

# Prevalence of Migraine Headaches and their Impact on the Academic performance of Medical Campus Students at University of Khartoum using ID-Migraine test as a screening tool: A cross-sectional study from Sudan

MOAID MOHAMEDOSMAN ALI MOHAMEDOSMAN<sup>1</sup>, Khabab Abbasher Hussien Mohamed Ahmed <sup>1</sup>, and Mohammed Omer<sup>2</sup>

<sup>1</sup>University of Khartoum Faculty of Medicine

<sup>2</sup>University of Gadarif Faculty of Medicine and Health Science

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## Abstract

Background Migraine — an episodic headache —is one of the most common types of primary Headache. Migraine is considered a serious health problem that affects the quality of life. During university life, students often report increased levels of stress, depression, anxiety, and irregular sleep, all of which are associated with migraines. Our aim was to determine the prevalence of migraine headaches among medical campus students at university of Khartoum, Sudan. Based on available data, migraine is on the rise in both general populations as well as university students. Methods In this cross-sectional and descriptive study, study population was composed of students registered to faculty of medicine, Dentistry and pharmacy at Khartoum University in the academic years of 2020-2021. Out of these 318 of them accepted to participate. Participants who had two or more headaches in the last 3 months formed the headache group. Afterwards, two preliminary questions were applied to the headache group and participants with at least one affirmative response were asked to perform the validated ID-Migraine test. Results The mean age of 318 students participated in the study was  $19.23 \pm 1.84$  (17-39 years), with adolescents: adult ratio being 2.5:1. 1613 students (43.7%) did have at least two headaches in the last three months. Migraine-type headache was detected in 266 subjects (7.2%) based on the ID-Migraine test. Of the migraine group, 72 were male (27.1%) and 194 were female (72.9%). There was no significant difference in migraine prevalence between adolescent and adult age groups. Conclusions With prevalence similar to adults, primary care physicians should be aware of the probability of migraine headaches in university students in order to maintain a successful school performance.

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MOAID MOHAMEDOSMAN ALI MOHAMEDOSMAN<sup>1</sup>, Khabab Abbasher Hussien Mohamed Ahmed<sup>2</sup>  
Mohammed Eltahier Abdalla Omer MBBS <sup>3</sup>

1. Medical student, University of Khartoum, Faculty of Medicine, Khartoum, Sudan, *moaiadosman11@gmail.com*
2. Medical student, University of Khartoum, Faculty of Medicine, Khartoum, Sudan, *Khabab9722@gmail.com*
3. MBBS, Gadarif University Faculty of Medicine and Health Sciences, Sudan, *Mohammedeltahier100@gmail.com*

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Migraine — an episodic headache —is one of the most common types of primary Headache. Migraine is considered a serious health problem that affects the quality of life. During university life, students often report increased levels of stress, depression, anxiety, and irregular sleep, all of which are associated with migraines. Our aim was to determine the prevalence of migraine headaches among medical campus students at university of Khartoum, Sudan. Based on available data, migraine is on the rise in both general populations as well as university students.

### Methods

In this cross-sectional and descriptive study, study population was composed of students registered to faculty of medicine, Dentistry and pharmacy at Khartoum University in the academic years of 2020-2021. Out of these 318 of them accepted to participate. Participants who had two or more headaches in the last 3 months formed the headache group. Afterwards, two preliminary questions were applied to the headache group and participants with at least one affirmative response were asked to perform the validated ID-Migraine test.

### Results

The mean age of 318 students participated in the study was  $19.23 \pm 1.84$  (17-39 years), with adolescents: adult ratio being 2.5:1. 1613 students (43.7%) did have at least two headaches in the last three months. Migraine-type headache was detected in 266 subjects (7.2%) based on the ID-Migraine test. Of the migraine group, 72 were male (27.1%) and 194 were female (72.9%). There was no significant difference in migraine prevalence between adolescent and adult age groups.

### Conclusions

With prevalence similar to adults, primary care physicians should be aware of the probability of migraine headaches in university students in order to maintain a successful school performance.

Keywords : Migraine , Prevalence , Khartoum University

### What is already known about this study?

Worldwide studies done about migraine prevalence among university students and the impact on their academic performance stated that The connection between recurrent and chronic headache and learning disabilities might be psychosocial (fear of failure) or anatomical (malfunctioning of the frontal and prefrontal areas). Only few population-based and clinical studies were done and good studies are still needed in order to understand the complex relationship better.

