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Short Communication

Migraine in Adolescents: Comparison of Attack Frequency During School and Vacation Periods

Johannes Drescher [1, 2], Charly Gaul [3], Peter Kropp [1], Yannic Siebenhaar [4], Dirk Reinel [2], Jörg Scheidt [4, *]

1. Institute of Medical Psychology and Medical Sociology, University of Rostock, Rostock, Germany; E-Mails: jdrescher@smartlytic.de; peter.kropp@med.uni-rostock.de
2. smartlytic GmbH, Hof, Germany; E-Mail: dreinel@smartlytic.de
3. Headache Center Frankfurt, Frankfurt, Germany; E-Mail: c.gaul@kopfschmerz-frankfurt.de
4. Institute for Information Systems, University of Applied Sciences Hof, Hof, Germany; E-Mails: joerg.scheidt@hof-university.de; yannic.siebenhaar@hof-university.de

* **Correspondence:** Jörg Scheidt; E-Mail: joerg.scheidt@hof-university.de

Academic Editor: Yasushi Shibata

Special Issue: The Pathophysiology and Treatment for Migraine

OBM Neurobiology
2022, volume 6, issue 3
doi:10.21926/obm.neurobiol.2203131

Received: May 18, 2022
Accepted: August 08, 2022
Published: August 16, 2022

Abstract

This citizen science project CLUE compared the attack frequency between school and vacation periods among adolescents. The data collection process adopted in citizen science projects opens up the possibility of conducting analyses by including a large number of participants over a long period and across different regions. The data on 684 migraine attacks reported by 68 adolescents aged 16 to 19 years were collected using an online platform and smartphone apps. A Fisher's exact test was used to compare the distributions of the migraine attack frequency during vacation and school periods in two different scenarios. In both scenarios, the attack frequency during school periods was significantly higher than that during vacation periods. The use of web-based data collection has some methodological limitations; however, it enabled the measurement of relative migraine attack frequency in students during vacation and school

periods. The higher prevalence of migraine during school periods indicates the requirement of increasing headache awareness among children.

Keywords
Migraine; pediatric migraine; headache; attack frequency; adolescents; citizen science

1. Introduction

Citizen science projects collect health data by using technologies, such as smartphone apps. Compared with conventional medical studies, citizen science projects include a larger number of participants residing in different regions over a longer period. In studies investigating migraine attacks, data collection in a real-world scenario is advantageous over that through questionnaires, as data can be collected during and immediately after an attack. Most clinical trials are limited to patients of headache clinics, resulting in a bias toward severely affected headache patients.

This paper presents results from the citizen science project CLUE (CLUsterkopfschmerz Erforschen). This project compared the migraine attack frequency in adolescents during school and vacation periods.

Recurrent headaches affect the quality of life in children and adolescents. According to a 2013 review, primary headache disorders are increasing in children and adolescents [1]. A survey on adolescents aged 12 to 19 years in Germany reported that migraine, in particular, affects the daily lives of many in this age group who rarely seek medical help [2]. A more recent study reported that the incidence of migraine is approximately 1% among 10-year-olds, whereas it is 3.49% and 1.72% among 19-year-old girls and boys, respectively [3]. Another German-based study that also evaluated the medications taken by schoolchildren confirmed that headache prevalence increases with age and is linked to school type [4]. A recent review on migraine triggers in children and adolescents [5] reported that stress and changes in sleep patterns, in particular, are the two main triggers. In a retrospective study of 102 children and adolescents, stress was cited as the most frequent trigger of migraine attacks in 75.5% of the patients [6]. The same group later conducted another prospective study, in which stress was revealed as the second most frequently reported trigger of migraine attacks [7].

The results of all previous studies were obtained using self-reported questionnaires, and the studies did not directly determine attack frequencies during school and vacation periods. The CLUE research project directly determined migraine attacks, thereby creating a database for future studies [8, 9].

2. Materials and Methods

2.1 The CLUE Project

The CLUE project, a citizen science project, investigated cluster headaches and migraines by using smartphones and web apps to collect data on headache attacks. Different apps were developed for collecting data on both diseases, and the apps were adapted to the clinical characteristics of the specific condition. Data on migraine attacks were collected from 2015 [10]. Participants could

register for the project at any time and start reporting their migraine attacks. The participants were informed about privacy issues during the registration process, and informed consent was obtained from all participants. To ensure privacy, all data were anonymized during data analysis. The study was approved by the Ethics Committee of the Medical Faculty of the University of Rostock (reference number A 2017–0091).

2.2 Aim of the Study

This prospective study determined the distribution of migraine attacks in schoolchildren during vacation and school periods.

