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The impact of lifestyle factors and chronic stress on the frequency and intensity of migraine and tension-type headaches among Austrian women

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Abstract

Background Primary headache disorders such as migraine and tension-type headaches represent an important public health problem. Besides genetic factors, environmental parameters, and, in particular, recent lifestyle patterns may contribute to the increasing prevalence of headache disorders.

Sample and methods 173 women, between the ages of 18 and 65 years, were enrolled in the present study. The present study focuses on the association between recent lifestyle patterns such as physical activity, time spent outdoors, time spent in front of TV or computer screens, nicotine consumption, weight status as well as chronic stress exposure, and the duration and intensity of migraine and tension-type headaches (TTHs) in a female sample from Austria. An extensive online questionnaire, consisting of 72 questions regarding sociodemographic background, headache anamnesis, lifestyle factors, such as sleep, and physical activity patterns, was distributed via online platforms by means of a snowball sampling system. Additionally, chronic stress was measured using the Trier Inventory for Chronic Stress.

Results Participants suffering from migraine were significantly older than women suffering from tension-type headaches (TTHs) and migraine. Age was significantly associated with migraine attack frequency. Women suffering from tension-type headaches (TTH) intensity showed significant associations with physical exercise, sleep, and chronic stress. Fewer hours of exercise and higher stress were connected with higher pain intensity. Migraine frequency, in contrast, correlated with daily hours spent in front of computer screen, while stress and physical exercise did not show associations with migraines.

Conclusion The study showed that lifestyle factors may be associated with and may have effects on primary headache disorders, especially tension-type headaches.

Take home message for students Primary headache disorders are not only painful for affected individuals, they also represent a serious public health problem. Recent lifestyle patterns, such as chronic stress, a lack of sleep, and a lack of physical activity seem to enhance the risk of suffering from primary headaches.

Introduction

Currently, more than 45% of the global adult population suffers from active headaches, the most common disorders of the neuro-system (Stovner et al. 2007). We have to distinguish between primary headaches, which have no known underlying cause, and secondary headaches, which are symptoms of other diseases (Headache Classification Committee of the International Headache Society 2018). The present study focuses on primary headache disorders which include several forms of migraines, tension-type headaches (TTHs), and trigeminal autonomic cephalalgias such as cluster headaches (Headache Classification Committee of the International Headache Society 2018). According to the Global Burden of Diseases, Injuries, and Risk Factors (GBD) studies (Vos et al. 2020), in the year 2016 nearly three billion individuals worldwide were estimated to suffer from the most common primary headache disorders, i.e. tension-type headaches (1.9 billion cases) or migraine (1.4 billion cases). Although primary headaches are among the most prevalent disorders worldwide (Stovner et al. 2007), they are not fatal and nearly everybody experiences headaches from time to time (Vos et al. 2020). Perhaps these are reasons why the importance of headaches as a major public health problem has only been recognized in the last 20 years (Vos et al. 2020). Nevertheless, GBD ranks headache disorders under the top ten of the most disabling diseases. This is due to the fact, that the most common primary headaches, i.e. migraine and chronic TTH, cause not only somatic but also psychological pain and, consequently, a marked decrease in the quality of life (Lipton et al. 2000). Furthermore, several studies have shown that migraines and TTHs have a profound negative impact on the larger economic situation (Hamelsky et al. 2005; Linde and Dahlöf 2004; Lipton et al. 2003; Lipton et al. 2000). These headache disorders cause direct costs for the public health care systems and also indirect costs due to work absences and reduced work efficiency (Jensen and Stovner 2008). These costs are expected to continue to rise in the future, since a significant increase in the prevalence of headaches has been observed over the past three decades. Lyngberg et al. (Lyngberg et al. 2005) reported a significant increase in TTH prevalence from 1989 to 2001 among the Danish population. Additionally, the prevalence of migraine increased in that 12-year period. This trend continues in other nations (Vos et al. 2020). The prevalence of primary headaches varies between different geographic regions. The Eurolight project, studying 8.000 residents from 10 European countries detected a headache lifetime prevalence of 91% and a 1-year prevalence of 79% (Steiner et al. 2014). In general, the prevalence of primary headaches in Europe is about 50%, which is the same as in Asia, Australia, and North America, while only 20% of the African population is affected (Stovner et al. 2007).

