HYGIENIC ASSESSMENT OF COFFEE AND CAFFEINATED BEVERAGE CONSUMPTION AND THE IMPACT OF THOSE ON THE HEALTH OF YOUNG ADULTS

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Currently, there is an increase in the consumption of caffeinated beverages, including coffee, in all age groups, including adolescents and young adults. The health risks associated with caffeine consumption are especially high in the youth, which results from the features of their physiological development and behavioral factors. For many age groups, including children, adolescents, and young adults, safe daily caffeine intake levels have not been established. The study aimed to perform hygienic assessment of coffee and caffeinated beverage consumption by medical students, as well as to determine possible health risks. A questionnaire survey of students of the medical and pediatric faculties (n = 300) was conducted using the standardized quastionnaire. Statistical data processing was performed using descriptive statistics, Student's t-test, Pearson's correlation coefficient. The findings highlight the heterogeneity of caffeine consumption patterns among students. Along with those who do not experience any noticeable effects from coffee, there is a significant group that experiences both positive (energy boost, calmness) and negative (tachycardia, sleep problems) consequences. The study found that frequent consumption of caffeinated beverages has a negative impact on the cardiovascular system and sleep. The regular consumption of those causes anxiety and leads to tolerance. The findings emphasize the relevance of the problem uncontrolled and early consumption of caffeine among young people. It is recommended to develop and implement the measures to inform the youth about safe levels of caffeine consumption.

Keywords: hygienic assessment, coffee, caffeine, students, health

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Compliance with ethical standards: the study was compliant with biomedical ethics requirements. The written informed consent was obtained from each participant.

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ГИГИЕНИЧЕСКАЯ ОЦЕНКА ПОТРЕБЛЕНИЯ КОФЕ И КОФЕИНСОДЕРЖАЩИХ НАПИТКОВ И ИХ ВЛИЯНИЯ НА СОСТОЯНИЕ ЗДОРОВЬЯ МОЛОДЕЖИ

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В настоящее время имеет место рост уровня потребления кофеинсодержащих напитков, в том числе кофе, во всех возрастных группах, включая подростков и молодежь. Риски для здоровья при потреблении кофеина особенно высоки среди молодежи, что обусловлено особенностями физиологического развития и поведенческими факторами. Для многих возрастных групп, в том числе детей, подростков и молодежи, безопасные уровни суточной нормы кофеина не определены. Целью исследования было выполнить гигиеническую оценку потребления кофе и кофеинсодержащих напитков учащимися медицинского университета и выявить возможные риски здоровью. Проведено анкетирование студентов лечебного и педиатрического факультетов (n = 300) с использованием стандартизованной анкеты. Статистическую обработку данных выполняли с использованием методов описательной статистики, t-критерия Стьюдента, корреляционного анализа Пирсона. Полученные данные подчеркивают неоднородность особенностей потребления кофеина студентами. Наряду с теми, кто не испытывает выраженных эффектов от кофе, существует значительная группа, у которой наблюдаются как положительные (прилив энергии, спокойствие), так и отрицательные (тахикардия, проблемы со сном) последствия. Проведенное исследование свидетельствует об отрицательном влиянии частого употребления кофеинсодержащих напитков на сердечно-сосудистую систему и сон. Их регулярное потребление вызывает тревожность, ведет к толерантности. Полученные данные подчеркивают актуальность проблемы неконтролируемого и раннего потребления кофеина в молодежной среде. Рекомендуется разработать и внедрить меры по информированию молодежи о безопасных уровнях употребления кофеина.

Ключевые слова: гигиеническая оценка, кофе, кофеин, студенты, здоровье

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Соблюдение этических стандартов: проведенное исследование соответствовало требованиям биомедицинской этики. От каждого участника получено письменное добровольное информированное согласие.

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Coffee is one of the most common drinks, regularly consumed by half of the world's population. Its popularity is due to a number of factors, including pharmacological effects, gastronomic qualities and social aspects. Coffee lifts one's mood and improves memory, increasing mental and physical activity. On the other hand, high doses of caffeine may cause heart rhythm disturbances in adolescents with heart diseases. Caffeine can increase feelings of anxiety and worry, which in turn can lead to increased blood pressure. Abruptly stopping regular caffeine consumption can cause withdrawal symptoms, which

include headache, fatigue, irritability, and changes in blood pressure [1].

In recent decades, the coffee chemical composition and its impact on human health have attracted increasing attention from scientists and researchers. Coffee contains over a thousand compounds, from volatile low-molecular to high-molecular ones. Its composition depends on many factors — variety, country of origin, soil composition, growing conditions, roasting technology, etc. The widespread consumption of coffee has prompted clinicians to actively study the effects of this beverage on health [2].

