

# How Specific Are Risk Factors for Headache in Adolescents? Results from a Cross-sectional Study in Germany

Steffi Lehmann<sup>1</sup> Astrid Milde-Busch<sup>1</sup> Andreas Straube<sup>2</sup> Ruediger von Kries<sup>1</sup> Florian Heinen<sup>3</sup>

<sup>1</sup>Institute of Social Paediatrics and Adolescent Medicine, Medical Faculty of the Ludwig-Maximilians-University Munich, Munich, Bavaria, Germany

<sup>2</sup>Department of Neurology, University of Munich, Munich, Germany

<sup>3</sup>Department of Paediatric Neurology and Developmental Medicine, Hauner Children's Hospital, University of Munich, Munich, Germany

**Address for correspondence and reprint requests** Steffi Lehmann, MEd, MPH, Medical Faculty, Institute of Social Paediatrics and Adolescent Medicine, Heiglhofstr. 63 München 81377, Germany (e-mail: steffi.lehmann@med.uni-muenchen.de).

Neuropediatrics 2013;44:46–54.

## Abstract

**Background** The identified preventable risk factors for primary headache in adolescents are smoking; consumption of coffee or alcoholic mixed drinks; physical inactivity; muscle pain in the head, neck, or shoulder region; and chronic stress.

**Objective** To investigate the interrelation of headache with other health complaints and the specificity of the above-mentioned risk factors for headache in adolescents.

**Methods** A total of 1,260 students (grades 10 and 11) filled in questionnaires on headache, dietary, and lifestyle factors. The type of headache and health complaints such as dizziness, abdominal pain, musculoskeletal pains, symptoms of possible fatigue syndrome, and psychic complaints were assessed.

**Results** Isolated headache was found in 18% of the headache sufferers; most frequently isolated tension-type headache (78.2%). Only among adolescents with a combination of headache (mainly migraine) and other health complaints, significant associations for almost all analyzed risk factors were found. The strength of the associations with the considered risk factors was very similar in all three analyzed strata except for considerably lower odds ratios for isolated headache.

**Conclusion** All analyzed risk factors are nonspecific for headache in adolescents because they also increase the risk for other health complaints. Interventions, therefore, should consider a holistic approach focusing not only on headache but also on a broader spectrum of health complaints.

## Keywords

- ▶ isolated headache
- ▶ adolescents
- ▶ pain
- ▶ health complaints
- ▶ risk factors
- ▶ specificity

## Introduction

Primary headache is a very common and relevant health problem all over the world causing enormous human, psychosocial, and economic burden for the sufferers and the society.<sup>1</sup> In Germany, the estimates for the headache prevalence among adolescents range between 48 and 83%.<sup>2–7</sup> The prevalence of headache increases with age<sup>8–11</sup>

and is higher in females<sup>12–15</sup> and adolescents aiming at higher education.<sup>3</sup> Several epidemiological studies stated that headache sufferers also report additional associated symptoms, conditions, and comorbidities such as abdominal pain,<sup>4,15–18</sup> musculoskeletal (back, neck, or shoulder) pains,<sup>4,15,18</sup> vertigo,<sup>16,19</sup> sleep problems,<sup>15,17,19,20</sup> tiredness,<sup>19</sup> or psychosocial symptoms (e.g., anxiety, depression, anger).<sup>16,17,20</sup> In a previous survey on adolescents' headache, several other health

received  
September 14, 2012  
accepted after revision  
December 12, 2012  
published online  
January 10, 2013

**Issue Theme** Headaches in Childhood and Adolescence; Guest Editor, Florian Heinen, MD.

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Stuttgart · New York

DOI <http://dx.doi.org/10.1055/s-0032-1333432>.  
ISSN 0174-304X.

complaints in adolescents was also measured, therefore providing the opportunity to assess the interrelation of headache with other health complaints and the specificity of the risk factors for headache in adolescents.