In order to develop strategies to reduce the prevalence of headaches, it is necessary to understand its aetiology and identify risk factors. There is no doubt that primary headaches have a strong genetic component (Sutherland et al. 2019), however, environmental factors influence the intensity and frequency of headache diseases, too. Often cited trigger factors are weather changes or alterations of barometric pressure, although various studies have yielded controversial results (Marrelli et al. 1988; Mukamal et al. 2009). Distinct intrinsic weather components, such as temperature, sunshine duration, wind speed, humidity, and seasonal factors seem to enhance headache (Yang et al. 2011). Furthermore, muscle tension, neck pain (Tolentino et al. 2018), and menstrual factors (Arjona et al.

2007; Campelo et al. 2021; van Casteren et al. 2021) have been reported to trigger primary headaches. The focus of the present study, however, lies on lifestyle factors and their impact on headache characteristics.

The interaction of lifestyle and headaches is not only interesting from a public health point of view, but also from an anthropological one. From an evolutionary perspective, we have to be aware that the recent lifestyle differs drastically from that of our ancestors, who lived in the so-called environment of evolutionary adaptedness (Bennett 2020). For most of human evolutionary history our ancestors practiced a foraging subsistence characterized by high physical outdoor activity, a diet rich in fiber and vegetable food with a low content of sugar and fat, an extremely low rate of overweight and obesity (Irons 1998) and a low chronic stress level. Therefore, the increasing rates of headache disorders may be due to the fact, that we are now living in an environment to which we are not adapted. Headaches may be one result of a mismatch between our evolutionary heritage and our current life circumstances. This has become especially true over the last decades of our daily life when we adopt a sedentary lifestyle typically characterized by spending a lot of time sitting in front of computer or TV screens, low physical outdoor activity, overnutrition with high fat and sugar intake, smoking, sleeplessness, a chronic Vitamin D deficiency, and a high chronic stress level (Walker et al. 2003).

All these parameters are associated with the occurrence of headaches. One of the most commonly named trigger factors for primary headaches is chronic stress (Boardman et al. 2005; Rasmussen 1993; Wöber et al. 2006; Wöber and Wöber-Bingöl 2010; Zivadinov et al. 2003). Chronic stress is often associated with sleep disturbances and sleeplessness. Suffering from sleep disturbances or sleeplessness increases headache frequency as well as headache intensity. This is true of TTH as well as of migraine (Pellegrino et al. 2018).

In the present study, we focused on the complex associations between recent lifestyle patterns and the frequency as well as the intensity of TTH and migraine. Therefore, we tested the following two hypotheses:

1. Recent lifestyle, characterized by low physical activity, little outdoor activity, low average sleeping hours, a high body mass index, and long periods spent sitting in front of computer or TV screens is associated with an increased frequency and an increased intensity of migraine and tension-type headaches.
2. High chronic stress levels are associated with an increased frequency and an increased intensity of migraine and tension-type headaches.

Sample and methods

Study design

Due to the Covid-19 situation, data collection could take place online only. SosciSurvey (Leiner 2019) was used to distribute a specially developed questionnaire containing 72 items and the questionnaire of the “Trierer Inventar zum chronischen Stress“ (Trier Inventory of Chronic Stress, TICS) according to Schulz et al. (Schulz et al. 2004). The link to the questionnaire was posted in several self-help groups for migraines or headaches, and the distribution followed a virtual snowball sampling, using social media platforms, such as Facebook, WhatsApp, and others. Snowball sampling is a non-probability sampling technique where existing study participants distribute the links among their friends and acquaintances. Consequently, the sample size grows like a rolling snowball (Goodman 1961; Baltar and Brunet 2012). The questionnaire was accessible online from the 21st December 2020 to the 21st February 2021.

For inclusion in the analyses, the following criteria were defined: female sex, aged between 18 and 65 years, and diagnosis of migraine or TTH. In addition, the following strict exclusion criteria were defined: age younger than 18 years or older than 65 years, chronic or acute diseases which might affect headache, any kind of medication which might induce headache.

Participants

In total, 219 people filled out the survey completely, but only 173 women aged between 18 and 65 years (x=34.8 years, SD=12.7 years) fulfilled the strict inclusion criteria mentioned above. Therefore, 35 male participants, 3 participants who did not identify as male or female, one woman who did not agree to the data usage for the analysis, one woman older than 65 years, and one woman whose health condition, might have influenced the intensity or frequency of headache validity for the analysis were excluded. Although we have no information about the birth places of the participants, all participants lived in German speaking countries and were able to understand and fill out a complex questionnaire in German language.

Questionnaire

A 72-item questionnaire was developed for this study. The questionnaire consisted of items concerning sociodemographic characteristics, questions specific to migraine and TTH, and questions about lifestyle patterns.