2.3 Participants

The participants from Germany, Austria, and Switzerland reported migraine attacks that occurred between January 1, 2015, and November 30, 2021. A standard headache questionnaire based on the International Classification of Headache Disorders (ICHD-3 beta) diagnosis criteria was used to diagnose migraine [11, 12]. The duration of a patient's participation in the project was the gap between the first and last reported attack. Participants reporting at least two migraine attacks were included in our study. In addition, to exclude other attacks, only those attacks with at least one of the typical symptoms accompanying migraine were considered. According to the ICHD-3 beta criteria, such symptoms are nausea, vomiting, and sensitivity to light and noise [12]. Patients with chronic migraine were excluded.

2.4 Data Collection

During the registration process, data on basic characteristics, such as sex, birthplace, residence place, and occupation (employed [full-time or part-time] and unemployed [student, retired, or unemployed]), were collected. During the study, for each migraine attack, the participants entered information regarding migraine onset, the last stage of the attack, pain characteristics, pain location, and pain intensity. The participants also provided information regarding accompanying symptoms (nausea; vomiting; sensitivity to light, sound, or odor; requirement for rest or movement; dizziness, etc.).

2.5 Statistics

Data were analyzed using the R language and R-studio environment [13]. For each participant, the period of participation was defined as the time between the first and the last reported attack. On the basis of residence place, vacation and school periods were determined by evaluating the vacation calendar of the corresponding federal state. Two scenarios were considered for defining vacation periods. In scenario 1, vacations were periods in which there were at least three consecutive school-free days. This condition is fulfilled by all school vacations in Germany and in cases where individual holidays border a weekend. In scenario 2, a simple distinction is made between school days and school-free days. School-free days are individual holidays, weekends, and school vacations. As vacation times differ among German regions, specific periods predefined by the calendar were not used.

The attack frequency in both scenarios was analyzed, and the number of vacation days with and without migraine attacks as well as the number of school days with and without attacks were determined for each participant. The corresponding numbers were aggregated for all participants. A Fisher's exact test (two-tailed) was used to determine the difference in the distribution of migraine attacks.

3. Results

In this study, the data of German participants who had indicated pupil or student as their occupation and who were aged 16 to 19 years when reporting attacks were analyzed. In addition, to determine the period of participation, each participant was required to report at least two migraine attacks. On the basis of these criteria, 68 participants who reported 684 attacks were included. The demographic characteristics of the participants are presented in Table 1.

Table 1 Patient characteristics.

Characteristic	**Patients* (N = 68)**	
Gender		
female	63 (93%)	
male	5 (7%)	
Age [years]	female	male
16–17	23	3
18–19	40	2
Sum	70	5
Migraine headache		
with aura	32 (47%)	
without aura	36 (53%)	

The number of days with and without attacks during school and vacation periods per participant were determined and added for all participants. The following numbers were obtained for the two scenarios (Table 2).

Table 2 Distribution of migraine attacks on school and vacation days (summed over all participants) for scenario 1 (vacation defined as at least three school-free days in a row) and scenario 2 (vacation defined as all school-free days, including weekends).

		Attacks	**No Attacks**	**Sum**	**p-value, OR**
Scenario 1	Total number of school days	529	5,891	6,420	OR = 1.43 95% CI: 1.18–1.73 p < 0.001
	Total number of vacation days	155	2,462	2,617	
	Sum	684	8,353	9,037	

Scenario 2	Total number of school days	416	4,292	4,708	OR = 1.47 95% CI: 1.25–1.73 p < 0.001
	Total number of vacation days	268	4,061	4,329	
	Sum	684	8,353	9,037	

Several systematic studies were performed to verify whether the result was sensitive to the chosen selection criteria of participants and attacks.

The choice of the age limit of 19 years can be questioned because the transition from school to university in Germany varies between 18 and 20 years. Changing this age limit yielded the results presented in rows 1 and 2 of Table 3.

Table 3 Summary of the systematic study results.

		Participants	**Attacks**	**Scenario 1**		**Scenario 2**	
				OR	**p**	**OR**	**p**
1	age ⩽20	87	820	1.37	<0.001	1.42	<0.001
2	age ⩽18	50	539	1.41	0.001	1.48	<0.001
3	female patients	63	657	1.41	<0.001	1.47	<0.001
4	male patients	5	27	2.48	0.279	1.33	0.545
5	migraine with aura	32	356	1.43	0.006	1.45	<0.001
6	migraine without aura	36	328	1.43	0.009	1.49	<0.001
7	participation ≥365 d	8	277	1.37	0.033	1.59	<0.001
8	participation <365 d	60	407	1.47	0.002	1.39	0.002
9	age ≥20 (students)	187	2,036	0.99	0.962	1.08	0.369
10	**Standard selection**	**68**	**684**	**1.43**	**<0.001**	**1.47**	**<0.001**

Further analysis was performed to determine whether the results differ between different subgroups. Slightly different results were observed for boys and girls (see Table 3, lines 3 and 4), and the results were statistically significant even though the number of male participants was small (scenario 1: $p < 0.001$; scenario 2: $p = 0.017$). Analysis of groups formed on the basis of migraine types (migraine with and without aura) yielded similar results (Table 3, lines 5 and 6); the results were compatible with each other within the limits of statistical error (scenario 1: $p = 0.362$; scenario 2: $p = 0.366$).

