

## Academic Stress as a Risk Factor for Primary Headache in Medical Students: A Literature Review

Fikry Habibi<sup>1</sup>, Hanik Badriyah<sup>2\*</sup>, Yunias Setiawati<sup>3</sup>

<sup>1</sup>Medical Program, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia

<sup>2</sup>Department of Neurology, Faculty of Medicine, Universitas Airlangga,  
Dr. Soetomo Regional General Hospital, Surabaya, Indonesia

<sup>3</sup>Psychiatric Department, Medical Faculty of Airlangga University, Surabaya, Indonesia

E-mail: [fikry.habibi-2022@fk.unair.ac.id](mailto:fikry.habibi-2022@fk.unair.ac.id);  
[hanikbadriyah@fk.unair.ac.id](mailto:hanikbadriyah@fk.unair.ac.id); [yunias.setiawati@fk.unair.ac.id](mailto:yunias.setiawati@fk.unair.ac.id)

\*Corresponding author details: Hanik Badriyah Hidayati; [hanikbadriyah@fk.unair.ac.id](mailto:hanikbadriyah@fk.unair.ac.id)

### ABSTRACT

Primary headache is one of the most frequently reported neurological complaints among medical students. The demanding nature of medical education, including heavy academic workload, peer competition, and constant performance pressure, contributes to elevated levels of academic stress. Current evidence indicates that academic stress can influence the central nervous system, alter pain modulation pathways, and disrupt stress hormone balance, thereby increasing the risk of developing tension-type headache (TTH) and migraine. Additional contributing factors such as sleep disturbances, anxiety, depression, excessive screen exposure, and poor study posture further strengthen the association between stress and primary headache occurrence. This literature review highlights that academic stress plays a significant role as a risk factor for primary headaches in medical students through neurophysiological mechanisms and lifestyle-related contributors. These findings emphasize the importance of implementing preventive strategies, including stress management, lifestyle modification, and comprehensive non-pharmacological interventions, to reduce headache incidence and improve the overall well-being of medical students.

**Keywords:** academic stress; primary headache; medical students; tension-type headache (TTH); migraine; stress mechanisms

### INTRODUCTION

Primary headaches are the most common neurological complaint reported by medical students. The heavy academic workload, competition with peers, and constant pressure to perform at a high level make medical education particularly stressful [1]. This stress can affect both psychological and physical health and contribute to the development of primary headaches, such as tension-type headache (TTH) and migraine. Research has shown that academic stress can influence the central nervous system, alter pain modulation, and disrupt stress hormone balance, all of which may lead to primary headaches [2,3].

Along with stress from school, medical students often have other mental health problems, like anxiety and depression, that happen at the same time. The combination of these factors can have a significant impact on the frequency, intensity, and duration of primary headaches, further affecting daily health [4,5,6]. In Indonesia, research on the relationship between academic stress and primary headaches in

medical students is still limited, especially in assessing multiple psychological factors. For this reason, a literature review is needed to summarize the existing scientific evidence and provide a clearer understanding of this topic [7,8].

The objective of this literature review is to enhance comprehension of academic stress as a contributing factor to primary headaches among medical students. Currently, there is insufficient evidence examining the interplay between academic demands and the psychological and physiological mechanisms that precipitate primary headaches in this demographic. Consequently, a thorough synthesis of existing studies is essential to elucidate the underlying mechanisms, contributing factors, and clinical ramifications of academic stress on the incidence of primary headaches.

### REVIEW CONTENT

#### A. Primary Headaches

Primary headaches are types of head pain that happen because of certain biological processes without any

structural changes, infections, or metabolic disorders [9]. The two types of headaches that students most often report are tension-type headache (TTH) and migraine [10]. TTH typically manifests as a dull, pressing, or constricting pain bilaterally, characterized by mild to moderate intensity, without inducing severe nausea, vomiting, or photophobia [12]. A migraine usually feels like a throbbing pain on one side of the head that ranges from mild to severe. Other symptoms that may come with it include nausea, photophobia, or phonophobia [11,13].