Sociodemographic questions included, for example, age, height, body weight, work, and education. For the questions regarding migraines as well as TTHs, the "International classification of headache diseases ICHD-3" by the Headache Classification Committee of the International Headache Society (Headache Classification Committee of the International Headache Society 2018) was used. The classifications for migraine and TTH and their respective types were used to group the participants according to their headache type or types. The first question described the particular headache and asked the participants whether or not they had experienced it. Those who chose the "yes" or the "not sure" option were then given several more questions regarding the respective headache type. This was done for migraine-type headaches and TTHs. This approach was chosen, so that participants who did not know what classifies as a migraine or a TTH, were able to answer according to the description.

Later on, all participants were asked some extra questions about headaches. Factors that cause or worsen headaches as well as those helping with improving headaches were also covered in the survey.

The questions regarding lifestyle included topics like screen time, physical activity patterns, sleep quality, time spent outdoors, and smoking. Furthermore, a section addressing the impact of menstrual cycle on headaches was included. Since no significant interaction between menstrual cycle parameters and headaches could be proven, menstrual cycle characteristics were not considered in further analyses.

Trier Inventory of Chronic Stress

The "Trierer Inventar zum chronischen Stress" (Trier Inventory of Chronic Stress, TICS) according to Schulz et al. (Schulz et al. 2004) was used to determine the chronic stress levels of the participants. The TICS consists of 57 questions and is a standardized questionnaire, providing reliability. The 57 questions are divided into different categories: work overload, social overload, pressure to perform, work discontent, excessive demands from work, lack of social recognition, social tensions, social isolation, and chronic worrying and a screening scale for chronic stress. Each question item is rated on a scale from "never" 0 to "very often" 4. The values of the questions for the different categories are then summed. The sums are then translated to T-scores according to the manual.

Statistical Analysis

The statistical analysis was conducted with IBM SPSS Statistics 27. All parameters were tested for normal distribution by using Kolmogorov-Smirnov tests. Since no normal distribution could be verified for all metric variables, exclusively non-parametric procedures were applied. Chi-square tests, Fisher-Exact-tests and Fisher-Halton-Freeman tests were used for the analysis. Chi-square-tests were preferred, but Fisher-Exact-tests and Fisher-Halton-Freeman tests were applied when more than 20% of the cell count was smaller than 5. Group differences were tested by using Kruskal-Wallis-H-tests. A power analysis was computed to test whether the small sample size allowed spearman rank correlations and multiple regression analyses. Spearman correlations were computed to test the correlation patterns between headache characteristics and lifestyle factors as well as chronic stress parameters with respect to their statistical significance. Multiple regression analyses were computed to test association patterns between headache characteristics and lifestyle parameters as well as chronic stress levels. The significance limit was set at $p < 0.05$ for all tests.

Results

Sample description

The participants were assigned to four groups according to the characteristics of their headaches. 41 women suffered from migraine, 20 women suffered from TTH, 97 women suffered from migraine and TTH, 19 women did not suffer from headaches. The mean age of the four subgroups (no headache, migraine, TTH and TTH + migraine) differed significantly (p=0.003). Women without headache showed the lowest mean age (x=26.6 years ± 5.6), while women suffering from migraine (x=38.0 years ± 13.8) represented the oldest group. The mean age of women suffering from TTH was 31.2 years ± 14.3, while women suffering from TTH and migraine were on average 36.3 years ± 12.6 old. Age correlated significantly with the frequency of migraine attacks among women suffering from migraine only (p=0.040) and among women suffering from migraine and TTH (p=0.004). Table 1 presents the socioeconomic characteristics and the weight status of the participants for each subgroup separately. Neither socioeconomic characteristics nor weight status differed significantly between the four subgroups.

Factors which might trigger migraine or tension-type headaches

An extensive list of possible migraine or TTH triggers was provided. The most often chosen trigger factors for migraine as well as TTH were change in weather, stress, lack of sleep, and neck and muscle tension (figure 1).

Lifestyle parameters and headache characteristics

The lifestyle parameters of the participants are presented in Table 2. The four sub-

groups did not differ significantly in the lifestyle parameters.
Within the subgroups however, the frequency of headache attacks correlated significantly with some lifestyle parameters. In detail, migraine frequency correlated significantly positively (p=0.004) with the hours spent in front of a computer screen per day. The frequency of TTH correlated significantly negatively with the sleeping hours per day (p=0.010) and significantly negatively with the hours of physical exercise per week (p=0.047). However, we have to be aware, that, with the exception of the correlation between hours of physical exercise per week and frequency of TTH, the correlation coefficients are below 0.30 and therefore explain less than 9% of variation. (Table 3).
These results were corroborated partly by the multiple regression analyses. While migraine frequency was significantly negatively (p=0.011) associated with age only, and migraine intensity showed no signif-