Several risk factors for headache were identified in epidemiological studies in children and adolescents.<sup>4,10,21–27</sup> Some of them such as genetic and climate factors are not influenceable. Others such as dietary and lifestyle factors can be targeted by interventions suggesting that the burden of headache might be reduced by successful preventive intervention. In a data set on German adolescents,<sup>28</sup> we recently identified several dietary and lifestyle factors associated with headache in grammar school students that might be amenable to interventions: smoking, consumption of coffee or alcoholic cocktails, and low physical activity. In addition, it has been shown that muscle pain and chronic stress are related to headache in adolescents.<sup>29,30</sup>

It is unclear, however, whether the identified risk factors are specific for headache in adolescents or not. Unspecific risk factors might be an indication that headache has to be considered as a prominent symptom within a complex of health complaints related to, for example, stress and other risk factors.

There are some individuals exhibiting only headache and no other health complaints. Now the question is whether the spectrum of risk factors is disjunctive between these adolescents with isolated headache and adolescents with headache in combination with other health complaints. This seems to be important with respect to our concept of headache. Is headache the tip of the iceberg in adolescents with a mixture of health complaints as suggested from the observation that most individuals with headache present additional health complaints as well? This concept would be further substantiated by identical risk factors. These questions were not addressed in previous analyses of the data set. The present analyses link other health complaints with headache and the potentially risk factors. In addition, the strength of these associations is compared with them between isolated headache and the risk factors to answer the main research question: Are the identified potentially preventable risk factors for headache in adolescents specific?

## Patients and Methods

### Study Sample and Procedure

The population-based cross-sectional study was performed on students from grades 10 and 11 (aged between 14 and 20 years) from public grammar schools in Munich, Germany. All principals from the 37 public grammar schools in Munich were informed about the study and were invited to participate. Eleven principals declared consent that their students from grades 10 and 11 can be invited for participation in the study and they named a contact person (teacher, school psychologist) at their school. The students and their parents were informed about the study by a letter distributed by the contact person. The parents signed an informed consent allowing their child to participate in the study. Contact persons collected these consent forms and stored them at school. For data safety, study members did neither obtain any

individual information on the potential participants nor gain insight into the informed consent forms.

The data were collected by means of a self-administered questionnaire during a regular school hour in class between October 2008 and February 2009. On the day of data collection, contact persons or class teachers identified those students whose parents had given written consent. Consent of the participants themselves was assumed when they handed over the completed questionnaires to the study members. Of all students present on the respective day of data collection, 94.8% agreed to fill in the questionnaire. The exact sampling procedure is described elsewhere in detail.<sup>29</sup> The approval for the presented cross-sectional study was obtained from the Data Safety Officer and the Ethic Committee (082–08) from the Medical Faculty of the Ludwig-Maximilians-University Munich and the Bavarian Ministry for Education and Culture.

### Instruments

**Headache classification.** Items of the headache questionnaire were based on the German translation of the *International Classification of Headache Disorders—2nd edition (ICHD-II)*.<sup>31</sup> A positive answer to the screening question “Did you have headache during the last six months?” identified adolescents with or without headache. Students with any headache answered further questions regarding frequency, duration, characteristics, and symptoms of their headache. On the basis of the criteria of ICHD-II, a classification of pure migraine (including the subtypes migraine with or without aura, chronic migraine, probable migraine, and probable chronic migraine) and pure tension-type headache (TTH, including the subtypes infrequent episodic TTH, frequent episodic TTH, chronic TTH, probable infrequent episodic TTH, probable frequent episodic TTH, and probable chronic TTH) were given. A double diagnosis of combined migraine and TTH could arise in subjects fulfilling the diagnostic criteria for both probable (chronic) migraine and probable (episodic or chronic) TTH that require compliance with all but one of the respective diagnostic criteria for migraine or TTH. All other subjects with headache who did not match any of these classifications for primary headache were considered to have miscellaneous headache (MH). The headache-type MH was excluded from further analyses because of too few cases ( $n = 55$ ). Headache sufferers who did not report any other health complaint (i.e., musculoskeletal pains, psychic complaints, possible fatigue syndrome, dizziness or abdominal pain, as defined below) were classified as isolated headache.

