University Faculty of Medicine, Department of Public Health, Sivas, Turkey

Abstract

Objective: This study examined the relationship between caffeine use and depression, anxiety, stress level and sleep quality in medical students.

Materials and Methods: This cross-sectional study was conducted between March 1, and April 15, 2022, by applying a face-to-face questionnaire to 700 medical students. Depression Anxiety Stress Scale-21 and the Pittsburgh Sleep Quality Index were used.

Results: In the last month, more than 80% of medical students consumed caffeine as tea, solid foods containing caffeine, and coffee. Female gender, increasing age, class level, smoking, family income and place of residence were the factors affecting the caffeine use among students. Caffeine consumption increased in those with high anxiety and stress scores. 73.1% of medical students had poor sleep quality, and as sleep quality worsened, students' caffeine use increased.

Conclusion: It may be offer medical students other alternatives instead of increased caffeine consumption to cope with anxiety and stress and to improve sleep quality.

Keywords: Medical student, caffeine, depression, anxiety, stress, sleep

Öz

Amaç: Bu çalışmanın amacı tıp fakültesi öğrencilerinde kafein kullanımı ile depresyon, anksiyete, stres düzeyi ve uyku kalitesi arasındaki ilişkinin incelenmesidir.

Gereç ve Yöntem: Kesitsel tipteki bu çalışma 1 Mart 2022-15 Nisan 2022 tarihleri arasında toplamda 700 tıp fakültesi öğrencisiyle yüz yüze anket uygulanarak yürütülmüştür. Çalışmaya katılan öğrencilere sosyodemografik veri formu, Depresyon Anksiyete Stres Ölçeği-21 ve Pittsburg Uyku Kalitesi İndeksi anketleri uygulanmıştır.

Bulgular: Son bir ay içerisinde tıp fakültesi öğrencilerinin %80'inden fazlasının çay, kafein içeren katı gıdalar ve kahve olarak kafein tükettiği görüldü. Kadın cinsiyet, artan yaş, sınıf düzeyi, sigara kullanımı, ailenin gelir düzeyi ve yaşanılan yer, öğrencilerin kafein kullanımını etkileyen faktörlerdi. Artan depresyon puanının kafein tüketimi üzerinde anlamlı bir etkisi yoktu. Fakat anksiyete ve stres puanı yüksek olanlarda kafein tüketiminin arttığı görüldü. Tıp fakültesi öğrencilerinin üçte ikisinden fazlası kötü uyku kalitesine sahipti ve uyku kalitesi kötüleştikçe öğrencilerin kafein kullanımı artmaktaydı.

Sonuç: Tıp öğrencilerine anksiyete ve stresle baş etmek ve uyku kalitesini iyileştirmek için artan kafein tüketimi yerine başka alternatifler sunmak gerektiğini düşünmekteyiz.

Anahtar Kelimeler: Tıp öğrencisi, kafein, depresyon, anksiyete, stres, uyku

Introduction

Caffeine (1,3,7 trimethyl xanthine) is a widely used legal psychostimulant substance that affects the central nervous system (1). Caffeine exerts its pharmacological effect by antagonizing adenosine receptors. The receptors it acts on are associated with sleep, arousal and cognitive parts of the brain (2). A safe dose intake of caffeine is said to be 250 mg

(500 mL beverage) per day. It has been shown that consuming more than 1 g of caffeine per day may cause toxic effects (3). The United States Food and Drug Administration, Health Canada, and the European Food Safety Authority (EFSA) have determined that a daily intake of 400 mg of caffeine is unlikely to be associated with a low risk of serious adverse events in the adult population. However, a maximum of 2.5 mg/kg per day

Address for Correspondence/Yazışma Adresi: İrem Akova MD, Sivas Cumhuriyet University Faculty of Medicine, Department of Public Health, Sivas, Turkey

Phone: +90 507 651 68 13 E-mail: irem-007@hotmail.com ORCID-ID: orcid.org/0000-0002-2672-8863

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by Health Canada and a maximum of 3 mg/kg per day by EFSA are recommended doses for children and adolescents (4). Although coffee is the most widely used beverage containing caffeine, many other caffeine-containing substances are in our lives, consciously or unconsciously. For these, we can give examples such as energy drinks, cold tea, tea, cola and chocolate (3). In the last 2 years, coffee consumption in the world has approached 166.63 million (from 60 kg bags) (5). High-dose caffeine intake is known to be associated with irritability, insomnia, depression, and anxiety (6-8). Especially in adolescents, caffeine accelerates aggression and reduces sleep hours (8). The decrease in sleep quality also causes a decrease in learning capacity and a decrease in performance (9). In addition to all these, considering its positive effects (increasing attention, relieving insomnia, etc.), caffeine is a very good psychostimulant for the young population studying at a medical school, where education continues and where it is necessary to focus on a desk for a long time (10).