Table 1 Sample description socioeconomic parameters according to headache group

	migraine	tension-type headaches	migraine + tension-type headaches	no headache
n	41	20	97	19
Civil status				
single	26.8%	45%	29.9%	38.9%
married/cohabitation	73.2%	55%	69%	61.1%
divorced/separated	0.0%	0	1%	0.0%
Educational level				
compulsory education	0%	0%	2.1%	10.5%
vocational training	14.6%	0%	11.5%	0%
high school	46.3%	40%	36.4%	36.8%
University degree	36.6%	60%	50.0%	52.7%
Occupation				
fulltime	41.5%	10.0%	28.9%	21.1%
part-time	34.1%	40.0%	33.0%	52.6%
unemployed	2.4%	5.0%	7.3%	5.3%
student	22.0%	70,0%	36.1%	73.7%
retired	7.3%	10.0%	10.3%	0.0%
Children				
yes	51.2%	20	25.8%	22.2%
no	48.8%	80	74.2%	77.8%
Smoking				
yes	14.6%	25.0%	12.4%	21.1%
no	85.4%	75.0%	87.6%	78.9%
Weight status (BMI)				
<18.50kg/m^2	7.7%	5.3%	9.7%	15.8%
18.50-24.99kg/m^2	53.8%	68.4%	66.7%	68.4%
25.00-29.99kg/m^2	24.4%	21.1%	12.9%	10.5%
≥30.00kg/m^2	12.8%	5.3%	10.8%	5.3%

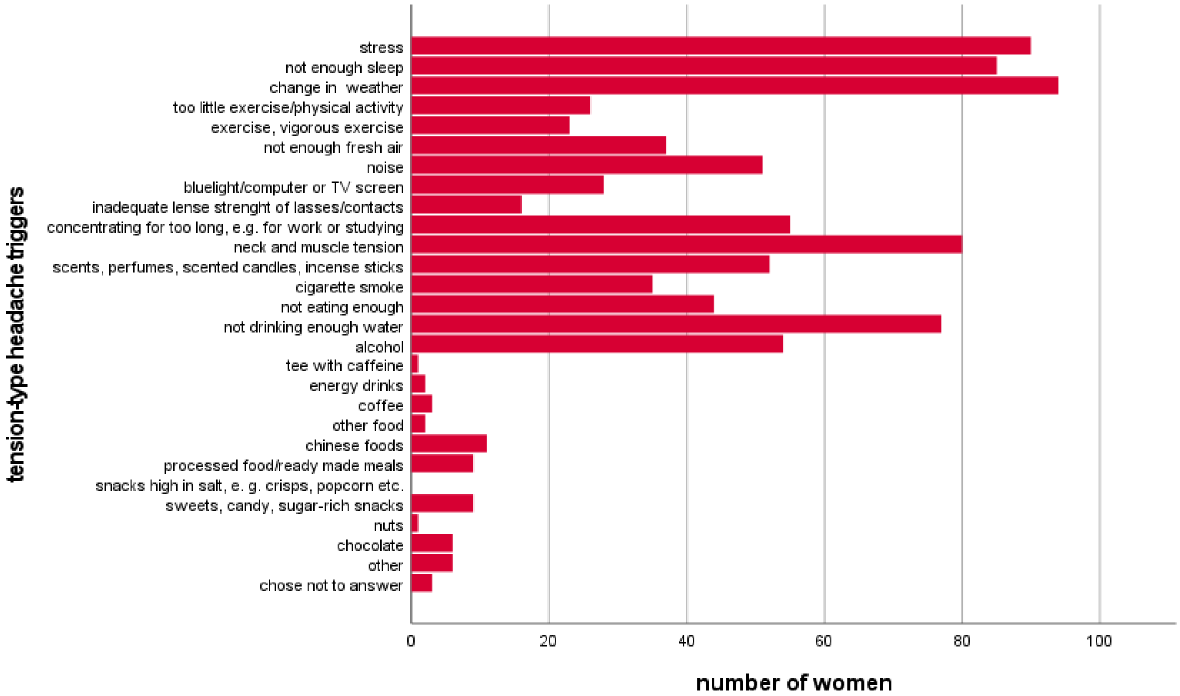

Figure 1 Trigger factors of tension-type headache attacks

icant associations with any lifestyle parameter nor with age, the frequency of TTH tension-type headache attacks was significantly negatively associated with the sleeping hours per day (p=0.029). The intensity of TTH was significantly positively related to smoking (p=0.049), the time spent in front of computer screens per day (p=0.049), and subjective stress level (p=0.026). The sleeping hours per day, however, were significantly negatively (p=0.009) associated with the intensity of TTH. The r-squares were quite low (Table 4).