**Health complaints.** Health complaints were assessed with the complaints list from von Zerssen (Die Beschwerden-Liste, 20 items)<sup>32</sup> and seven additional items (back, neck, or shoulder and abdominal pain, feelings of pressure or bloating in the abdomen, heartburn or acid regurgitation, menstrual molar, and other pains). For each of the 27 items, all students were asked to rate their personal severity on a 4-point Likert scale (*severe, moderate, scarcely, not at all*). For analyses, the dimensions were dichotomized (*severe/moderate vs. scarcely/not at all*). The definition of relevant health complaint groups was guided by two principles: (1) confinement to the most common health complaints and (2) consistency within

greater categories. The health complaints that were most frequently described by the participants were summarized on the basis of medical or psychological coherence into three different complaints groups: musculoskeletal pains, possible fatigue syndrome, and psychic complaints. The group *musculoskeletal pains* is based on the complaints list questions pertaining to back pain and/or neck or shoulder pain. The group *psychic complaints* is based on a positive answer to at least one of the questions to brooding and/or inner restlessness. In the case that the participants reported at least three of the following five single symptoms, they were classified as possible fatigue syndrome: feeling of weakness, fatigue, irritability, excessively high sleep requirement, and insomnia. Dizziness and abdominal pain were separately assessed in the complaints list. For further analyses, the health complaints, respectively complaints groups, were further summarized as any health complaints (at least one of the following: dizziness, abdominal pain, musculoskeletal pains, possible fatigue syndrome, and psychic complaints), excluding any headache.

**Risk factors.** The questionnaire covered as possible risk factors items on dietary habits and lifestyle factors that were classified and dichotomized as follows: *coffee* (*none* vs. *any*: < 1 cup per week/ < 1 cup per day/ ≤ 1 cups per day), *alcohol* (*none*: nothing vs. *any*: < 1 glass per month/ < 1 glass per week/ ≤ 1 glasses per day), *smoking* (*no* vs. *yes*: seldom/once per week/several times per week/daily), and *physical inactivity* (How often do you do sport outside school?—*yes*: never/less than once a week vs. *no*: once a week/2/3/4/5/6/7 times a week). Muscle pain was assessed by the yes–no question: “Do you feel pain in the head, neck, or shoulder?” For the measurement of chronic stress experience, the 12-item Screening Scale of Chronic Stress (SSCS) was used which is part of the self-report instrument Trier Inventory of Chronic Stress (57 items in total).<sup>33</sup> The SSCS incorporates items from five different dimensions: chronic worries, school and social overload, pressure to succeed, and lack of social recognition. For each item, the frequency of personal experience within the past 3 months had to be indicated on a 5-point Likert scale from 0 (*never*) to 4 (*very often*). For the performed analyses, the results from the SSCS were dichotomized and used as the variable chronic stress (above average SSCS score vs. normal/below average) (see also the studies by Milde-Busch et al<sup>29</sup> and Schulz et al<sup>33</sup>).

Further questions concerned potentially confounding variables such as sex (female and male), grade (10th and 11th), and socioeconomic variables. The following socioeconomic variables were considered: students own income (*nothing* vs. *any*), monthly pocket money (dichotomized as 50 Euro per month or less vs. more than 50 Euro per month), and questions on parents' employment status, which were categorized into full-time versus not full-time, separately for student's mother and father.