The duration of participation varied considerably among the patients; therefore, the difference in the results between patients with long participation duration (1 year or longer) and those with short participation duration (less than 1 year) was evaluated (Table 3, lines 7 and 8). In scenario 1, significantly fewer attacks were observed during vacations among patients with long participation duration than among patients with short participation duration ($p = 0.003$). However, in scenario 2, opposite results were obtained ($p = 0.002$).

The distribution of attacks among students aged ⩾ 20 years was examined. Because school vacations differ greatly from students' lecture-free periods, the attacks were evenly distributed (Table 3, line 9).

The higher observed effect in scenario 2 may indicate that a significantly fewer number of attacks on weekends alone could explain the effects in both scenarios. Therefore, a further investigation was performed, excluding all weekends as well as attacks on weekends. Moreover, a significantly higher number of attacks was observed on school days (Monday to Friday) than on vacation days ($p = 0.001$, OR = 1.44, 95% CI: 1.15–1.81).

4. Discussion

Stress is one of the most common triggers of migraine attacks in adults as well as in children and adolescents [5-7]. Analyzing data on the distribution of migraine attacks in children and adolescents revealed a significantly higher frequency of migraine attacks during school days than during vacation days.

The higher prevalence of migraine during school days is in line with the results of other studies; moreover, children and adolescents rarely seek professional help [2]. Therefore, a deeper understanding of headaches in children is required [14]. Because headache and migraine in children and adolescents influence the quality of life, low-threshold educational interventions offered in school can be used to reduce headache frequency [15]. Group sessions primarily based on nonmedical therapies — the first choice for therapy — have been proven to be effective in severely affected children [16]. The effectiveness of these interventions indicates the influence of stress on headache. Stress may be the major reason leading to the difference in headache frequency between school days and vacation days in this study.

This study has a few limitations. First is the data collection process. Participants could join or leave the study at any time, and whether participants reported all of their attacks could not be verified. Moreover, selective reporting by the participants could not be ruled out. Whether the fewer attack numbers during vacation days were because the participants forgot to report their attacks could not be verified.

The diagnosis of migraine was not confirmed by a physician but was determined on the basis of a standard questionnaire based on the ICHD-3 beta criteria [12]. Although only attacks with at least one of the typical symptoms accompanying migraine were included, it cannot be ruled out whether patients without migraine also participated in the study. Moreover, whether nonmigraine headaches were reported could not be verified.

This publication addresses two questions: 1) Are there differences in attack frequency between vacation days and school days in children and adolescents? 2.) Can valid results be achieved using web-based data collection, in which a large number of patients from different parts of the country report their migraine attacks over a long period of time?

The first question can be answered with yes. A statistically significant decrease in migraine attacks during vacation periods was observed. Regarding the second question, it can be said that the web-based collection of health data can be at least a good complement to classical health studies; however, the weaknesses of the data collection process must also be taken into account. It cannot be ruled out that students forgot to report their attacks during vacation days. Therefore, the lower attack frequency during vacations should be verified by further studies.

5. Conclusions

The attack frequency decreased significantly during vacation periods in adolescents. The web-based collection of health data in the context of a citizen science project, such as CLUE, can at least be a good complement to the data collection process adopted in other clinical studies. However, the results obtained should be interpreted with caution due to the weaknesses described above and should be verified by further studies.

Author Contributions

JD made significant contributions to the conception and realization of the data collection, accompanied the data analysis and contributed to the writing of the manuscript. CG contributed significantly to the medical conception of the data collection. CG and PK interpreted the medical results of the study and made significant contributions to the writing of the manuscript. YS and DR helped develop the method for statistical analysis of the data. JS accompanied the entire research process and contributed significantly to the writing of the manuscript. All authors read and approved the final manuscript.

Funding

The citizen science project CLUE (CLUsterkopfschmerz Erforschen" was funded by the German Federal Ministry of Education and Research (BMBF–Project 01BF1701)).

Competing Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr Gaul has received honoraria for consulting and lectures within the past 3 years from Allergan Pharma, Lilly Germany, Novartis Pharma, Hormosan Pharma, Grünenthal, Sanofi-Aventis, Weber & Weber, Lundbeck, Perfood and TEVA. He does not hold any stocks of pharmaceutical companies. He is honorary secretary of the German Migraine and Headache Society. Dr Kropp has received honoraria for consulting and lectures within the past 3 years from Allergan Pharma, Lilly Germany, Novartis Pharma, and TEVA. All other authors declare that there is no conflict of interest.

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