Caffeine use has increased considerably in recent years to reduce the negative effects of depression, anxiety, stress levels and sleep patterns for academic success in medical school and continuing clinical training (10). In a study of medical school students, it was reported that most students use coffee moderately as a source of caffeine, and this amount is only slightly increased in high-stress situations such as exams (11). In a study conducted in 2011, it was shown that the consumption of beverages containing caffeine, such as energy drinks, increased in students under stress (12). Similarly, in a study conducted among second-year medical students in Pakistan in 2010, it was emphasized that the consumption of caffeinated beverages increased during stressful times such as exam times (13). In a survey conducted among 700 university students in Bahyren in 2020, the relationship between psychological symptoms and caffeine was examined and symptoms such as headache, panic attacks, and anxiety due to high caffeine intake were observed (14).

The aim of this study was to determine the amount of caffeine use in medical school students, considering sociodemographic characteristics, and to examine the relationship between caffeine use and depression, anxiety, stress level and sleep quality.

Materials and Methods

This cross-sectional study was carried out between 1 March 2022 and 15 April 2022 with Sivas Cumhuriyet University Faculty of Medicine term 1st, 2nd, 3rd, 4th, 5th, and 6th grade students. According to the information received from the Dean's Office, the total number of students studying in these classes was 1143 for the 2021-2022 academic year. Minimum sample size was calculated as 553 using the formula $n = \frac{DEFF * Np(1-p)}{[(d^2/Z^2_{1-\alpha/2} * (N-1) + p * (1-p))]$ in OpenEpi (Version 3) (N=1143, the effect value $d = 3\%$, confidence interval = 95%, $p = 50\%$). The number of students in each class considered as a stratum was calculated and proportioned to the number of samples. Thus, the number of students from each class to enter the sample was determined. In total, 808 (70.7%) students were reached.

Students (108 students-13.4%) who were previously diagnosed with any psychiatric disease and were using medication for this reason were not included in the study (this situation was questioned in the sociodemographic data form). The study was completed with 700 (61.2%) students.

Ethical approval (decision no: 2022-01/16, date: 13.01.2022) was obtained from Sivas Cumhuriyet University Non-Interventional Ethics Committee for the study. Necessary permission for the study was obtained from the Dean of the Faculty of Medicine (number: 134847, date: 21.02.2022). Students who agreed to participate in the study were informed about the study and their written informed consent was obtained. The data collection process was carried out in accordance with the Declaration of Helsinki rules. Data collection tools were applied face-to-face to the participants by the researchers.

Sociodemographic Data Form, Depression Anxiety Stress Scale-21 (DASS-21) and Pittsburgh Sleep Quality Index (PSQI) were used to obtain research data.

The sociodemographic data form was consisted of a total of 17 questions about age, gender, body weight, height, class, smoking, alcohol use, academic achievement, history of psychiatric illness (depression, anxiety, etc.), and beverages containing caffeine (consumed in the last month).

DASS-21 is a four-point Likert-type scale containing 7 questions for each of the depression, stress, and anxiety dimensions. "Not suitable for me" was coded as 0, "somewhat suitable for me" was coded as 1, "usually suitable for me" was coded as 2, and "completely suitable for me" was coded as 3 (15). According to Lovibond S., and Lovibond P., normal scores from three subscales are less than 9 for depression, 7 for anxiety, and less than 14 for stress (16). The validity and reliability study of the Turkish version of the scale was performed by Yilmaz et al. (17) According to the Turkish validity and reliability study, Cronbach's alpha values of DASS-21 subscales were found to be 0.81 for depression, 0.80 for anxiety, and 0.75 for stress (17).