Caffeine (1,3,7-trimethylxanthine) representing white, silky, needle-shaped crystals with a slightly bitter taste belongs to purine alkaloids. Being a the central nervous system stimulant, it regulates and enhances excitation processes in the cerebral cortex. As a result, mental and physical performance increases, reaction time is shortened, vigor appears, and drowsiness temporarily disappears or decreases [3, 4].

Instant coffee usually contains less caffeine than whole bean coffee, but the exact amount depends on the type and preparation method. This is due to the production technology: instant coffee is made from beans that undergo multi-stage processing, during which most of the natural caffeine is destroyed.

Caffeine is a psychostimulant and diuretic found in the beans of the coffee plant and is an ingredient in coffee, cola drinks, chocolate, a number of patented "energy drinks" and weight-loss products. It is the most commonly used psychoactive substance in the world. A number of clinical conditions associated with its use have been described, although given its widespread use, severe disorders are relatively rare. Caffeine intoxication is associated with the consumption of relatively high doses (i.e. more than 1 g per day). Caffeine withdrawal is a common phenomenon reported in people who have consumed caffeine over a long period of time or in large quantities. Anxiety disorders may develop as a result of caffeine consumption, often occurring after intoxication or heavy consumption [5, 6].

If abused and doses exceeded (the values are individual for each person), signs of intoxication may be observed: increased anxiety, insomnia, tachycardia, arrhythmia, increased blood pressure, nausea. With chronic use of caffeine-containing substances, addiction occurs, which is associated with the formation of new adenosine receptors in brain cells, and the effect of caffeine gradually decreases [6, 7].

In addition to caffeine, energy drinks contain taurine, theobromine, and theophylline (cocoa alkaloids), which block adenosine and enhance the effects of caffeine. Even common carbohydrates, such as glucose, fructose, and sucrose, have a stimulating effect on the brain and prevent sleep. This effect complements and enhances the stimulating effect of caffeine.

According to Rospotrebnadzor, mixing coffee with energy drinks can lead to unpredictable consequences, such as mental agitation, nervousness, or, conversely, apathy and depression [8].

Despite recommendations to start drinking coffee no earlier than 16 years old, young people start drinking coffee at the age of 10–12 years old, when organs and systems are still developingAt this age, even small amounts of caffeine can cause more severe effects: anxiety, irritability, decreased ability to concentrate, sleep problems, increased heart rate and blood pressure. Caffeine is especially harmful for children with increased excitability or hidden cardiac problems. By the age of 18–20 years, such young people more often complain of headache, including migraine-type one.

According to the pediatric community guidelines, the maximum daily dose of caffeine is 2.5–3 mg per 1 kg of body weight. That is, a teenager weighing 40 kg can consume no more than 100–120 mg of caffeine per day in beverages, which is roughly equivalent to one cup of weak coffee or a cup of tea. For adults, the recommended daily intake is 400 mg of caffeine, which is approximately 3–4 cups per day [9].

According to the director of the Federal Research Center of Nutrition and Biotechnology D.B. Nikityuk, reducing coffee consumption is recommended for people with gastrointestinal and cardiovascular diseases. According to nutritionists, cold coffee is especially harmful, as it causes vascular spasms and slows down digestion [10, 11].

According to other authors, up to 80% of students consume caffeinated beverages, including coffee, daily [12–14]. Medical students also tend to drink more coffee especially when preparing for exams, doing a lot of homework, or under heavy academic pressure, which reduces their sleep time and quality. Coffee only provides a temporary boost of energy, and drinking it during a session can be harmful, as the caffeine contained in the drink contributes to the nervous system exhaustion and reduces the body's functional reserves.

The aim of the study was to provide a hygienic assessment of the consumption of coffee and caffeinated beverages by medical university students to examine their impact on health and to identify possible risks.

METHODS

To achieve the intended goal, the following research stages were identified and implemented:

– a sociological study in the form of an anonymous survey of a student audience aimed at studying the prevalence and characteristics of coffee and caffeinated beverage consumption in this target group;

– assessment of the impact of coffee consumption on physiological state and cognitive functions of the body, including an analysis of potential negative health consequences.

A questionnaire survey of students of medical and pediatric faculties (n = 300) was conducted using the standardized questionnaire containing questions about the frequency, volume and type of beverage consumed. The respondents' average age was 20 ± 0.6 years.

Statistical data processing was performed using descriptive statistics, Student's t-test, Pearson's correlation coefficient to assess the strength and direction of the relationship between the variables considered. The qualitative data were compared using the chi-squared test (X^2). The differences were considered significant at $p < 0.05$.

