PREDICTORS OF CHILDREN'S HEADACHES DURING THE SECOND COVID-19 PANDEMIC WAVE IN THE COUNTRY WITH LONG-LASTING LOCKDOWN

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SUMMARY

Objectives: The current study examined the links and interactions among headaches, screen-based media use, physical activity, sleep, and the family environment in Lithuanian school-aged children during the second COVID-19 lockdown.

Methods: The study comprised data of 541 children aged 7–14 years from different Lithuania regions, and without chronic health conditions or developmental disorders. Information about the child was provided by their parents or caregivers who filled questionnaire on child's screen time, sleep duration and quality, physical activity, parental distress, parent-child relationship, history of child's headaches and infectious diseases.

Results: During the study period, 54% of the children had headaches, and the frequency was positively associated with child's age, screen time and parental distress, as well as negatively related to physical activity (PA), sleep quality, and the parent-child relationship. Parental education was related to child's PA, screen time and sleep quality. The results of binary logistic regression analysis and path analysis revealed that sleep quality and parental distress were significant predictors of headaches in children.

Conclusions: Family and child or adolescent education and lifestyle modification aiming to improve sleep hygiene and PA, and to reduce screen-based sedentary behaviour should be provided. Family centred approach for more effective coping with distress and improvement of parent-child relationship is also important in treating child and adolescent headache.

Key words: children, COVID-19 pandemic, headache, screen-based media use, parenting behaviours

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INTRODUCTION

Headache is the most frequently observed complaint in paediatric populations. It is known that headache is a multifactorial disorder including the genetic, medical, neuropsychological, and also psychosocial factors (1–3). According to various epidemiological studies, 30%–75% of children and adolescents experience headache at least once a year, and 6% to 10 % have severe and frequent headaches, and the number tends to increase with age (3–6). A study conducted in Lithuania in 2010, including children aged 11, 13, and 15 years, revealed that 35%–50% of the participants suffered from headaches (7), and in 2016 seventy-four percent of children and adolescents aged 7 to 17 were reported to experience headache at least once per year (4). The incidence of headaches before puberty was found to be similar among girls and boys. The gender gap starts to appear at the age of 11, when the higher frequency is found in girls (4, 6, 8, 9). This is explained by the fact that girls are more likely to have migraines than boys and with age this difference increases even more, while reaching an adult radio of 3:1 (1). Despite the high frequency, headaches in children and adolescents are underestimated (3), also they lack the proper definition and treatment, which has a negative impact on quality of life, education and emotional problems (10).

The impact of COVID-19 on the youngsters' mental and physical health is well documented (11–13). However, there is a lack of studies on the prevalence and risk factors of children's and adolescents' headache – as a psychosomatic expression of tension. The current results available in the scientific literature are ambiguous. On the one hand, it is likely that during the pandemic, headache in youngsters have become even more frequent due to changes in their lifestyle such as increased screen time, disturbed sleep, a stressful home environment, and isolation (14). On the other hand, increased daily flexibility and decreased social and physical needs may have had a positive effect on the frequency of pain (14–16). Moreover, the first lockdown, although had brought unexpected and strict restrictions, had fewer negative effects than the second one, which was long-lasting and probably more exhaustive (11, 16). The pandemic had a tremendous impact on the lifestyle and daily activities of

children and adolescents (17, 18). Changes in lifestyle, especially those related to the sleep regime, physical activity, and screen-based media use could also pose the additional risks for headaches in youngsters (1, 5, 19).

The proportions of partial or total school closures differed between the first and second wave of the pandemic. At the beginning of the first wave, many countries had closed schools completely, but during the second wave, most countries tried to keep schools open or at least partially open. Lithuania was one of the countries that applied strict and long-lasting lockdown due to COVID-19. In the spring of 2020, during the first lockdown in Lithuania, exclusively online education for students was introduced, which lasted almost three months. The second lockdown was introduced at the beginning of November 2020 and lasted till April 2021. School-aged children had spent in distant education for four months (1st to 4th grades, from mid of December to the mid of April) or for half a year (5th to 12th grades, from November to June)*.

The global COVID-19 pandemic has led to a greater use of smart technologies and more sedentary behaviour worldwide in populations of all age groups. Due to spending more time away from structured school settings, children and adolescents might have experienced fewer opportunities for physical activity (PA) and more sedentary screen-time related behaviour (11, 17). Online education also might increase a risk of using the internet for an uncontrolled amount of time as well as unattended content in school-aged children. Prolonged screen-based media use in children has been discussed as one of the main triggers for recurrent headaches (5) and is attributed to sedentary behaviour (20). Thus, we propose, that during the lockdown the incidence of the headaches in young populations might be also related to more screen time and less PA.