Chronic stress and headache characteristics

Chronic stress was estimated by using the Trier Inventory of chronic stress (TICS). The four subgroups differed significantly only in the component social overload (p=0.045). The highest scores for the components social overload and pressure to perform were found for women suffering from TTH and migraine, while the highest scores for work overload, lack of social recognition and social tensions were found in women suffering from migraine only. Women affected by TTH only showed the highest scores for work discontent, excessive demands from work, social isolation, and chronic worrying. Women without headache always showed the lowest scores of chronic stress components.

As presented in Table 5, the frequency of migraine attacks correlated significantly positively with work discontent (p=0.026), a lack of social recognition (p=0.030), and social isolation (p=0.046). The intensity of migraine correlated significantly positively with pressure to perform (p=0.044), social tensions (p=0.040), and chronic worrying (p=0.047). The frequency of TTH correlated significantly with a lack of social recognition (p=0.049), social isolation (p=0.016), and chronic worrying (p=0.028). The intensity of TTH correlated significantly positively with work overload (p=0.011), a lack of social recognition (p=0.041), social tensions (p=0.031), and

chronic worrying (p=0.024). As pointed out above, the correlation coefficients were quite low – mostly below 0.30. Therefore, we have to state that even some of the statistically significant correlations may only indicate a low biological importance.
The results of the multiple regression analyses are presented in Table 6.
While the pressure to perform was positively associated with migraine intensity (p=0.005), a lack of social recognition (p=0.037) and social isolation (p=0.021) were significantly positively associated with the frequency of TTH. Again, the r-squares were quite low (below 0.44).

Discussion

It was hypothesized that recent lifestyle characterized by low physical activity, little outdoor activity, low average sleeping hours, a high body mass index, and long periods of time spent sitting in front of computer or TV screens is associated with an increased frequency and an increased intensity of migraine and TTH. Furthermore, it was tested, whether high chronic stress levels are associated with an increased frequency, and an increased intensity of migraine and TTH.
Both hypotheses could be verified in the present study. This means that recent lifestyle factors as well as the burden of

Table 2 Sample description lifestyle parameters according to headache group

	Migraine	TTH	migraine + TTH	no headache
N	41	20	97	19
Screen time (hours/ day)				
<1 hour	2.5%	0.0%	1.0%	0.0%
1-6 hours	47.5%	55.0%	58.3%	66.7%
6-12 hours	50.0%	45.0%	39.6%	33.3%
>12 hours	0.0%	0.0%	1.0%	0.0%
Outdoor activity (hours/week)				
<4 hours	48.8%	50.0%	32.0%	33.3%
4-7 hours	36.6%	40.0%	41.2%	33.3%
7-14 hours	7.3%	5.0%	18.6%	27.8%
>14 hours	7.3%	5.0%	8.2%	5.6%
Physical exercise (hours/week)				
No exercise	10.5%	15.8%	11.5%	26.3%
<2 hours	23.7%	42.1%	28.1%	15.8%
2-4 hours	36.8%	15.8%	26.0%	36.8%
4-7 hours	17.1%	21.1%	28.1%	15.8%
7-9 hours	4.9%	0.0%	5.2%	0.0%
<9 hours	4.9%	5.3%	1.0%	5.3%
Sleep (hours/day)				
<6 hours	22.0%	20.0%	19.8%	27.8%
7-8 hours	70.7%	70.0%	68.8%	50.0%
>9 hours	7.3%	10.0%	11.5%	22.2%

chronic stress trigger the intensity and frequency of primary headaches. However, before we start to discuss the results in detail, we have to state that this study has some important limitations. On the one hand, the sample size was quite small – only 173 adult women were included in the study and the three headache subgroups were quite small. Although the power analyses allow Spearman rank correlations and multiple regression analyses for such small group sizes, we have to state, that this study has the character of a pilot study. Furthermore, and although few correlations were of statistical significance, the rather low correlation coefficients below 0.30 point to low biological importance of these associations. This is also true of the rather

Table 3 Headache patterns and lifestyle factors. Spearman correlations.

	migraine				tension-type headache			
	frequency		Intensity		frequency		intensity	
Lifestyle parameters	M +TTH	M	M +TTH	M	TTH +M	TTH	TTH + M	TTH
Body mass index (kg/m²)	0.12	-0.05	-0.07	-0.11	-0.08	0.42	-0.07	0.19
Sleep (hours/ day)	-0.07	-0.08	-0.16	-0.24	**-0.29****	0.21	0.17	0.44
Screen time (hours/day)	0.05	**0.29****	-0.08	0.01	-0.11	0.22	0.17	0.37
Outdoor activity (hours/week)	0.13	0.05	0.03	-0.23	-0.08	-0.33	0.17	-0.19
Exercise (hours/week)	-0.07	0.19	0.11	-0.07	0.01	**-0.48***	-0.15	-0.17

Legend: M=migraine; TTH=tension-type headache
Bold letters indicate significant correlations * p <0.05, ** p<0.01

Table 4 The impact of lifestyle parameters on the intensity and frequency of migraine and TTH headache. Multiple regression analysis.