RESULTS

The sample consisted of 28% male students and 71% female students. It was found that half of those surveyed regularly consume energy drinks, including coffee (41%). According to the data obtained, 70% of students prefer instant coffee, and 30% prefer bean coffee.

A significant proportion of respondents (40%) began drinking coffee at an early age (13 years), usually limiting themselves to one cup a day. In our study, 47% of students drink 2–3 cups daily, and 20% of students drink more than three cups of coffee daily, which could potentially affect their health.

The frequency of coffee consumption during the day has been determined: The majority of students (48%) drink coffee in the morning, 27% in the afternoon, 20% in the evening, and 5% at night. This regime may be associated with the need

to maintain working capacity during periods of intense academic workload.

The study shows that 16% of students experience negative effects from coffee consumption, including increased heart rate and sleep problems. Thus, in this group of respondents, 30% report occasional tachycardia, which is consistent with the known cardiac stimulating effect of caffeine mediated by adenosine receptor blockade. Our findings indicate a positive correlation between coffee consumption and heart rate (HR, r = 0.68). Increased heart rate indicates possible risks and the need to pay close attention to the dosage and timing of the caffeinated beverage consumption.

The impact on sleep appears to be minor for 81% of respondents, but 17% report trouble falling asleep, which is a classic side effect of caffeine, especially when consumed in the evening. A significant correlation was found between drinking coffee at night and difficulty falling asleep (r = 0.58). The energizing effect expected by many caffeine consumers does not occur in 65% of students. For the rest, the duration of stimulation varies: in 17% it lasts 2–3 hours, and in 12% it lasts only an hour. Such variability may be due to individual characteristics of caffeine metabolism, genetic predisposition, and tolerance.

A small percentage reported dry mouth (13.4%) and headache (3%), suggesting that these side effects are rare. However, it is important to consider that self-reports may not show the real picture due to the symptom perception subjective nature.

When studying the effects of caffeine on cognitive function, taking into account gender differences, it was found that girls require a higher dose of caffeine than boys to achieve a similar level of performance. This difference may be due to a number of factors. First, differences in caffeine metabolism between males and females may affect the rate at which it is absorbed and eliminated from the body. Second, hormone levels, such as estrogen levels, can influence sensitivity to caffeine. Third, differences in body weight and body fat percentage may also matter for how caffeine is distributed in the body. The results demonstrate the importance of carefully monitoring one's own response to caffeine and adjusting the dosage according to your individual needs and characteristics.

Many students (54%) do not associate the caffeinated beverage consumption with specific situations, which may indicate the spontaneous nature of consumption and the absence of a pronounced dependence. The remaining 46%, on the contrary, indicate situational conditioning, which is consistent with the data from studies demonstrating the use of caffeine as a means of enhancing cognitive activity during periods of intense mental load, such as during exams [13, 15, 16].

The correlation between coffee consumption and work productivity seems to be more complex and nonlinear. While moderate coffee consumption may help improve attention and concentration, excessive consumption may lead to nervousness and decreased performance, as has been shown, in particular, in papers by other authors [17, 18].

This study showed a high level of awareness among medical students about the potential harm of caffeine (81%), but this awareness does not always translate into changes in consumer behavior.

DISCUSSION

The findings highlight the heterogeneity of caffeine consumption patterns among students. Along with those who do not experience any pronounced effects of coffee, there is a significant group in which both positive (energy boost, calmness) and negative (tachycardia, sleep problems) consequences occur. The data obtained are consistent with the results of other authors who studied the characteristics of coffee consumption by medical students [2, 4, 9, 17]. These studies also noted a significant number of respondents reporting negative effects associated with caffeine consumption, despite a conscious desire to improve cognitive function. This indicates the importance of taking into account individual characteristics of the body (genetic factors, age, gender, body weight, fact of having chronic diseases, etc.) and the dosage of caffeine when formulating guidelines on coffee consumption, especially in the student environment, where the access to energy drinks and coffee is relatively free.

The reported positive correlation between coffee consumption and heart rate is consistent with the results of studies by other authors [1, 2, 9]. The heart rate increases proportionally with caffeine consumption due to stimulation of the sympathetic nervous system.

The study revealed mixed effects of coffee on the cardiovascular and nervous systems. Further research is needed to understand individual differences in response to caffeine.