Sleep plays a crucial role in the aetiology of headaches in children and adolescents (21–22). Even after the first lockdown, children more frequently had problems falling asleep and staying asleep, and also had headaches (23). One of the possible risk factors for headache frequency during the pandemic was disruption of sleep regime and duration (19). Sleep is also related both to PA and screen-based media use (17, 24), but the importance of interactions between sleep quality, screen media use, and PA while predicting the frequency of headaches in school-aged children is still unknown, especially during the stressful periods such as pandemic.

Finally, the emotional stress experienced by a child, the family distress, and parent-child relationships are important for the psychosomatic pain in children, as well as headache (2, 19). The changes due to COVID-19 pandemic required parents to act in new roles without much support (25), and families felt fear and uncertainty about the future. Parents' stress increased during the pandemic period, and this could also have negative impact on the relationship with a child (26, 27).

Thus, in this study, our aim was to assess the links among somatic complaints such as headaches, screen-based media use, physical activity, sleep, and the family environment in a Lithuanian sample of children and adolescents aged 7 to 14 years by the end of the second lockdown due to COVID-19. We hypothesized that the incidence of headache in school-aged children was related to more screen time, less PA and poorer sleep quality. In addition, parental distress and relationships with a child might increase the probability of headache.

MATERIALS AND METHODS

Sample and Procedure

This research sample included data from 541 children, aged 7–14 years (mean = 9.80, SD = 1.97), who did not have any serious chronic health conditions or developmental disorders. Information about the children was provided by their parents or caregivers. The vast majority of the questionnaires – 525 (97%) were completed by mothers, 14 (2.6%) by fathers, and 2 (0.4%) by foster caregivers. Note, that no significant differences in studied variables were found comparing the reports of mothers and fathers, except mothers reported slightly higher children's physical activity than fathers (mothers: mean rank = 272.26; fathers: mean rank = 185.07; $Z = -2.16$, $U = 2{,}486.00$; $p < 0.05$).

The research sample represents mainly children from educated families that are not from the social and economic risk group (Table 1).

Parents living in various regions of Lithuania were invited to take part in the research through schools and social media. Furthermore, parents (14% of a sample) who previously participated in our other longitudinal studies and provided personal email addresses with consent for communication were also invited to take part in this study. All parents signed an informed consent

Table 1. *Demographic characteristics of the participants (N = 541)*

Characteristics	Sample	
	n	%
Child gender		
Girls	253	47
Boys	288	53
Child age		
7–10 years	313	58
11–14 years	228	42
Parental* education		
High (≥ 16 educational years)	509	94
Medium (13–15 educational years)	32	6
Parental* employment status		
Employed	511	95
Unemployed	30	5
Infectious diseases		
Had	509	94
Did not have	32	6

*Respondent parent

*The social restrictions were applied in Lithuania during the second lockdown: persons or families from one household were not allowed to meet any other persons or families living in another household indoors. Exceptions were made only for single elders and single-parent families with preschool children, allowing to have a 'social bubble', e.g., meeting one person or family from another household.

form for this study and completed online questionnaires. The approval of the Ethics Committee of Psychological Research of Vilnius University was obtained for the study (No. 65, 2021-04-21). The data analysed in this study were collected by the end of the second lockdown in April–May 2021.

Measures

Child's screen time was assessed by parent's responses to questions about the duration for which their child usually uses various types of screen-based devices (including smart phone, tablet, computer, game console, and TV) for educational needs and for leisure time on weekdays and weekends, while choosing one of the options: 1) 'no use at all or very rare usage', 2) 'about 30 minutes per day', 3) 'about 1 hour per day', 4) 'about 2 hours per day', 5) 'about 3 hours per day', 6) 'about 4 hours per day', 7) 'about 5 hours per day', 8) 'about 6 or more hours per day'. To assess the average daily screen time, first each option was converted into minutes as follows: 1) 0 minutes, 2) 30 minutes, 3) 60 minutes, 4) 120 minutes, 5) 180 minutes, 6) 240 minutes, 7) 300 minutes, and 8) 360 minutes. The following formula was used to count the average daily use: (screen use on weekdays [converted to minutes] x 5 days + screen use on weekends [converted to minutes] x 2 days) / 7 days), thus the higher score indicated the longer screen time.

Child's headaches were assessed by the parent's answer to the following question: "How often during the past three-four months has your child experienced headaches?" picking one of the options: 'never', 'sometimes', 'often', and 'very often'. The variable used in the bivariate regression model was created distributing children into two groups: never experienced headaches; and experienced headaches (sometimes, often, or very often).