	R^2	B	Sig	95% CI	R^2	B	Sig	95% CI
		Migraine frequency				Migraine intensity		
Age	0.28	-0.02	0.011	-0.03 – -0.01	0.27	0.01	0.071	-0.01 – 0.02
Smoking		0.04	0.875	-0.45 – 0.53		0.04	0.776	-0.25 – 0.33
Screen time (hours/day)		0.11	0.510	-0.21 – 0.42		0.02	0.837	-0.16 – 0.20
Exercise (hours/week)		0.05	0.503	-0.11 – 0.21		0.04	0.426	-0.05 – 0.13
Outdoor activity (hours/week)		0.02	0.848	-0.17 – 0.21		-0.03	0.620	-0.08 – 0.13
Sleep (hours/day)		-0.15	0.350	-0.45 – 0.16		-0.07	0.446	-0.25 – 0.11
Body mass index (kg/m²)		0.03	0.173	-0.01 – 0.06		0.01	0.782	-0.02 – 0.02
	TTH frequency				TTH intensity			
Age	0.36	0.07	0.228	-0.05 – 0.19	0.45	0.01	0.805	-0.01 – 0.01
Smoking		2.67	0.177	-1.23 – 6.57		0.36	0.049	0.01 – 0.73
Screen time (hours/day)		2.05	0.157	0.80 – 4.90		0.25	0.049	0.01 – 0.51
Exercise (hours/week)		-0.81	0.265	-2.23 – 0.62		-0.03	0.614	-0.16 – 0.09
Outdoor activity (hours/week)		-0.83	0.296	-2.41 – 0.74		-0.14	0.067	-0.28 – 0.01
Sleep (hours/day)		-3.11	0.029	-5.88 – -0.33		-0.31	0.009	-0.53 – -0.08
Body mass index (kg/m²)		-0.02	0.901	-0.35 – 0.31		0.01	0.808	-0.03 – 0.03

low r-squares found during the multiple regression analyses. Therefore, we have to be aware that even though a statistical significance could be observed, the biological importance is only modest. Another limitation is, that data collection took place using an online survey only. This study design is due to the Covid-19 pandemic, which made face-to-face interviews and direct data collection impossible. It was therefore not possible to include the effect of Vitamin D deficiency on headaches (Kjaergaard et al. 2012), because it was not possible to collect blood samples of the participants.

In our sample, 23.7% of the participants suffered from migraine, 11.6% from TTH, but 54.3% suffered from both headache conditions. We compared the three headache subgroups and one group of women who reported to be not affected by headaches. The four groups did not differ significantly in sociodemographic factors, with the exception of age. The effects of socioeconomic parameters have been widely described (Molarius et al. 2008). Furthermore, the well-described effects of menstrual cycle patterns as trigger factors for headaches (Arjona et al. 2007; Campelo et al. 2021) could not be proven in the present study. Women suffering from different types of primary headaches and women without headaches did not differ significantly in lifestyle parameters such as weight status, nicotine consumption, sleeping hours per day, physical exercise hours per week, outdoor activity per week, or hours spent in front of a computer or TV screen per day. Furthermore, the four groups did not differ significantly in the components of chronic stress, with the exception of social overload. Consequently, no significant differences in lifestyle parameters and in most of the chronic stress components could be observed between the four subgroups. Both, women suffering from TTH as well as women suffering from migraine attacks reported changes in weather, stress, a lack of sleep and neck or muscle tension as the most important trigger factors of headache. These observations are in accordance with the results of several other studies (Marrelli et al. 1988; Altura and Altura 2001;

Table 5 Headache patterns and stress factors. Spearman correlations.