However, relating to our patients' learning and school performance, history is crucial when a student with primary headaches is evaluated. Learning disabilities seem to have a high prevalence among students with primary headache syndromes especially migraine.

The connection between the two is complex and might be either part of a common brain pathophysiology and/or a consequence of poor quality of life.

The main migraine predictors were Functional Gastrointestinal Disorders (FGIDs), family history of migraine, female gender, and enrollment in the second academic year. Exam stress and sleep disturbances were the commonest triggers.

The majority of the participants reported that their educational performance and ability to attend sessions were affected during migraine attacks

The participants had a relatively high incidence of migraine. The predictors were FGIDs, gender, and academic year. There was a need for migraine screening and management among medical students. The study concluded that Students' sleep habits, as well as their concentration levels during classes, as well as

their social and emotional lives, were found to be affected by headaches. Headaches affected some participants negatively, causing them to lose concentration on academic, family, social, or leisure activities.

Some studies found that during tests and evaluations, the intensity of their headaches increased, potentially jeopardizing their academic success. The study concluded that Students' sleep habits, as well as their concentration levels during classes, as well as their social and emotional lives, were found to be affected by headaches. Headaches affected some participants negatively, causing them to lose concentration on academic, family, social, or leisure activities.

In some studies Emotional stress, sunshine or bright light, sleep deprivation, and hunger were the most common trigger factors. Inability to engage in outdoor sports, as well as household chores, and school absenteeism were the common impacts on the quality of life of among 76.8% of the migraineurs.

### **What does this study add?**

In our study we found that the prevalence of migraine is reported to be the highest in females rather than males. However it is also six times more among adults and university students, a significant difference between adolescent and adult populations so this was very high with regards to the not very huge number of participants., and also this study conducted in more stressful periods like midterms or final examinations would have revealed a higher prevalence of migraine headaches. Also, the methods used to determine the prevalence of migraine type headaches can significantly affect the prevalence rates explaining the differences observed in the epidemiological studies.

### **Background**

Primary headache disorders are a diverse group of neurologic conditions that cause recurrent or persistent headaches with no obvious cause {1}. Migraine is being recognized as a significant health problem affecting the quality of life and a major cause of morbidity among young adults specially students, and one of the major health related resources consumers It is a chronic neurological disease that affects 15% of the population, but there is little information about its prevalence in Sudan{2}. During university life, students often report increased levels of stress, depression, anxiety, and irregular sleep, all of which are associated with migraines .Migraine is on the rise in both general populations and university students, according to available statistics. The activation of the so-called trigeminovascular system (TGVS) causes it: trigeminal afferents activate structures involved in pain transmission and perception, as well as the release of vasoactive peptides (presumably causing neurogenic inflammation). The primary cause of TGVS activation and the mechanism of pain generation after TGVS activation are the two major open questions in migraine headache neurobiology Regarding the main cause of TGVS activation, two theories have dominated the field: cortical spreading depression (a slowly moving wave of cortical depolarization) and the existence of a brainstem generator (dysfunctional brainstem nuclei involved in ant nociception as a primary cause of migraine).In terms of migraine pain mechanisms, two main theories have been proposed: neurogenic inflammation of the meninges and trigeminal nerve and nucleus sensitization. There is a strong genetic component to migraine. CACNA1A (which encodes a subunit of the voltage-gated  $\text{Ca}^{2+}$  channel  $\text{CaV}2.1$ ) and ATP1A2 (which encodes a subunit of the  $\text{Na}^{+}/\text{K}^{+}$  ATPase) are the only two genes known to cause a rare form of migraine. The discovery of migraine-linked mutations, as well as the identification of the most likely primary cause of TGVS activation, has provided us with new targets for the development of anti-migraine compounds. Due to the prevalence of the disease and the fact that currently available drugs are not always successful, this is a critical area {3, 4, 5, 6, 16, 17, 18, 19, 20, 21, 22} Migraine headaches have a wide range of prevalence rates. The prevalence of migraine-type headaches varies depending on the technique used to diagnose them in different studies. There have been few studies on the prevalence of migraine in Sudanese university students. It is particularly significant among university students because of its negative effects on quality of life. WHO must maintain a high level of concentration and achievement. Headaches have a significant effect on university students' academic performance. Students with migraines have a 62.7 percent decrease in capacity compared to students with episodic tension-type headaches (ETTH), who have a 24.4 percent decrease in capacity. Furthermore, students suffering from migraine headaches missed more school than those suffering from

ETTH.