## Statistical Analyses

The prevalence of headache types, health complaints, and risk factors was calculated. The analyses stratified for type of

headache and sex were conducted. Differences and associations between categorical variables were tested by using  $\chi^2$  tests and *p* values less than 0.05 were considered to indicate a significant difference. To analyze the strength of associations of possible risk factors with headache, separate logistic regression models, adjusted for sex, grade, and socioeconomic variables as potential confounders, were performed for the following outcomes: isolated headache, any of the five health complaints, and any headache in combination with any of the five health complaints (each comparing against no complaints). The following six potential risk factors functioned as independent variables: smoking; consumption of coffee or alcoholic mixed drinks; physical inactivity; muscle pain in the head, neck, or shoulder region; and chronic stress. To account for multiple testing, Bonferroni correction was applied to tests of the logistic regression models, separately for each of the six potential risk factors (adjusted significance level  $\alpha$ : 0.05/6 = 0.0083). All *p* values less than 0.0083 were considered to indicate a significant association. The adjusted odds ratios (OR) with 95% confidence intervals (CI) were estimated. For all analyses, SAS software package (version 9.2, SAS Institute Inc. Cary, North Carolina, United States) was used.

## Results

### Characteristics of the Study Population

Altogether, 1,818 adolescents were invited for participation in the study. At the day of data collection, 1,504 adolescents (82.7%) were present at school. The causes for absence were suffering from seasonal infectious diseases or participating in school activities somewhere else. Overall, 1,426 of these students (94.8%) actually filled in the questionnaire. Because of missing values in relevant socioeconomic variables, 166 questionnaires had to be excluded from analyses. Students with excluded questionnaires did not significantly differ from remaining subjects with respect to the headache prevalence.<sup>29</sup> Finally, questionnaires from 1,260 students from the grades 10 and 11 (age range between 14 and 20 years, mean age 16 ± 0.9 years) entered the statistical analyses. Of the included participants, 56.4% were female and 43.6% male; 51.7% attended the 10th grade and 48.3% the 11th grade. Grade was used as an equivalent for age (mean age of those in 10th grade 15.6 years and of those in 11th grade 16.7 years). Details on invited students and participation rates have been described elsewhere in detail.<sup>29</sup>

### Prevalence of Headache Types and Other Health Complaints

In total, 1,047 students (83.1%) suffered from any headache at least once during the last 6 months. From all headache sufferers, 12.3% were classified as pure migraine, 58.6% as pure TTH, 23.8% as any migraine plus any TTH, and 5.3% as any MH. The frequency of any of these headache types was higher in female adolescents than in male adolescents (*p* < 0.001, MH: *p* = 0.035).

The distribution of other health complaints is illustrated in ►Table 1. Almost all of the reported health complaints were significantly more frequently reported by female than

**Table 1** Prevalence of health complaints, stratified by sex

Health complaints	Total		Sex				p <sup>a</sup>
			Female		Male		
	n	%	n	%	n	%	
Single health complaints							
Any headache	1,047	83.1	590	88.2	457	77.3	< 0.001
Back pain <sup>b</sup>	601	47.7	403	60.2	198	33.5	< 0.001
Excessively high sleep requirement <sup>c</sup>	574	45.6	351	52.5	223	37.7	< 0.001
Neck or shoulder pain <sup>b</sup>	567	45.0	394	58.9	173	29.3	< 0.001
Inner restlessness <sup>d</sup>	453	36.0	316	47.2	137	23.2	< 0.001
Irritability <sup>c</sup>	439	34.8	298	44.5	141	23.9	< 0.001
Fatigue <sup>c</sup>	417	33.1	293	43.8	124	21.0	< 0.001
Feeling of weakness <sup>c</sup>	388	30.8	286	42.8	102	17.3	< 0.001
Brooding <sup>d</sup>	381	30.2	263	39.3	118	20.0	< 0.001
Dizziness	342	27.1	257	38.4	85	14.4	< 0.001
Stings, pain, or dragging in the breast	317	25.2	231	34.5	86	14.6	< 0.001
Insomnia <sup>c</sup>	307	24.4	204	30.5	103	17.4	< 0.001
Abdominal pain	306	24.3	241	36.0	65	11.0	< 0.001
Feelings of heaviness or tiredness of the legs	288	22.9	190	28.4	98	16.6	< 0.001
Restlessness of the legs	256	20.3	145	21.7	111	18.8	0.209
Intolerance to cold	256	20.3	180	26.9	76	12.9	< 0.001
Heavy sweating	219	17.4	109	16.3	110	18.6	0.295
Feelings of pressure or bloating in the abdomen	206	16.3	159	23.8	47	8.0	< 0.001
Nausea	199	15.8	145	21.7	54	9.1	< 0.001
Tremble	178	14.1	128	19.1	50	8.5	< 0.001
Intolerance to heat	175	13.9	109	16.3	66	11.2	0.008
Dyspnea	148	11.7	111	16.6	37	6.3	< 0.001
Feelings of a lump, narrowness or choke in the throat	119	9.4	72	10.8	47	8.0	0.085
Heartburn or acid regurgitation	111	8.8	54	8.1	57	9.6	0.326
Difficulties swallowing	107	8.5	59	8.8	48	8.1	0.637
Weight reduction	69	5.5	45	6.7	24	4.1	0.038
Other pains	38	3.0	243	3.4	15	2.5	0.976
Menstrual molimen (only girls)	361	54.0	361	54.0	–	–	–
Health complaints groups							
Musculoskeletal pains	736	58.4	482	72.0	254	43.0	< 0.001
Psychic complaints	603	47.9	403	60.2	200	33.8	< 0.001
Possible fatigue syndrome	349	27.7	82	12.3	267	45.2	< 0.001
Dizziness	342	27.1	257	38.4	85	14.4	< 0.001
Abdominal pain	306	24.3	241	36.0	65	11.0	< 0.001
No complaints (no headache and none of the analyzed health complaints)	93	7.38	19	2.8	74	12.5	< 0.001
<b>Total study population<sup>e</sup></b>	1,260	100.0	669	100.0	591	100.0	–