Child's sleep quality variable was derived in this study from four main sleep parameters: sleep duration, sleep onset latency, night waking, and daytime sleepiness. Sleep duration was reported by parents in hours and minutes, and sleep onset latency was reported by selecting one of the options: less than 15 minutes, between 15–30 minutes, between 31–45 minutes, between 46–60 minutes, longer than 60 minutes, other. Night waking was reported by picking one of the options: almost never, sometimes, almost every night, several times per night. Parents were also asked about the children's daytime sleepiness by choosing one of the options: never or almost never, sometimes, often, almost always or always. For further analysis, a variable of sleep quality was created. First of all, the distributions into two groups by each of the sleep quality components were made: appropriate sleep duration by age (1) and too short sleep duration by age (0), sleep onset latency until 30 minutes (1) and sleep onset latency more than 30 minutes (0), never experiencing night awakening (1) and experiencing night awakening (0), and finally never experiencing daytime sleepiness (1) and experiencing daytime sleepiness (0). The final sleep quality variable was calculated adding together all of the components: sleep duration, sleep onset latency, night waking, and daytime sleepiness, where a higher score presented better sleep quality, ranging from 0 to 4.

Child's physical activity was reported by parents answering the question about how much time per day the child is physically active during the last three–four months by picking one of the options – 'less than 30 minutes', '30–60 minutes', 'more than 60 minutes'.

Parental distress was measured with a set of six items asking the frequency of the following symptoms: sadness/depression, irritability/bad moods, anxiety/distress, sleep problems, lack of energy during the last three–four months by picking one of five options: 1 (almost every day), 2 (two-three times a week), 3 (almost once a week), 4 (almost once a month), 5 (rarely or almost never). The latter variable was re-coded by contraries; thus, the higher score indicated the higher parental distress. The scale reliability is good, Cronbach's alpha = 0.86.

Parent-child relationship was measured by asking parents to rate the child's relationship with parents using a Likert-type scale from 1 (very bad) to 5 (very good). Thus, the higher score means better relationship.

Also, parents reported on a child's infectious diseases with answering 'yes' or 'no' to the question if a child was sick with any of infectious diseases (acute respiratory, digestive disease, etc.) during the past three–four months.

Statistical Analysis

Bivariate Spearman correlations among study variables were calculated. Mean comparisons between two independent groups were counted using a Mann-Whitney U signed ranks test. The predictions of experiencing headaches were calculated using binary logistic regression. Correlations, descriptive statistics, distributions, comparisons, and regression were run in SPSS 23.0. A path model was established and tested using SPSS Amos 19. Parameters were attained by maximum likelihood estimation. The evaluation of model fit was based on the χ^2 value as well as on a variety of descriptive fit indices.

RESULTS

In this study sample, according to parents, 46% of children never had headaches during the study period, while 46% had headaches sometimes and 8% had headaches often or very often. Thirteen percent of children were physically not active, while 28% were physically active for less than 30 minutes, 36% – for about 30–60 minutes, and 23% for more than 1 hour daily. Headaches, physical activity, screen time, sleep quality, parental distress, and parent child relationships were compared between boys and girls and significant differences were found in mean rank scores only for screen time: boys spent more time daily using screen-based media devices than girls (boys: mean rank = 283.86; girls: mean rank = 256.36; $Z = -2.04$, $U = 32729.00$; $p = 0.041$). No significant differences of study variables were found among children of employed and unemployed parents ($p > 0.05$).

Descriptive and bivariate correlations among the study variables are presented in Table 2. The frequency of headaches was positively associated with child's age, screen time and parental distress, as well as negatively related to PA, sleep quality, and also the parent-child relationship. The results revealed that child's age was also related to PA, screen time and sleep quality. Parental education was related to child's PA, screen time and sleep quality. Incidence of infectious diseases was related to sleep quality and parental distress (Table 2).