The significance of migraine headaches in university students is revealed by these findings. To ascertain the prevalence, large populations must be subjected to useful, reliable, and validated screening tests. Lipton et al. developed and validated the Identity Migraine (ID Migraine TM) test, which is a proper and useful screening tool that can be applied quickly to large populations. In primary care, this test's sensitivity, specificity, and positive predictive value have been determined to be 81 percent, 75 percent, and 93 percent, respectively. Adolescence is defined by the World Health Organization (WHO) as young people aged 10 to 19. The university population includes both teens and adults {9}. With a sensitivity of 62.1 % and a specificity of 71.1 %, the test has been validated for use among adolescent students {8}. In this study, our goal is to use the ID Migraine rapid detection tool to determine the prevalence of migraine in college students. The prevalence of migraine in the general population ranged from 2.6 percent to 32 percent. The prevalence of migraine headache was estimated to be between 12.2 percent and 27.9 percent among medical university students, and between 7.1 percent and 13.7 percent among schoolchildren (6 to 18 years. Females were found to be more likely than males to suffer from migraines. The duration of migraine attacks became shorter as people got older, while chronic (daily) migraine became more common Anxiety, hypertension, irritable bowel syndrome, and depression were the most frequently observed comorbidities with migraine. Stress, fatigue, sleep disturbances, prolonged exposure to excessive sunshine or heat, and starvation were the most common headache-inducing factors}. The prevalence and risk factors of migraine headache in Arab countries are comparable to reports from western countries. Longitudinal studies are still needed to examine the prognosis and predictors of chronic diseases in Arab countries {7}.

Migraine is a major cause of morbidity among young adults especially students, and one of the major health related resources consumers.

Migraine is a very important disease and there is no enough researches done for it and is easily preventable- but at the same time it affects quality of life such as students' academic performance- by proper practice of consuming good prescribed drugs, so this research will help primary health care providers in the effort to decrease adult students' morbidity.

## **Objectives:**

### **General objectives:**

To determine the prevalence of migraine among young students in medical campus at university of Khartoum and the impact on their academic performance.

### **Specific objectives:**

- To find out the impact on academic performance of those having the disease.
- To determine most affected gender, age.
- To assess family association.

## **Methods:**

### **Study design:**

University based observational descriptive cross-sectional study.

### **Study area:**

The medical campus at university of Khartoum which contains three faculties (medicine, dentistry and pharmacy) and located in El Qasr Ave, Khartoum, Sudan.

### **Study population:**

All Medical campus students at university of Khartoum.

Inclusion criteria:

1- All medical campus students in the three faculties (medicine, dentistry and pharmacy) males and females in all batches at university of Khartoum.

2- Willing to take part in the study.

Exclusion criteria:

Post-graduate students at the medical campus university of Khartoum.

### **Sampling techniques:**

Probability sampling: systematic random sampling All cases (all batches medical campus students that diagnosed by migraine using ID-Migraine test as a screening tool) available at medical campus university of Khartoum.

### **Sample frame:**

Simple random selection in university of Khartoum medical campus.

### **Sample size:**

All cases available in medical campus university of Khartoum in the period of data collection.

Equation used:

$$no = \frac{Z^2pq}{e^2}$$

Where: no=initial sample size required,

z = probability that e is not exceeded.(e score of 1.645 corresponds to 90%confidence level),

p= expected prevalence (estimated as 0.5),

q=1-p,

e=maximum acceptable random sampling error (here is 5%)

So my initial sample size (no) is=  $0.67650625/(5\%) = 270$

So by this equation: the last sample size  $n = no/(1+(no/N))$ , where N is population size which is 3814 medical campus students, it was found to be 253 samples from the study population.

### **Data collection methods:**

Structured interview-pretested close ended self-administered questionnaire.

### **Data collection tools:**

Interview by self-prepared questionnaire that include questions about socio demographic status, age and gender...etc. was taken from the candidates (ID-Migraine test as screening tool was used). A questionnaire was constructed based upon my objectives and the literature previewed. Due to Covid-19 restrictions; all questionnaires were distributed online using Google form, through social media platforms. Mostly WhatsApp and Telegram were used.