PSQI was used to determine the sleep duration and quality of individuals (18). It consists of 19 items and its score varies between 0-21 points. Sleep quality is good when the score is lower than five, and poor sleep quality when it is five or higher. Sensitivity and specificity were found to be 89.6% and 86% (18). Ağargün et al. (19) revealed the Turkish reliability and validity study of the test.

Statistical Analysis

The data obtained from our study were evaluated with the SPSS 22.0 (IBM Corp., Armonk, NY, USA) package program. Numerical variables were given as mean and standard deviation, categorical variables as numbers and percentages. The normality of the data was checked with the Kolmogorov-Smirnov test. Binary logistic regression analysis was used to determine the relationship between caffeine use and other characteristics. While performing the logistic regression analysis, gender, age, class, body mass index, smoking, alcohol use, monthly family income, place of residence, depression, anxiety, stress, and sleep quality scores were included in the model for each questioned caffeine-containing food. Afterwards, first graders

were excluded, and academic success was included in the same model for each caffeine-containing food. Reliability analysis of the scales used was made. Cronbach's alpha values of DASS-21 subscales were 0.895 for depression, 0.842 for anxiety, and 0.876 for stress. $p < 0.05$ was considered significant.

Results

The descriptive characteristics of the participants are presented in Table 1. Most of the students participating in the study were female, most of them did not smoke or drink alcohol, 96.3% of them had an academic grade of over 2. Those staying with families were in the minority. More than one-third of the students had high levels of depression and anxiety, and most had poor sleep quality (Table 1).

Table 2 shows descriptive statistics for caffeine consumption over the past month. In the last month, of the students, 89% had consumed at least one glass of tea, 83% had consumed at least once solid foods containing caffeine, 81.9% had consumed at least one cup of coffee, 44.3% had consumed at least one glass of herbal tea, 37% had consumed at least one glass of cola and 8.1% had consumed at least one glass of energy drink (Table 2).

The logistic regression model estimating the relationship between caffeine-containing beverage/food consumption and other characteristics is given in Table 3. Having a female gender increased the consumption of coffee 2.4 times ($p < 0.001$), increased the consumption of herbal tea 4.1 times ($p < 0.001$), increased the consumption of solid foods containing caffeine 1.9 times ($p = 0.007$) and decreased the consumption of cola ($p < 0.001$). Energy drink consumption increased 1.2 times ($p = 0.024$) with increasing age. Those in the 2nd, 3rd, 4th, or 5th grade had higher tea consumption (2.2, 2.7, 2.9, and 17.7 times, respectively), while those in the 6th grade had a 3.2 times higher coffee consumption. While the consumption of cola was less in the 2nd ($p = 0.006$) or 4th ($p = 0.016$) grade students, the energy drink consumption was less in the 5th ($p = 0.005$) or 6th ($p = 0.001$) graders. Smoking increased the consumption of coffee 3.5 times ($p = 0.003$), increased the consumption of cola 1.8 times ($p = 0.019$), and increased the consumption of energy drink 7.2 times (< 0.001). Increasing family income increased the consumption of herbal tea 1.01 times ($p = 0.004$). While staying in dormitory increased the herbal tea consumption 1.8 times ($p = 0.011$), staying in student house decreased the consumption of tea ($p = 0.013$). Increasing depression score decreased the consumption of energy drink ($p = 0.038$). Increasing anxiety score increased the consumption of solid foods containing caffeine 1.1 times ($p = 0.041$). Increasing stress score increased the consumption of cola 1.1 times ($p = 0.020$). Worsening sleep quality increased the coffee ($p = 0.026$), tea ($p = 0.032$) and cola ($p = 0.014$) consumption 1.1 times.

Discussion

As caffeine use is becoming more and more common among medical students, given the above-average amount of stress in their daily lives (10,11,13,20), this study examined the relationship between medical school students' caffeine use and their depression, anxiety, stress levels, and sleep quality.