Medical students are more likely to experience tension-type headaches (TTH) than migraines due to the cumulative effects of academic stress and mental fatigue, which can increase pericranial muscle tension [12]. Additionally, study activities that require long periods of intense focus, along with habits that involve poor ergonomic posture, make primary headaches worse. These headaches can make it hard for students to do well in school, lower their productivity, and make their lives worse overall when they happen a lot [14].

### **B. Academic Stress**

Academic stress is a psychological and physiological response that occurs when academic demands are perceived to surpass an individual's capacity to cope or adapt [15]. Medical students experience elevated levels of academic stress compared to other disciplines, attributable to a rigorous curriculum, significant cognitive demands, and social and professional pressures [17]. Tests that happen often, heavy workloads, clinical evaluations, competition among students, and not enough time to rest are all things that can make school stressful [16].

Schoolwork stress affects more than just mental health; it also affects physical health. Stress can make the autonomic nervous system, hormones, and metabolism less stable [18,19]. Over time, unmanaged academic stress can make it harder to learn, make you more tired, mess up your sleep patterns, and cause medical problems like primary headaches [20]. Therefore, understanding academic stress is essential for assessing the risk factors associated with headache occurrence in medical students [21].

### **C. Biological Mechanisms Connecting Stress and Headache**

There are a lot of biological reasons why stress and primary headaches are related. Chronic stress activates the hypothalamic-pituitary-adrenal (HPA) axis, resulting in increased cortisol release over time [22]. Cortisol levels that stay high for a long time are known to mess with pain modulation, lower the pain threshold, and make you more sensitive to painful stimuli. Consequently, individuals exhibit increased vulnerability to episodes of primary headaches [23,24].

Second, emotional stress causes a reflexive rise in the tone of the pericranial muscles, especially in the head, neck, and shoulders [11,12]. Muscle tension

that lasts a long time because of bad study posture, like when reading, writing, or using electronic devices, can send pain signals to the central nervous system all the time and make the peripheral nervous system more sensitive. This mechanism is a primary contributor to recurrent tension-type headaches in students [25,12].

Third, stress can make the sympathetic nervous system too active, which makes the body's fight or flight response stronger. This activation affects blood vessels, autonomic regulation, and nociceptor sensitivity, which creates conditions in the body that make headaches more likely to happen. The interaction of these biological mechanisms makes medical students who are under a lot of stress more likely to get primary headaches, which are defined by more frequent and severe headaches [2,19].

### **D. Supporting and Confounding Factors**

Some lifestyle choices can make the connection between academic stress and primary headaches stronger. Sleep disturbances are one of the most important of these factors [26]. Students who do not get enough sleep have trouble regulating neurotransmitters, handling stress, and feeling pain [27]. Anxiety and depression, which often happen at the same time as stress, can also make headache symptoms worse over time [28].

Too much screen time can also cause primary headaches in two ways: by making the eyes stay on the screen for too long and by not sitting up straight [29]. If you look down at digital devices for a long time, the muscles in your neck and shoulders can get tense, which can make TTH more likely [30,31]. Not being active or living a sedentary lifestyle makes muscles less flexible and makes the body less able to handle stress, which makes headaches more likely [32,33].

Not drinking enough water, eating at strange times, and skipping breaks are other things that can cause this. Medical students frequently exhibit these behaviors due to their demanding academic and clinical schedules [34,35].

### **CONCLUSION**

After reading the literature, it is clear that stress is a major factor in the development of TTH in teenagers. The HPA axis is turned on, cortisol levels go up, peripheral and central sensitization happen, and pericranial muscle tension goes up. Things like not getting enough sleep, having too much schoolwork, and using digital devices too much make this connection even stronger. TTH makes life worse for teens, especially when it comes to their schoolwork and mental health.

In general, the link between stress and TTH means that stress management techniques, changes to one's lifestyle, and full non-drug interventions should all be part of prevention efforts. If TTH isn't managed properly, it could turn into a long-term problem that is harder to treat.

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