<sup>a</sup>Results from  $\chi^2$  test. Significant results are marked in bold ( $p < 0.05$ ).

<sup>b</sup>Back, neck, or shoulder pains are summarized to the health complaints group “Musculoskeletal pains.”

<sup>c</sup>Excessively high sleep requirement, irritability, fatigue, feeling of weakness, and insomnia are summarized to the health complaints group “possible fatigue syndrome.”

<sup>d</sup>Inner restlessness and brooding are summarized to the health complaints group “Psychic complaints.”

<sup>e</sup>All percent values in each column do not add up to 100.0% because combinations of several health complaints are possible.

by male adolescents ( $p < 0.001$ ). The most common health complaints pertained to musculoskeletal pains (58.4%), psychic complaints (47.9%), possible fatigue syndrome (27.7%), dizziness (27.1%), and abdominal pain (24.3%). In total, there were 93 of all 1,260 students (7.4%) neither reporting headache nor any of the above-mentioned health complaints at all. The male to female ratio among these was 4:1 ( $p < 0.001$ ).

Among the 1,047 adolescents with headache 188 (18.0%) did not report any other health complaints and thus were assigned to the category isolated headache (–Table 2). Most of these individuals with isolated headache had pure TTH (78.2%).

The most frequently associated complaints with headache were musculoskeletal pains (57.0 to 76.0%) and psychic complaints (45.6 to 69.0%). Identical patterns of combinations were noticeable for combinations of other health complaints for pure migraine and for migraine and TTH; whereas, pure TTH was less often associated with other health complaints (–Table 2).

### Frequency of Possible Risk Factors

The consumption of alcoholic mixed drinks (61.3%) and coffee (55.2%) was widespread (–Table 3). In total, 26.6% of the students stated they smoke and 24.4% to be physically inactive. For 20.4% of all students, an SSSS score above average was found and 47.6% described to have muscle pain in the head, neck, or shoulder region. More female than male adolescents reported drinking coffee; to be physically inactive; to have an above-average SSSS score; and to have muscle pain in the head, neck, or shoulder region ( $p < 0.001$ ). No differences for the sex variable were found for the consumption of alcoholic mixed drinks and smoking. Significantly more students with headache than students without headache reported to consume coffee or alcoholic mixed drinks, to have an above-average SSSS score, and to have muscle pain ( $p \leq 0.002$ ). Significantly more students with health complaints (excluding headache) than students without health complaints at all stated physical inactivity, chronic stress, and muscle pain ( $p \leq 0.002$ ) (–Table 3). The detailed distribution of dietary and lifestyle factors in the

study population and their associations with the adjustment variables sex, grade, and socioeconomic variables can be found elsewhere.<sup>28</sup> The prevalence of the analyzed six risk factors among adolescents with any headache was higher than in those reporting any of the five other health complaints alone (–Table 3).