In our study, we observed that more than 80% of medical school students consumed caffeine as tea, solid foods containing caffeine, and coffee in the last month. In another study conducted with university students in Turkey, it was determined

Table 1. Descriptive characteristics of the participants (n=700)	
	Value
Gender	
Female	395 (56.4)
Male	305 (43.6)
Age (years)	21.6±2.6
Year level	
1	160 (22.9)
2	133 (19.0)
3	84 (12.0)
4	79 (11.3)
5	108 (15.4)
6	136 (19.4)
Body mass index	22.9±3.4
Smoking	
No	568 (81.1)
Yes	137 (18.9)
Alcohol drinking	
No	563 (80.4)
Yes	137 (19.6)
Self-reported academic grades* (n=540)	
1-2	20 (3.7)
2-3	216 (40.0)
3 and over	304 (56.3)
Monthly family income	9912.1±10134.0
Place of residence	
Homestay	195 (27.9)
Dormitory	272 (38.9)
Student house	233 (33.2)
Depression**	
Normal	486 (69.4)
High	214 (30.6)
Anxiety**	
Normal	448 (64.0)
High	252 (36.0)
Stress**	
Normal	621 (88.7)
High	79 (11.3)
Sleep quality***	
Good	188 (26.9)
Poor	512 (73.1)
n: Number of participants. Values are presented as mean ± standard deviation or number (%).	
*Except for first year students, **Depression Anxiety Stress Scale-21 results, ***Pittsburgh Sleep Quality Index results.	

that the most consumed caffeine source was tea with a rate of 81%, like the one in our study (3). Since Turkey leads the world in terms of annual per capita tea consumption by countries (21), these findings in our country are not surprising. In a recent review, it was reported that the most common stimulant used by medical students was coffee, followed by other types of caffeine such as tea and sugary energy drinks (10). In a study conducted with adolescents, like our study, it was reported that 10.3% of students drank more than one can of high-caffeine energy drink per month (9).

In our study, female gender, increasing age, class level, smoking, family income and place of residence were the factors affecting the caffeine use of students. It was remarkable that coffee consumption was higher only in interns and tea consumption was much higher in fifth and sixth grade students. As a matter of fact, in the study conducted by MacLean et al. (22), it was reported that the stress level of most of the senior medical school students increased, and in the study conducted by Iqbal et al. (23), the highest anxiety level was found in those studying in the fifth grade. As we observed in our study, the increase in students' caffeine consumption with increasing anxiety

and stress scores supports this situation. On the other hand, similar to our study, there is a study reporting that caffeine consumption does not affect academic performance among university students, as well as a study showing that it reduces academic achievement (9,24).

In our study, increasing depression score did not have a significant effect on caffeine consumption, but as an expected situation, we observed that energy drink consumption decreased as the depression score increased. On the other hand, those with high anxiety and stress scores had an increased caffeine consumption. In some other studies, it was reported that the caffeine consumption of medical students increased as they were under stress (11,13). In addition, it has been demonstrated that high-dose caffeine intake increases the level of stress and may be associated with anxiety and depression (14,25,26). In a study conducted among 10th grade students in Istanbul in 2015, it was shown that substance use or use of caffeinated beverages increased in students with high anxiety levels (27). Likewise, in a study conducted among young people in Austria in 2014, it was found that the tendency to use caffeinated beverages increased in those with high anxiety levels (28).

Sleep deprivation is common among university students, and in a study, it was reported that 71% of university students slept poorly and did not feel rested in at least five of the last seven days (29). In our study, we observed that more than two-thirds of medical students had poor sleep quality. It has been reported that caffeine use has increased in medical students to reduce the negative effects of sleep patterns (10). As a matter of fact, in our study, we found that as the sleep quality deteriorated, the caffeine use of the students increased. In a study conducted in the United States, it was determined that the consumption of energy drinks containing caffeine is a popular practice among university students and that the consumption of these drinks increases especially if the student has insufficient sleep (30). However, it is necessary to be careful about caffeine consumption because there are studies reporting that caffeine consumption worsens sleep quality (9,26,31).

The limitations of our study can be listed as follows. Students' depression, anxiety, stress levels and sleep quality were determined using only scales. The mental status assessments of the participants were not supported by clinical examinations. On the other hand, as far as we know, this study is important in that it is the first study in Turkey to examine the relationship between caffeine use in medical students and their mental state and sleep quality.