In addition, a multivariate logistic regression analysis was applied to predict headaches. We included child's age, incidence of

Table 2. *Descriptives and correlations between the main variables*

	1	2	3	4	5	6	7	8
1. Headaches	–							
2. Physical activity	−0.17**	–						
3. Screen time	0.21**	−0.29**	–					
4. Sleep quality	−0.32**	0.27**	−0.23**	–				
5. Parental distress	0.17**	−0.11*	0.13**	−0.20**	–			
6. Parent-child relationship	−0.13**	0.18**	−0.12**	0.16**	−0.28**	–		
7. Parental education	−0.05	0.14**	−0.14**	0.11*	−0.03	0.01	–	
8. Child's age	0.22**	−0.27**	0.42**	−0.19**	−0.07	−0.04	−0.05	–
9. Infectious diseases	0.07	0.03	0.02	−0.09*	0.09*	−0.05	−0.04	−0.01
Mean	1.63	2.70	334.19	3.69	16.37	4.04	–	9.80
Standard deviation	0.64	0.96	138.16	0.97	5.69	0.83	–	1.97

*p < 0.05; **p < 0.01; ***p < 0.001

infectious diseases, parental education, physical activity, screen time, sleep quality, parental distress, and parent-child relationship as predicting variables (Table 3). The results of the analysis revealed that child's age (OR = 0.84, 95% CI: 0.76–0.94), sleep quality (OR = 1.71, 95% CI: 1.37–2.12) and parental distress (OR = 0.96, 95% CI: 0.93–0.99) were significant predictors of headaches in children; the likelihood of experiencing headaches increased with decreasing sleep quality and increasing child's age and also parental distress.

Finally, according to the theoretical assumptions and correlation and regression analyses of this study, a model predicting headaches was developed and a path analysis for the hypothesised model was performed. The model fits the data well (Fig. 1). The results of the analysis revealed that parental distress and sleep quality directly predicted headaches. None of the variables indirectly predicted headaches. Furthermore, parental distress predicted parent-child relationship and also screen time, and screen time predicted PA. Sleep quality was explained by PA and screen time. The model explains 17% of the variance of children's headaches ($p < 0.05$). All paths in the model were controlled for the child's age and parental education (paths not displayed in Fig. 1). The exclusion of any depicted insignificant paths between variables (parental distress on PA and parent-child relationship on screen time) resulted in a significant decrease of the model accuracy.

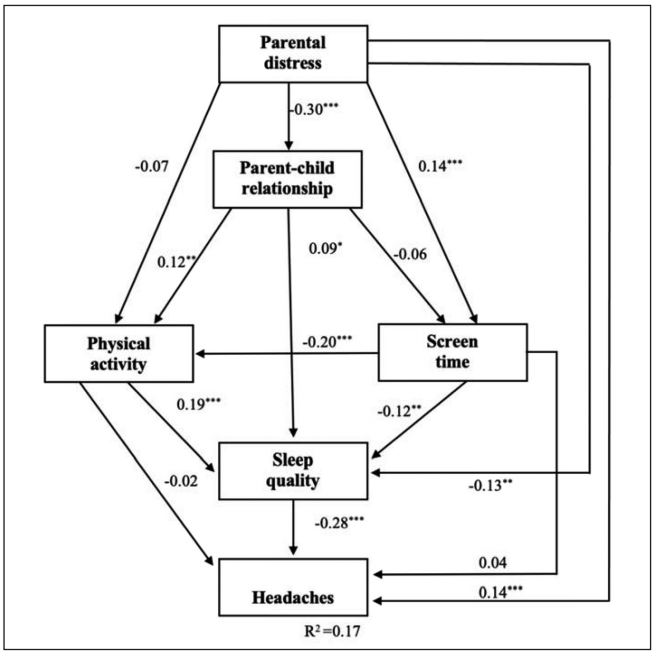

Fig. 1. *A path model to predict the headaches.*

Controlled variables (child's age, infectious diseases, and parental education) are not depicted. Model fit statistics: $\chi^2 = 0.81$, CFI = 1.00, NFI = 0.99, RMSEA = 0.000, TLI = 1.00, AIC = 106.80, χ^2 p = 0.369.

χ^2 – chi-square test; CFI – confirmatory fit index; NFI – Bentler-Bonett Normed Fit Index; RMSEA – root mean square error of approximation; TLI – Tucker-Lewis index; AIC – Akaike information criterion; ***p < 0.001; **p < 0.01; *p < 0.05

Table 3. *Multivariate logistic regression analysis for study variables predicting headaches*

Variable	Headaches		
	OR	95% CI	p-value
Child's age	0.84	0.76–0.94	0.001
Parental education	0.74	0.33–1.66	0.464
Infectious diseases	0.65	0.28–1.51	0.320
Physical activity	1.06	0.86–1.31	0.601
Screen time	0.99	0.99–1.00	0.211
Sleep quality	1.71	1.37–2.12	< 0.001
Parental distress	0.96	0.93–0.99	0.031
Parent-child relationship	1.19	0.93–1.51	0.171