### Associations between the Possible Risk Factors and Headache and Other Health Complaints

Only among the adolescents with a combination of any headache and other health complaints were significant associations observed for all assessed risk factors except for the consumption of alcoholic mixed drinks. The strength of the associations with the considered risk factors was very similar in all three analyzed strata (isolated headache, any of the five health complaints, and the combination of both) with the exception of considerably lower OR for the associations between isolated headache and chronic stress or muscle pain (–Table 4). Because most cases of isolated headache were adolescents with TTH, we hypothesized that the absence of an association was related to TTH. Indeed, no significant associations to neither of the potential risk factors could be seen for isolated TTH (data not shown).

## Discussion

### Key Findings

Only 18% of the individuals with headache reported isolated headache. The identified risk factors, smoking; consumption of coffee or alcoholic mixed drinks; physical inactivity; chronic stress; and muscle pain in the head, neck, or shoulder, were not specific for headache in adolescents but appeared to be related to a broader array of other health complaints in adolescents. The apparently low or absent associations of chronic stress and muscle pain to isolated headache are likely to be a reflection of the fact that isolated TTH, which accounted for most of the cases with isolated headache, is apparently not at all or not strongly associated with muscle pain and chronic stress.

**Table 2** Relative frequency of isolated headache and headache in combination with other health complaints, stratified for type of headache

	Any headache <i>N</i> = 1,047 (100.0%) <sup>a</sup>	Pure migraine <i>N</i> = 129 (100.0%) <sup>a</sup>	Migraine + TTH <i>N</i> = 249 (100.0%) <sup>a</sup>	Pure TTH <i>N</i> = 614 (100.0%) <sup>a</sup>
Isolated headache + no other health complaints ( <i>N</i> = 281), <i>n</i> (%)	188 (18.0)	9 (7.0)	20 (8.0)	147 (23.9)
Headache + dizziness ( <i>N</i> = 490), <i>n</i> (%) <sup>b</sup>	312 (29.8)	66 (51.2)	106 (42.6)	132 (21.5)
Headache + abdominal pain ( <i>N</i> = 463), <i>n</i> (%) <sup>b</sup>	281 (26.8)	48 (37.2)	85 (34.1)	140 (22.8)
Headache + musculoskeletal pains ( <i>N</i> = 798), <i>n</i> (%) <sup>b</sup>	663 (63.3)	98 (76.0)	184 (73.9)	350 (57.0)
Headache + possible fatigue syndrome ( <i>N</i> = 490), <i>n</i> (%) <sup>b</sup>	315 (30.1)	60 (46.5)	109 (43.8)	134 (21.8)
Headache + psychic complaints, ( <i>N</i> = 697), <i>n</i> (%) <sup>b</sup>	546 (52.1)	89 (69.0)	150 (60.2)	280 (45.6)

Abbreviations: MH, miscellaneous headache; TTH, tension type headache.

<sup>a</sup>All percent values in each column do not add up to 100.0% because combinations of several health complaints are possible.

<sup>b</sup>The values of "Pure migraine," "Migraine + TTH," and "Pure TTH" do not add up to the values of "Any headache" because the headache-type MH had been excluded because of too small numbers ( $n = 55$ ).