Conclusion

As a result, in our study, we found that more than 80% of medical students consumed caffeine in the form of tea, solid foods containing caffeine, and coffee in the last month. Female gender, increasing age, class level, smoking, family income and place of residence were the factors affecting the caffeine use of students. Increasing depression score did not have a significant effect on caffeine consumption, but caffeine consumption increased in those with high anxiety and stress scores. More than two-thirds of medical students had poor sleep quality,

Table 2. Descriptive statistics for caffeine consumption (in the last month) (n=700)

	n (%)
Coffee*	
Never	127 (18.1)
1-2 cups a day	484 (69.1)
3 or more cups a day	89 (12.7)
Tea	
Never	77 (11.0)
1-2 glasses a day	412 (58.9)
3 or more glasses a day	211 (30.1)
Cola	
Never	441 (63.0)
1-2 glasses a day	241 (34.4)
3 or more glasses a day	18 (2.6)
Herbal tea	
Never	390 (55.7)
1-2 glasses a day	284 (40.6)
3 or more glasses a day	26 (3.7)
Energy drink	
Never	643 (91.9)
1-2 glasses a day	50 (7.1)
3 or more glasses a day	7 (1.0)
Solid foods containing caffeine**	
Never	119 (17.0)
1-2 times a day	502 (71.7)
3 or more per day	79 (11.3)
n: Number of participants	
*Nescafe, filter coffee, Turkish coffee, espresso derivatives. **Milk/dark chocolate, cookies, cake	

Table 3. Descriptive statistics for caffeine consumption (in the last month) (n=700)