The questionnaire consisted of eight sections;

- *Demographic information.*
- *Migraine according to (MS-Q).*
- *Questions for determination of probability migraine type headache: preliminary questions.*
- *Determination of migraine type headache: three items of ID-Migraine test.*
- *Headache severity assessment.*

- *Triggering factors.*
- *Family correlation.*
- *Academic performance evaluation.*

### **Study variables:**

Independent variables:

Gender, Age, weight, height, and Study faculty.

Dependent variables:

Migraine according to (MS-Q) questions for determination of probability migraine type headache (preliminary questions), three items of ID-Migraine test, academic performance, headaches severity assessment questions triggering factors, family correlations.

### **Data Entry and Analysis:**

Microsoft Excel was used for data entry and SPSS v.25 for data analysis.

Frequencies and pie/bar charts were used for descriptive data.

Pearson chi-square test was used for inferential data.

### **Ethical Consideration:**

1-Ethical approval was taken from Department Of Community Medicine, University Of Khartoum, and the research was conducted after approval from my supervisor.

2-Volunteerism (each individual was voluntarily participating).

3-Each individual was having the right of withdrawal at any time of the study.

4-The researcher was committed of doing no harm.

5-Consent was obtained in a written way and brief introduction was given before taking the information from the candidates.

6-High degree of confidentiality was preserved.

### **Limitations of the study:**

1- Survey taking fatigue; due to the fact that my questionnaire is long.

2- Due to the Covid-19 pandemic, a lot of people have been practicing social distancing; therefore I couldn't interview candidates face to face.

3- In contrast, people are also being more vigilant about their health; due to the pandemic, and therefore it is also possible that the prevalence estimated is an overestimation.

4-Some questions were not easily understood by the participants.

5-Some candidates didn't fill the whole questionnaire.

### **Results**

At the end of the study, out of 3814 students 270 were supposed to be collected but fortunately the data was collected from 318 participants and was analyzed. Of the participants, 15.72% were male ( $n = 50$ ) and 83.81% female ( $n = 259$ ). The mean age of the participants was  $21.64 \pm 1.84$ , ranging from 17 to 28 years of age. 252 students (79.2%) who replied "yes" to the question "Did you have two or more headaches in the last 3 months?" formed the headache group. Of the headache group, 12.69% were male ( $n = 32$ ) and 87.3% female ( $n = 220$ ). Female participants had significantly higher headache rates than male ones (Pearson  $\chi^2 = 35.344$ ,  $p < 0.001$ ).

As preliminary questions were analyzed, 157 participants of the headache group (49.4%) had at least one positive response. 81 participants (25.5%) had "a desire to talk to a healthcare professional about this headaches", and 150 participants expressed that "his/her ability to work, study or enjoy life was limited" (47.2%).

This group of participants was further evaluated in terms of migraine type headaches with application of the 3-item ID Migraine test. Of this group, 34.3% (n = 109) gave at least two positive responses and had positive ID Migraine tests. The prevalence of migraine among all participants according to ID Migraine test was 2.9%. Of the migraine group, 14 were male (12.8%) and 95 were female (87.2%). The rate of migraine in female participants was found to be significantly higher than male ones (Pearson  $\chi^2 = 60.725$ ,  $p < 0.001$ ). The mean age of the participants with migraine was  $21.72 \pm 1.91$ , ranging from 17 to 28 years of age. There was no statistical significance between the ages of participants and migraine prevalence (Pearson  $\chi^2 = 16.958$ ,  $p = 0.593$ ). Of the participants, 14.7% (n = 16) were in the adolescent age, whereas 85.3% (n = 93) were in the adult group, with a ratio of 1:6. In comparison, there was significant difference between adolescent and adult age groups concerning the migraine rates (7.0% and 7.8%, respectively) In addition, shows the prevalence according to gender.