**Table 3** Relative frequency of potential risk factors stratified for sex, headache, and health complaints

Potential risk factors	Total N = 1,260 (100%)	Sex		Any headache		Any of the five health complaints (excluding headache) <sup>a</sup>		
		Male N = 591 (100%)	Female N = 669 (100%)	No N = 213 (100%)	Yes N = 1,047 (100%)	No N = 93 (100%)	Yes N = 114 (100%)	p <sup>b</sup>
Coffee consumption (N = 1,227), n (%)	None	290 (49.1)	242 (36.2)	109 (51.2)	423 (40.4)	56 (60.2)	50 (43.9)	0.012
	Any	288 (48.7)	407 (60.8)	97 (45.5)	598 (57.1)	33 (35.5)	61 (53.5)	
Physical inactivity (N = 1,244), n (%)	No	486 (82.2)	451 (67.4)	170 (79.8)	767 (73.3)	83 (89.2)	83 (72.8)	<b>0.002</b>
	Yes	307 (24.4)	209 (31.2)	38 (17.8)	269 (25.7)	8 (8.6)	28 (24.6)	
Alcoholic mixed drinks, cocktails, and hard drinks (N = 1,148), n (%)	None	169 (28.6)	206 (30.8)	81 (38.0)	294 (28.1)	34 (36.6)	44 (38.6)	0.931
	Any	374 (63.3)	399 (59.6)	107 (50.2)	666 (63.6)	46 (49.5)	58 (50.9)	
Smoking (N = 1,253), n (%)	No	429 (72.6)	489 (73.1)	169 (79.3)	749 (71.5)	79 (84.9)	87 (76.3)	0.187
	Yes	335 (26.6)	176 (26.3)	42 (19.7)	293 (28.0)	14 (15.1)	25 (21.9)	
Chronic stress (N = 1,260), n (%)	No	530 (89.7)	473 (70.7)	192 (90.1)	811 (77.5)	91 (97.8)	95 (83.3)	< <b>0.001</b>
	Yes	257 (20.4)	196 (29.3)	21 (9.9)	236 (22.5)	2 (2.2)	19 (16.7)	
Muscle pain in head, neck, or shoulder region (N = 1,260), n (%)	No	386 (65.3)	274 (41.0)	149 (70.0)	511 (48.8)	81 (87.1)	64 (56.1)	< <b>0.001</b>
	Yes	600 (47.6)	395 (59.0)	64 (30.0)	536 (51.2)	12 (12.9)	50 (43.9)	

<sup>a</sup>Health complaints include the following: dizziness, abdominal pain, musculoskeletal pains, possible fatigue syndrome, and/or psychic complaints.

<sup>b</sup>The p values derived from  $\chi^2$  test with consideration of Bonferroni correction for multiple comparisons for each variable. Significant results after Bonferroni correction are shown in bold ( $p < 0.0083$ ).

**Table 4** Adjusted odds ratio, 95% CI, and *p* values for isolated headache, health complaints, and the combination of both in comparison with no complaints at all—adjusted for sex, grade, and socioeconomic variables

Risk factors	Isolated headache ( <i>N</i> = 188)			Any headache + any of the 5 health complaints ( <i>N</i> = 841)			Any of the 5 health complaints (excluding headache) ( <i>N</i> = 114) <sup>a</sup>		
	OR	95% CI	<i>p</i> <sup>b</sup>	OR	95% CI	<i>p</i> <sup>b</sup>	OR	95% CI	<i>p</i> <sup>b</sup>
Coffee consumption ( <i>N</i> = 1,227)									
None	1	0.92–2.68	0.098	1	1.38–3.53	0.002	1	1.05–3.64	0.034
Any	1.57			2.21			1.96		
Physical inactivity ( <i>N</i> = 1,244)									
No	1	0.55–3.12	0.544	1	1.57–7.15	0.002	1	1.11–6.77	0.029
Yes	1.31			3.35			2.74		
Alcoholic mixed drinks, cocktails, and hard drinks ( <i>N</i> = 1,148)									
None	1	0.81–2.56	0.220	1	1.01–2.77	0.044	1	0.61–2.33	0.601
Any	1.44			1.68			1.20		
Smoking ( <i>N</i> = 1,253)									
No	1	0.71–2.87	0.313	1	1.29–4.38	0.005	1	0.95–4.77	0.068
Yes	1.43			2.38			2.13		
Chronic stress ( <i>N</i> = 1,260)									
No	1	0.28–7.43	0.665	1	2.83–48.36	< 0.001	1	1.34–29.28	0.020
Yes	1.44			11.69			6.27		
Muscle pain in head, neck, or shoulder region ( <i>N</i> = 1,260)									
No	1	0.57–2.48	0.650	1	4.17–14.85	< 0.001	1	2.34–11.07	< 0.001
Yes	1.19			7.87			5.09		