	migraine				**tension-type headache**			
	frequency		**intensity**		**frequency**		**intensity**	
	M +TTH	M	M+TTH	M	TTH +M	TTH	TTH + M	TTH
Work overload	-0.05	0.12	-0.04	-0.11	-0.01	0.38	**0.26****	0.28
Social overload	-0.09	0.12	-0.16	-0.02	0.01	-0.14	0.11	0.19
Pressure to perform	0.01	0.17	-0.03	**-0.29***	-0.13	0.19	0.18	0.19
Work discontent	-0.04	**0.31 ***	-0.05	-0.17	-0.11	0.35	0.12	0.21
Excessive work demands	-0.16	0.09	-0.15	-0.04	-0.09	0.41	0.09	0.39
Lack of social recognition	-0.09	**0.31***	0.07	-0.01	0.02	**0.48***	-0.02	**0.47***
Social tensions	-0.04	-0.08	**0.19***	-0.14	-0.13	0.29	0.07	**0.49***
Social isolation	**0.17***	0.09	-0.09	-0.09	**0.28***	0.05	0.02	0.26
Chronic worrying	0.03	0.11	**0.18***	-0.12	-0.03	**0.53***	**0.23***	0.25
chronic stress	-0.11	0.16	0.07	-0.0	-0.01	0.37	**0.21***	0.20

Legend: M=migraine; TTH=tension-type headache

Bold letters indicate significant correlations * p <0.05, ** p<0.01

Engstrøm et al. 2014b; Meyer et al. 2016; Rafique et al. 2020; Engstrøm et al. 2014a). Without any doubt, sleep is important for general health and quality of life, because sleep is required to regenerate, relax and revitalize, and it is needed to recharge emotional batteries (Mukherjee et al. 2015; Ohlmann and O'Sullivan 2009). In the present study, a significant association between a lack of sleeping hours per day and increased frequency and intensity of TTH could be observed. The direction of causality cannot be determined, that is, it is possible that a lack of sleep increases TTH attacks or the headaches might cause the lack of sleep. Nevertheless, these findings are partly in accordance with previous studies. Kelman and Rains (Kelman and Rains 2005) found that participants who slept less, in particular less than six hours per night, experienced more frequent and severe headaches. Correspondingly, Alberti (Alberti 2006) detected that short-time sleepers had more frequent headaches than long-time sleepers. Furthermore, no significant associations between sleeping hours and migraine frequency and intensity were detected. These findings are in contrast to the findings of Ødegård et al. (Ødegård et al. 2010) and Walters et al. (Walters et al. 2014) who reported a significant association between poor sleep quality as well as sleep disturbances and migraine frequency. Some studies show that migraine attacks

Table 6 The impact of chronic stress on the intensity and frequency of migraine and TTH headache

	R^2	B	Sig	95% CI	R^2	B	Sig	95% CI
		migraine frequency			migraine intensity			
Work overload	0.26	0.01	0.966	-0.02 – 0.02	0.44	-0.01	0.509	-0.02 – 0.01
Social overload		-0.01	0.697	-0.02 – 0.02		0.01	0.088	-0.01 – 0.02
Pressure to perform		0.02	0.222	-0.01 – 0.04		-0.02	**0.005**	-0.03 – -0.01
Work discontent		0.01	0.984	-0.02 – 0.02		-0.01	0.233	-0.02 – 0.01
excessive work demands		-0.01	0.813	-0.02 – 0.02		-0.01	0.093	-0.02 – 0.01
Lack of social recognition		0.01	0.390	-0.01 – 0.03		0.01	0.966	-0.01 – 0.01
Social tensions		-0.01	0.191	-0.03 – 0.01		0.01	0.480	-0.01 – 0.01
Social isolation		0.01	0.123	-0.03 – 0.03		0.01	0.992	-0.01 – 0.01
Chronic worrying		0.02	0.160	-0.01 – 0.05		0.01	0.163	-0.01 – 0.03
chronic stress		-0.03	0.282	-0.08 – 0.02		0.01	0.835	-0.02 – 0.03
		TTH frequency			TTH intensity			
Work overload	0.38	0.03	0.758	-0.16 – 0.22	0.31	0.01	0.112	-0.01 – 0.03
Social overload		-0.04	0.680	-0.22 – 0.14		-0.01	0.898	-0.02 – 0.01
Pressure to perform		-0.03	0.796	-0.23 – 0.18		0.01	0.433	-0.01 – 0.03
Work discontent		-0.03	0.671	-0.19 – 0.12		0.01	0.346	-0.01 – 0.02
excessive work demands		-0.16	0.141	-0.37 – 0.05		-0.01	0.798	-0.02 – 0.02
Lack of social recognition		0.19	**0.037**	0.01 – 0.37		-0.01	0.242	-0.03 – 0.01
Social tensions		-0.09	0.253	-0.23 – 0.06		0.01	0.454	-0.01 – 0.02
Social isolation		0.14	**0.021**	0.02 – 0.26		0.01	0.798	-0.01 – 0.02
Chronic worrying		0.01	0.961	-0.29 – 0.31		0.01	0.418	-0.02 – 0.04
chronic stress		0.20	0.350	-0.23 – 0.63		0.01	0.642	-0.03 – 0.05

Bold letters indicate significant impact can also be provoked by excessive sleep (Kelman and Rains 2005; Rafique et al. 2020; Wöber and Wöber-Bingöl 2010).