In the migraine group (n = 109), 3 item ID Migraine test showed 56% of the participants (n = 61) "felt nauseated or sick to the stomach", 82.6% of the participants (n = 90) were "bothered by light (a lot more than when they don't have headaches)", and 94.5% (n = 103) expressed that "their headaches limited their ability to work, study or do what they needed to do for at least one day". The headache severity assessment was done and found to be that 11.9% of the participants (n=13) were experiencing "mild headache", 30.3% of the participants (n=33) expressed that they were suffering from "severe headache", and 57.8% of the participants (n=63) were having "moderate headache". Headache triggering factors were also been asked and 21.1% of the participants (n=23) were triggered by "emotional stress or anxiety", 23.9% of the participants (n=26) were triggered by "eating habits", 24.8% of the participants (n=27) were triggered by "fasting", 64.2% of the participants (n=70) were triggered by irregular sleep, 33.9% of the participants (n=37) were triggered by "physical activity", 39.5% of participants (n=43) were triggered by "menstruation", 58.7% of the participants (n=64) were triggered by "noise", 36.7% of the participants (n=40) were triggered by "tests or exams", 48.6% of the participants (n=53) were triggered by "reading hours (when you are studying for example)", 2.8% of the participants (n=3) were triggered by "smoking", and 71.6% of the participants (n=78) were triggered by "exposure to sun". The question of the family correlation had been asked and 28.4% of the participants (n=31) were having at least part of their families diagnosed by migraine

### Impact of headaches on academic life

The majority of participants (74.3 %) continued attending lectures while experiencing a headache. A large portion of the participants stated that headaches affected studying for tests and/or examinations (92.7 %). Majority reported that experiencing a headache limited their concentration at lectures (97.2 %;  $p < 0.001$ ) and felt too tired to continue working (98.2 %;  $p < 0.001$ ). Almost more than half of the participants (53.2 %) indicated that the headache was more intense than usual when studying for tests and exams ( $p < 0.001$ ). Almost more than a third of participants that experienced a headache when studying, stopped studying due to the headache (33.9 %), and some (8.3 %) continued without the use of medication. However, a significant proportion (57.8 %) continued with the use of medication ( $p < 0.001$ ).

Sleeping patterns were altered during tests and/or examination periods (90.8 %;  $p < 0.001$ ). More than a third of the participants studied for long periods without taking regular breaks (42.2 %). A large number of participants consumed beverages such as caffeinated energy drinks, chocolate or coffee (66.1 %) to help sustain their concentration for a longer period of time. Consumption of these drinks during a headache made the study session less effective ( $p < 0.001$ ). Lighting in the study area was adequate and did not affect studying (75.2 %;  $p < 0.001$ ).

### Discussion

This study has been conducted among adolescents and adults registered to different faculties of medical cam-

pus at Khartoum University, Khartoum, Sudan. ID Migraine test has been used for screening migraine type headaches. ID Migraine check showed that, 2.9% (n 109) of the 3814 students had hemicrania sort headache. The prevalence of migraine is reported to be the highest in females rather than males. However it is also six times more among adults and university students, a significant difference between adolescent and adult populations. There are few studies focusing on migraine among university students in Sudan showing differences in prevalence. Halay reported a prevalence of 40% of those who had at least two headache episodes. Females were more affected by migraine than males and the most common triggering factors were irregular/lack of sleep, stress/anxiety, noise, and fatigue/physical activity, which accounted for 91.0 percent, 88.0 percent, 85.7 percent, and 84.6 percent of the population with migraine, respectively. Menstruation-related migraines were reported by 46.7 percent of females. The impact of migraine on work, everyday activities, and leisure was mild to extreme for 78.2% of migraine sufferers{2}, but in this study 21.1% of the participants were triggered by “emotional stress or anxiety”, 23.9% of the participants were triggered by “eating habits”, 24.8% of the participants were triggered by “fasting”, 64.2% of the participants were triggered by irregular sleep, 33.9% of the participants were triggered by “physical activity”, 39.5% of participants were triggered by “menstruation”, 58.7% of the participants were triggered by “noise”, 36.7% of the participants were triggered by “tests or exams”, 48.6% of the participants were triggered by “reading hours (when you are studying for example)”, 2.8% of the participants were triggered by “smoking”, and 71.6% of the participants were triggered by “exposure to sun”. In some international studies for example in Nigeria One thousand six hundred and seventy-nine students aged 11-18 years were recruited. The overall prevalence of headache was 19.5%, compared to my study which of 3814 about 2.9% but the same in that prevalence rate is more in females compared to males {14}. Several studies throughout the world show different results. The prevalence of migraine among university students is reported to be, 27.9% in a Kuwaitian study, 9.0% in a Chinese study among 5,129 students. 7.2% in a Turkish study among 3694 students {11, 10, 13}. We found the prevalence of migraine headaches relatively lower than Sudanese and also international studies. Our relatively large number of subjects will affect the results. Since the screening test is based on the presence or absence of headaches in the past three months, the duration of the study may also be a limiting factor, which varies from study to study. A study conducted in more stressful periods like midterms or final examinations would have revealed a higher prevalence of migraine headaches. In addition, the method used to determine the prevalence of migraine can significantly affect the prevalence, which explains the differences observed in epidemiological studies. The female/male ratio was (7:1) (95/14) in our study, whereas in other study in Israel was 1.25:1 in Haifa which mean that our study ration was very high {12}. A new finding is that most of the students in this group continued to attend classes despite their headaches. This is a typical feature of other studies that reported the same situation, but their attention was reduced, which had a negative impact on their research. Changes in sleep patterns during headache attacks make tests and examinations worse. Sleep disturbances have previously been reported to influence the frequency and duration of migraines {15}.