95% CI – 95% confidence interval; OR – odds ratio

DISCUSSION

The results of our study revealed that more than half of surveyed parents (54%) indicated that their children and teenagers had headaches during the second lockdown due to COVID-19 pandemic, and this corresponds to global results where headache is one of the most frequent health complaints. The overall incidence and frequency of headaches in our sample is comparable to the findings of previous epidemiological research worldwide (3, 6). In addition, the results of our study confirmed previous findings that the incidence of headaches increases with age (4, 6, 8). Neither gender of child, neither presence of infectious diseases during the past three–four months were significantly

related to presence of headache in our study. The pre-pandemic study in Lithuania done in 2016 (4) revealed that three quarters of school-aged population had at least one episode of headache per year, and in the survey conducted in 2010 (7) 38% of male and 52% of female adolescents experienced headache at least once per month. In both studies, children completed questionnaires themselves. As our study was not population-based and the different methods were used (e.g., several months vs. one-year captured, parent-reported vs. child-reported), we could not reject or confirm, that the incidence of headache has changed during the COVID-19 pandemic in Lithuanian children.

Based on the results of this study, the main risk factors for headache in children and adolescents during the second lockdown were higher parental distress and poor youngster's sleep quality. These were the direct predictors of headache. Although screen time and PA were not significant predictors of headache, both predicted sleep quality. Moreover, shorter screen time significantly correlated with higher PA.

The results of our study revealed that screen time, PA and sleep quality are important not only for mental health problems (17) and school readiness (24), but also for headaches. In accordance with our study, the direct link or significance of the screen exposure to the frequency of paediatric headache was not unequivocally confirmed also in a recent study (5). Excessive screen-based media use can play an important role in overall well-being of children (11, 28). We also found, that reduced PA was related to sleep quality, and this is in line with many other studies (17, 24, 29). Inactivity and sedentary behaviour can also lead to the muscle weakness (30). According to WHO recommendations, children and adolescents should be active for at least one hour per day, as well as limit the amount of time spent being sedentary (31). However, only less than one quarter participant children have met this recommendation in our sample during pandemic, although the insufficient PA of Lithuanian children and youth was continuously documented in previous pre- and peri-pandemic studies as well (11, 32).

Active lifestyle might be also an important in reducing the incidence of headaches through improvement of sleep. As sleep disorders and headaches are often comorbid and interrelated in children and adolescents (21, 22), education and lifestyle modification including sleep hygiene could play a significant role in overall success in reducing headaches (33).

Finally, the parental distress plays a significant role in explaining the incidence of headache, according to the results of our study. The direct effect of it might be due to biological predispositions of more intense emotional and physical reactions to stressful situations and probably due to less effective coping used in families (2). In our study parental distress also predicted parent-child relationship as well as longer screen time and worse sleep quality. Higher parental stress level creates less favourable child's and adolescent's environment (e.g., worse parent-child relationship, higher use of screens), especially during more stressful time. The results of our study support the idea that in order to explain headaches in children and adolescents we should consider not only separate factors but take into consideration the interrelations of much broader spectrum of factors.

Several limitations of our study should be considered. First, the study sample was not representative, and the families had a favourable socioeconomic background and were more educated. Second, this study is cross-sectional and therefore does not allow to identify causal relationships between variables, thus longitudinal studies in a field are highly encouraged. Third, the incidence of headache was reported by parents and measured only with one question. The multi-informant and also more objective methods used to assess headaches, physical activity and screen time could provide further validation of our results. It would be especially important to further explore the interplay of main triggers of headache (e.g., emotional stress, sleep, screen use, and PA) using the biopsychosocial framework (e.g., also including the clinical samples of children with various types of diagnosed headache: migraine, tension-type headache, etc.). Finally, the predictors of headache in children and adolescents found in this lockdown study should be re-evaluated during the less stressful periods.

Even considering these limitations, the results of our study confirm the importance of environmental factors on headache in childhood and adolescence (2), and support the importance of the lifestyle management for the prevention and treatment of the youngsters' headache (1, 10). As we stated before, appropriate family and child/adolescent education and lifestyle modification aiming to improve sleep hygiene and PA and to reduce screen-based sedentary behaviour should be provided. Where applicable, the family-centred approach to encourage more effective coping with distress and to improve the parent-child relationship, could be also valuable in treating child and adolescent headaches.

CONCLUSION

During prolonged second lockdown children's sleep quality and parental distress were significant predictors of headaches in children aged 7 to 14 years. Improving parent-child relationship, children's physical activity and reducing screen-based sedentary behaviour could improve sleep quality and therefore reduce headaches.

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Conflicts of Interest

None declared

Data Availability Statement

The raw data supporting the conclusions of this article will be made available by the corresponding author.

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