Characteristics	Coffee (at least one cup a day)*	Tea (at least one glass a day)*	Cola (at least one glass a day)*	Herbal tea (at least one glass a day)*	Energy drink (at least one glass a day)*	Solid foods containing caffeine (at least once a day)*
	OR ₃ (95% CI), p	OR ₃ (95% CI), p	OR ₃ (95% CI), p	OR ₃ (95% CI), p	OR ₃ (95% CI), p	OR ₃ (95% CI), p
Gender (Ref C= Male)						
Female	2.37 (1.50-3.72), <0.001	1.40 (0.81-2.41), 0.224	0.50 (0.35-0.71), <0.001	4.12 (2.82-6.00), <0.001	0.71 (0.37-1.37), 0.304	1.89 (1.19-3.00), 0.007
Age (years)	0.96 (0.85-1.09), 0.550	0.99 (0.86-1.16), 0.951	1.08 (0.97-1.20), 0.160	1.05 (0.94-1.17), 0.369	1.18 (1.02-1.37), 0.024	0.91 (0.79-1.04), 0.176
Year level (Ref C= 1)						
2	1.54 (0.82-2.89), 0.183	2.19 (1.08-4.44), 0.030	0.48 (0.48-1.04), 0.006	1.20 (0.72-2.02), 0.488	0.53 (0.22-1.28), 0.156	1.96 (0.92-4.16), 0.080
3	1.32 (0.64-2.74), 0.450	2.65 (1.05-6.69), 0.039	0.80 (0.48-1.04), 0.473	0.66 (0.35-1.25), 0.203	0.41 (0.14-1.22), 0.109	0.99 (0.45-2.16), 0.974
4	1.84 (0.79-4.29), 0.161	2.86 (1.03-7.94), 0.044	0.42 (0.48-1.04), 0.016	0.73 (0.36-1.49), 0.385	0.33 (0.09-1.20), 0.093	1.28 (0.53-3.09), 0.577
5	1.59 (0.65-3.89), 0.312	17.73 (3.40-92.51), 0.001	0.53 (0.48-1.04), 0.089	0.72 (0.34-1.53), 0.394	0.15 (0.04-0.57), 0.005	1.70 (0.65-4.41), 0.277
6	3.16 (1.15-8.67), 0.026	4.17 (1.27-13.67), 0.018	0.50 (0.48-1.04), 0.087	0.63 (0.28-1.41), 0.259	0.09 (0.02-0.37), 0.001	2.15 (0.77-6.01), 0.147
Body mass index	1.03 (0.96-1.11), 0.370	0.99 (0.92-1.08), 0.929	1.01 (0.96-1.06), 0.742	1.02 (0.96-1.07), 0.580	0.98 (0.90-1.08), 0.731	0.99 (0.94-1.07), 0.946
Smoking (Ref C= No)						
Yes	3.51 (1.54-7.97), 0.003	1.45 (0.64-3.25), 0.372	1.77 (1.10-2.84), 0.019	1.13 (0.69-1.85), 0.642	7.23 (3.37-15.51), <0.001	0.75 (0.42-1.34), 0.328
Alcohol drinking (Ref C= No)						
Yes	1.30 (0.64-2.61), 0.468	0.77 (0.36-1.65), 0.499	0.84 (0.52-1.36), 0.482	1.58 (0.98-2.57), 0.062	1.19 (0.56-2.55), 0.653	1.08 (0.60-1.96), 0.797
Self-reported academic grades** (n=540) (Ref C= 1-2)						
2-3	1.18 (0.29-4.78), 0.820	0.38 (0.05-3.16), 0.371	1.35 (0.49-3.74), 0.563	3.23 (0.99-10.49), 0.052	32.7 (0.01-99.9), 0.998	1.31 (0.41-4.19), 0.644
3 and over	1.03 (0.26-4.18), 0.965	0.38 (0.04-3.16), 0.367	1.19 (0.43-3.31), 0.736	2.98 (0.92-9.67), 0.070	35.7 (0.01-99.9), 0.998	1.12 (0.35-3.58), 0.844
Monthly family income	1.01 (1.01-1.01), 0.066	1.01 (1.01-1.01), 0.208	1.01 (1.01-1.01), 0.773	1.01 (1.01-1.01), 0.004	1.01 (1.01-1.01), 0.310	1.01 (1.01-1.01), 0.303
Place of residence (Ref C= Homestay)						
Dormitory	1.03 (0.62-1.73), 0.907	0.71 (0.36-1.42), 0.336	1.24 (0.81-1.89), 0.329	1.75 (1.14-2.70), 0.011	1.02 (0.43-2.40), 0.966	1.75 (0.99-3.10), 0.055
Student house	0.78 (0.45-1.36), 0.380	0.39 (0.18-0.82), 0.013	1.05 (0.68-1.63), 0.818	1.47 (0.95-2.28), 0.083	1.10 (0.46-2.64), 0.834	0.74 (0.44-1.25), 0.255
Depression score***	1.01 (0.95-1.06), 0.902	0.97 (0.91-1.03), 0.358	0.98 (0.94-1.02), 0.325	0.99 (0.95-1.05), 0.586	0.93 (0.86-0.99), 0.038	0.96 (0.91-1.01), 0.105
Anxiety score***	1.01 (0.94-1.07), 0.930	0.97 (0.90-1.05), 0.483	0.97 (0.93-1.03), 0.312	1.01 (0.95-1.05), 0.958	1.04 (0.95-1.14), 0.366	1.08 (1.01-1.16), 0.041
Stress score***	1.01 (0.94-1.07), 0.996	1.01 (0.93-1.08), 0.916	1.06 (1.01-1.11), 0.020	1.04 (0.99-1.09), 0.160	1.08 (0.99-1.17), 0.083	1.06 (0.99-1.13), 0.098
Sleep quality score***	1.11 (1.01-1.21), 0.026	1.12 (1.01-1.23), 0.032	1.08 (1.02-1.16), 0.014	0.99 (0.93-1.06), 0.821	1.09 (0.98-1.21), 0.124	0.99 (0.91-1.07), 0.756

*Reference category= Never, **Except for first year students, ***Depression Anxiety Stress Scale-21 results, ****Pittsburgh Sleep Quality Index results
n: Number of participants, OR₃: Adjusted odds ratio, CI: Confidence interval, Ref C: Reference category

and as sleep quality worsened, students' caffeine use increased. We think that it is necessary to offer medical students other alternatives instead of increased caffeine consumption to cope with anxiety and stress and improve sleep quality.

Ethics

Ethics Committee Approval: Ethical approval (decision no: 2022-01/16, date: 13.01.2022) was obtained from Sivas Cumhuriyet University Non-Interventional Ethics Committee for the study.

Informed Consent: Students who agreed to participate in the study were informed about the study and their written informed consent was obtained.

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Authorship Contributions

Concept: İ.A., E.N.D., A.E.S., E.H.S., Design: İ.A., E.N.D., A.E.S., E.H.S., Data Collection or Processing: E.N.D., A.E.S., Analysis or Interpretation: İ.A., E.N.D., A.E.S., E.H.S., Literature Search: İ.A., E.N.D., A.E.S., E.H.S., Writing: İ.A., E.N.D., A.E.S., E.H.S.

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