Although attending meetings frequently, the learning model was disrupted: most people were unable to study, many continued to learn from drugs, some dropped out of school due to headaches, and some continued to study without taking drugs. This can have a negative impact on test results and success rates due to wasted time, especially since those who continue the research report increased pain intensity during exercise. In addition, the frequency and intensity of headaches increased during the test and examination. It is related to the stress that students experience during their studies; students who drink caffeine and energy drinks while studying may stay awake longer. Although the level of energy drink intake during study periods was not calculated in this study, students should be warned about the negative consequences of drinking significant amounts of these beverages. Headache severity assessment was showing that majority of them were having moderate headache, this is common as well as in previous studies.

## Conclusions:

Migraine is a common adolescent ailment, despite the fact that it is considered to be an adult ailment. Even in neurology practice, it is still an underappreciated disorder. As a consequence, it's easy to overlook it in both teens and adults. Primary care doctors should be aware of the risk of migraine headaches in order to ensure a good school outcome. The ID Migraine™ test is an useful valid and quick screening tool, will help



primary care physicians in order to diagnose migraine in adolescents as well.

### **Recommendations:**

- 1- More research should be done on migraine headaches among university students in Sudan and among the population in general and concentrating especially on the impact of it on different aspect of life.
- 2-I recommend that all who diagnosed by migraine should be considered as cases needed to be monitored and managed well according to standard guidelines.
- 3- When it comes in dealing with migraine as a disease, there is an obvious gap in the knowledge. I recommend for it to be added as part of the medical curriculum.
- 4- The students should be made aware of the services provided by the university clinic, on a regular basis.

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### **Declarations:**

#### **Availability of data and materials**

The materials datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

#### **Competing interests**

The authors declare that they have no competing interests.

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#### **Authors' contributions**

All authors participated in planning the study, data collection, results and discussion sections.

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#### **List of Abbreviations/Definitions**

(TGVS); Trigeminal vascular system  
 (WHO); World Health Organization  
 (ETTH); episodic tension-type headaches  
 (CSD); cortical spreading depression  
 (EEG); electroencephalogram  
 (HARDSHIP); Headache-Attributed Restriction, Disability, Social Handicap, and Impaired Participation  
 (HrQoL); health-related quality of life  
 (TTH); tension-type headache  
 (NPRS); Numeric Pain Rating Scale  
 (FGIDs); Functional Gastrointestinal Disorders  
 (HIT-6); Headache Effect Test  
 (WhatsApp); what's application  
 (UdH); undifferentiated headache

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### **References:**

1. Robbins MS, Lipton RB: The epidemiology of primary headache disorders. *Semin Neurol.* 2010, 30 (2): 107-119. 10.1055/s-0030-1249220.
2. Halay, S., Saror, S., Abdalla, A., Balla, S., Elmukashfi, T., Awadalla, H., Abdelrahman, A., Swareldahab,