<sup>a</sup>Health complaints include the following: dizziness, abdominal pain, musculoskeletal pains, fatigue syndrome, and/or psychic complaints.

<sup>b</sup>The *p* values consider Bonferroni correction for multiple comparisons for each variable. Significant results after Bonferroni correction are shown in bold (*p* < 0.0083).

There are many publications that have addressed comorbidities with headache such as abdominal pain,<sup>4,15–18</sup> musculoskeletal (back, neck, or shoulder) pains,<sup>4,15,18</sup> vertigo,<sup>16,19</sup> sleep problems,<sup>15,17,19,20</sup> or tiredness.<sup>19</sup> Our findings are in line with these observations. Interestingly, however, isolated TTH accounted for most of the cases of isolated headache, suggesting that migraine might be more often related to other health complaints than TTH.

The weak associations of chronic stress; muscle pain in the head, neck, or shoulder region; the consumption of coffee or alcoholic mixed drinks; and smoking with isolated headache is mainly a reflection of the weak association between isolated TTH and these risk factors. To our knowledge, the associations between possible risk factors and isolated primary headache (types)—explicitly excluding other health complaints—have not been investigated previously.

### Strength and Limitations

Our study is one of the few population-based studies investigating headache in adolescents focusing on generally healthy persons, conducted in schools and not in a clinical setting. The participation rate was high (94.8%) and only a small number of questionnaires had to be excluded (11.6%). The large

number of participants made it possible to distinguish between different headache types and perform subgroup analyses.

The headache prevalence is especially high among students aiming at higher education.<sup>3</sup> The external validity is limited because the participants attending grammar schools in the German city of Munich, Bavaria, and belong to families with a relatively high socioeconomic status.

The classifications of headache types and other health complaints were not validated by a physician's diagnosis but were based according to the responses of the participants in the questionnaire that contained established instruments (criteria of the ICHD-II, complaints list from von Zerssen). Only health complaints that were most frequently described by the participants were included in further analyses. Besides headache, dizziness, and abdominal pain, common health complaints were summarized on the basis of medical or psychological coherence into three different complaint group.

In cross-sectional studies, exposure and disease are recorded at the same time. Hence, only statistical associations can be studied, but no temporal relations. A discussion of further strengths and limitations of the present cross-sectional study can be found elsewhere.<sup>28,30</sup>

## Conclusion

In adolescents isolated headache appears to be rather the exception than the rule. This pertains particularly to pure migraine and migraine + TTH, suggesting that migraine mainly reflects a prominent symptom within a complex of health complaints related to, for example, stress and other risk factors. This concept is further supported by the observation that risk factors were proved to be nonspecific for isolated TTH, which accounted for the most cases of isolated headache. Only among adolescents presenting a combination of headache and other health complaints significant associations could be seen for almost all analyzed risk factors. Interventions, therefore, should consider a holistic approach focusing not only on headache but also on a broader spectrum of health complaints.

### Funding

This research project was not supported by a specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### Conflict of Interest

The authors certify that they have no financial interest to disclose.

### Acknowledgments

The authors thank Astrid Blaschek, Michaela Bonfert, Kristina Huß, Christoph Schankin, and Petra Sostak for giving lessons regarding headache in the participating schools and their support in the data collection. They also thank all participants for their time and efforts. They also thank the contact persons and principals of the participating grammar schools in Munich for their support and organization of the data collection.

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