It should be noted that traditionally, coffee consumption is often considered in the context of potential cardiometabolic risks, especially in young adults and in the student population. However, a simplistic view of coffee as an exclusively negative factor overlooks the multifaceted nature of its effects on the body and the results of current research. Recent scientific papers demonstrate that regular coffee consumption is associated not only with potential risks, but also with a number of positive effects. The effect of coffee on reducing abdominal obesity, hyperglycemia, and lipogenesis has been shown. It is believed that caffeine and other bioactive compounds found in coffee may stimulate lipolysis and thermogenesis, promoting fat loss. Some research shows that coffee consumption is associated with increased insulin sensitivity and reduced hyperglycemia [4].

Thus, a comprehensive analysis of the impact of coffee consumption on student health requires consideration of not only potential risks, but also the benefits related to weight control, glycemia, and lipid metabolism that are documented in the literature.

The observed significant gap in preferences between instant and bean coffee deserves the closest attention and points to a complex interaction of material, pragmatic and, possibly, cultural aspects. The significant predominance of instant coffee can be explained by several reasons. Most likely, the choice of instant coffee is due to its availability and speed of preparation, which corresponds to the fast pace of life typical of the student environment. Availability plays an important role: instant coffee is ubiquitous in dormitories, student cafeterias and cafes. In turn, the preference for grain coffee by 30% of students may reflect a desire for higher quality and natural taste. This choice is made by students who have an increased interest in the culture of coffee consumption. It is worth noting that whole-grain coffee, as a rule, wins in terms of its taste and content of nutrients, which is consistent with the data of other authors [6] and allows for a deeper understanding of the impact of coffee and caffeinated beverages on the health of young adults.

The need to maintain concentration while studying is certainly an important factor influencing caffeine consumption, which is confirmed by a number of other authors, such as A. Mulica, who report on the effect of caffeine on students' short-term memory [19].

The impact of caffeine on mental performance has been the subject of numerous studies, the results of which are often contradictory. Many studies show that moderate caffeine consumption can improve short-term memory, reaction time, and attention, while some people may experience adverse

effects (anxiety, insomnia, nervousness) that can negatively impact cognitive functions [2, 5].

Despite widespread awareness of its potential harm, caffeine consumption among students remains high. This may be due to several factors: the need for increased concentration while studying, the desire to cope with fatigue and the pressure of the academic process, social habits and rituals associated with coffee consumption.

It's also important to remember that knowledge about the dangers of caffeine alone doesn't always lead to behavioral changes. Personal belief, motivation, and access to alternative ways to improve performance and manage stress play an important role [2, 5]. Therefore, information campaigns and educational programs should be aimed not only at raising awareness, but also at developing a conscious attitude towards caffeine consumption and developing self-regulation skills.

In addition, other aspects of students' lives should also be taken into account. Fatigue caused not only by academic workload, but also by social activity and part-time jobs, can push one to consume caffeinated beverages as a way to cope with these “challenges.”

Social habits and rituals also play a role. Going to a cafe together, discussing academic issues over a cup of coffee, or even just starting the day with coffee — all of this forms stable habits that may be associated not only with the physiological need for caffeine, but also with the need for socialization and a sense of stability.

To better understand the phenomenon of caffeine consumption by students, further study of these relationships, analysis of motivation, and the development of educational programs aimed at developing a conscious and responsible attitude towards the caffeinated beverage consumption are necessary.

Further research should be aimed at understanding the motives and factors that determine caffeine consumption, such as the need for increased concentration during learning, the desire to cope with fatigue and the pressure of the academic process, as well as developing effective prevention strategies and promoting a healthy lifestyle among students.

CONCLUSIONS

The widespread consumption of coffee and caffeinated beverages among young people requires increased attention from public health experts. It is recommended that measures be developed and implemented to inform young people about safe levels of caffeine consumption. The findings highlight the relevance of the problem of uncontrolled and early caffeine consumption by the youth. Exceeding the recommended doses of caffeine can lead to anxiety, irritability, increased heart rate, and other unwanted effects. Of particular concern is the popularity of energy drinks, which contain high doses of sugar and other stimulants that are potentially dangerous to health in addition to caffeine. It is important to keep in mind that individual sensitivity to caffeine can vary, and even moderate doses can cause negative reactions in some people. Further research is needed to more thoroughly assess the impact of caffeine on various aspects of youth health, including cognitive function, mental health, and reproductive health.

As a preventative measure, it is proposed to introduce information campaigns in educational institutions aimed at raising awareness about the risks associated with excessive caffeine consumption among young adults. It is also reasonable to collaborate with caffeinated beverage manufacturers to develop healthier alternatives with reduced caffeine and sugar content.

We believe it is necessary to teach the younger generation healthy lifestyle strategies, including adequate sleep, regular physical activity, and a balanced, healthy diet. This will help reduce the need for stimulants, such as caffeine.

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