- Z., Amara, Z., Malik, E., Mirgani, K. and Mohamed, H., 2021. Prevalence of Migraine and Trigger Factors among Adult Rural Sudanese Population 2018.
- 3.Nosedá, R. and Burstein, R., 2021. Migraine pathophysiology: Anatomy of the trigeminovascular pathway and associated neurological symptoms, cortical spreading depression, sensitization, and modulation of pain .
4. Wessman, M. et al. A susceptibility locus for migraine with aura, on chromosome 4q24. *Am. J. Hum. Genet.* 70, 652–662 (2002).
5. Moskowitz, M. A. & Macfarlane, R. Neurovascular and molecular mechanisms in migraine headaches. *Cerebrovasc. Brain Metab. Rev.* 5, 159–177 (1993).
6. May, A. & Goadsby, P. J. The trigeminovascular system in humans: pathophysiologic implications for primary headache syndromes of the neural influences on the cerebral circulation. *J. Cereb. Blood Flow Metab.* 19, 115–127 (1999).
7. El-Metwally, A., Toivola, P., AlAhmary, K., Bahkali, S., AlKhathaami, A., Al Ammar, S., Altamimi, I., Alosaimi, S., Jawed, M. and Almustanyir, S., 2021. The Epidemiology of Migraine Headache in Arab Countries: A Systematic Review.
8. Zarifoğlu, M., Karli, N. and Taşkapilioğlu, Ö., 2021. Can ID Migraine™ be Used as a Screening Test for Adolescent Migraine?.
9. Deleu, D., Khan, M., Humaidan, H., Al Mantheri, Z. and Al Hashami, S., 2021. Prevalence and Clinical Characteristics of Headache in Medical Students in Oman..
10. Wang X, Sun J, Xing Y, Zhou H, Zhao Y, Zhu Y. The Prevalence and Awareness of Migraine Among University Students in Harbin, China. *J Oral Facial Pain Headache.* 2015 Fall;29(4):384-9. doi: 10.11607/ofph.1521. PMID: 26485386
11. Al-Hashel JY, Ahmed SF, Alroughani R, Goadsby PJ. Migraine among medical students in Kuwait University. *J Headache Pain.* 2014 May 10;15(1):26. doi: 10.1186/1129-2377-15-26. PMID: 24886258; PMCID: PMC4029817
12. Genizi J, Gordon S, Kerem NC, Srugo I, Shahar E, Ravid S. Primary headaches, attention deficit disorder and learning disabilities in children and adolescents. *J Headache Pain.* 2013 Jun 27;14(1):54. doi: 10.1186/1129-2377-14-54. PMID: 23806023; PMCID: PMC3698063.
13. Oztora S, Korkmaz O, Dagdeviren N, Celik Y, Caylan A, Top MS, Asil T. Migraine headaches among university students using ID Migraine test as a screening tool. *BMC Neurol.* 2011 Aug 19;11:103. doi: 10.1186/1471-2377-11-103. PMID: 21854556; PMCID: PMC3176162.
14. Ofovwe GE, Ofili AN. Prevalence and impact of headache and migraine among secondary school students in Nigeria. *Headache.* 2010 Nov;50(10):1570-5. doi: 10.1111/j.1526-4610.2010.01776.x. Epub 2010 Oct 14. PMID: 20946430.
15. Basdav J, Haffejee F, Puckree T. Impact of headaches on university students in Durban, South Africa. *Springerplus.* 2016 Sep 29;5(1):1679. doi: 10.1186/s40064-016-3372-1. PMID 27733981; PMCID: PMC5042922.
- 16.Goadsby, P. J., Lipton, R. B. & Ferrari, M. D. Migraine — current understanding and treatment. *N. Engl. J. Med.* 346, 257–270 (2002).
- 17.Knight, Y. E. & Goadsby, P. J. The periaqueductal grey matter modulates trigeminovascular input: a role in migraine? *Neuroscience* 106, 793–800 (2001).
- 18.Goadsby, P. J., Edvinsson, L. & Ekman, R. Vasoactive peptide release in the extracerebral circulation of humans during migraine headache. *Ann. Neurol.* 28, 183–187 (1990).

19. Sarchielli, P., Alberti, A., Codini, M., Floridi, A. & Gallai, V. Nitric oxide metabolites, prostaglandins and trigeminal vasoactive peptides in internal jugular vein blood during spontaneous migraine attacks. *Cephalalgia* 20, 907–918 (2000).
20. Goadsby, P. J. & Edvinsson, L. The trigeminovascular system and migraine: studies characterizing cerebrovascular and neuropeptide changes seen in humans and cats. *Ann. Neurol.* 33, 48–56 (1993).
21. Olesen, J., Larsen, B. & Lauritzen, M. Focal hyperemia followed by spreading oligemia and impaired activation of rCBF in classic migraine. *Ann. Neurol.* 9, 344–352 (1981).
22. Limmroth, V. et al. Changes in cerebral blood flow velocity after treatment with sumatriptan or placebo and implications for the pathophysiology of migraine. *J. Neurol. Sci.* 138, 60–65 (1996).