Sleep is only one factor which affects headache. Our daily lifestyle is often characterized by a low rate of physical exercise and/or outdoor activity. In the present study, however, no significant associations between the amount of physical activity per week and migraine attacks occurred. Similar results have been provided by Rasmussen (Rasmussen 1993) and Winter et al. (Winter et al. 2011), who also did not find any connections of migraine with physical activity patterns. TTH frequency showed a significant negative association with the number of exercise hours per week, while no significant associations between headache characteristics and outdoor activity were found. These findings are in contrast to the results of (Hagen et al. 2018), who reported no significant associations between physical activity and the frequency and intensity of TTH. In our study, women with strong and very strong pain intensity spent less hours per week on exercise. This result is in accordance to (Kikuchi et al. 2007), who showed that greater intensities led to less physical activity. On the other hand, the present study yielded a significantly positive association between TTH intensity and hours spent in front of a computer or TV screen per day. Consequently, a sedentary lifestyle seems to trigger TTH pain intensity, although the headaches may be triggered by looking at the screen per se.

Another well-documented trigger of headache is chronic stress (Boardman et al. 2005; Pellegrino et al. 2018; Rasmussen 1993; Wöber et al. 2006; Wöber and Wöber-Bingöl 2010; Zivadinov et al. 2003). In this study, stress was measured by using the Trier Inventory for Chronic Stress (TICS) (Schulz et al. 2004). Headache sufferers generally had higher TICS- scores than the non-headache controls. These differences, however, were not of statistical significance. Migraine frequency and intensity correlated with various components of chronic stress, such as pressure to perform, work discontent, lack of social recognition, social tensions, social isolation and chronic worrying. This was also true of TTH for which, in addition, a significant association with work overload was found. In general, the higher the chronic stress scores, the higher were the frequency and intensity of migraine and TTH. However, these associations were only found for correlations using multiple regression models and only the pressure to perform score was significantly associated with migraine intensity. Similarly, Antonov and Isacson (Antonov and Isacson 1997) found work overload to be significantly associated with the intensity of TTH. Connections of work stress and headaches have also been made by Lynberg et al. (Lyngberg et al. 2005).

A possible explanation for links of chronic stress and TTH is that stress can lead to increased pain sensitivity and can affect pain processing. Abnormal pain processing is also relevant in TTH (Cathcart et al. 2010; Cathcart et al. 2012). Additionally, stress often causes jaw clenching and contractions of muscles in the neck. This could also have effects on headaches (Cathcart et al. 2010; Cathcart et al. 2012). Another aspect is that chronic stress can cause changes in the brain and cause inability to remain in allostasis (Maleki et al. 2012; Pellegrino et al. 2018). This could cause and worsen headaches. Summing up, this study mainly found connections of stress with TTH, in particular with the intensity of them. In accordance to this, several other studies found associations too and several explanations for possible connecting mechanisms exist.

The results of the present study emphasise the effect of lifestyle parameters and chronic stress components on primary headache characteristics. These association patterns are of importance, because primary headache disorders have a high global prevalence and pose a burden for many individuals. From the viewpoint of Evolutionary Anthropology, we have to be aware that modern environments and recent lifestyle patterns differ drastically from those experienced by our ancestors during human evolution and humankind's past. This change has led to so called lifestyle and environment mismatches, which have been linked to several health issues. Common mismatches are lack of physical activity, high caloric intake, and high levels of psychological stress, bright lights etc. Lifestyle factors also have the potential to be associated with headache disorders, such as migraines and TTH. Sensitivity to environmental inputs might have posed an evolutionary advantage. Many migraine triggers are potentially dangerous in high doses. Thus, detecting them in smaller doses could have been advantageous. Triggers like that are e.g., scents and odours, foods, but also stress and other factors. Additionally, the mismatch in lifestyle could also have had impacts on headache disorders as well as caused a rise in prevalence (Bennett 2020; Brenner et al. 2015; Loder 2002).

We can conclude that the increasing prevalence of primary headache disorders may be triggered by recent lifestyle characteristics which are in marked contrast to the lifestyle we are adapted for.

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