

ORIGINAL ARTICLE

Risk Factors for Headache in Children

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SUMMARY

Background: 10% to 30% of all children worldwide suffer from headaches at least once a week, potentially constituting a serious health problem that may lead to impairment in multiple areas. Therefore, one aim of the epidemiological longitudinal study "Children, Adolescents, and Headache" (KiJuKo) is the study of potential risk factors for the development of recurrent headaches.

Methods: In the first survey (2003), questionnaires were sent to 8800 households with a child between 7 and 14 years of age. Three further surveys followed, one each year from 2004 to 2006. A number of predictors having to do with family characteristics and leisure activities were identified on the basis of the first survey and were then studied in the second survey ($n = 2952$) with respect to their influence on the new occurrence of headaches.

Results: The risk of developing recurrent headaches between the first and the second survey was elevated by a factor of approximately 1.8 for boys who experienced quarrels in the family more than once per week, and by a factor of 2.1 for boys who only "sometimes" had free time for themselves. The risk of developing recurrent headaches was 25% higher in girls whose parents' behavior towards the child positively or negatively reinforced the occurrence of headaches.

Conclusions: These findings are in accordance with those of other studies showing that, for boys, the frequency of quarreling in the family and the extent of leisure time are major factors in the development of recurrent headaches. For girls, the manner in which the parents respond to the child's headache seems to be important.

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Key words: child health, headache, epidemiology, morbidity risk, leisure activities

The prevalence of headache in children and adolescents continues to rise. International studies have documented this trend (1, 2). In addition, it is assumed that headache symptoms persist into adulthood in a relatively high percentage of cases (about 50%) (3).

Recurrent headaches in particular are considered to come about not only as a consequence of pathophysiological mechanisms, but as a multifactorial event (4) in which psychosocial components also play a role. The study of potential risk factors for the initial appearance (incidence) and maintenance of headaches in children is, therefore, of obvious importance.

The results of the studies that have been performed to date are comparable to no more than a limited extent, because of considerable methodological differences and deficiencies. Furthermore, only a handful of longitudinal studies have been carried out on this subject in Germany until now (5, 6), often involving only a small number of cases. These reasons provided the motivation for the present longitudinal epidemiological study, called "Children, Adolescents, and Headache" (in the original German: Kinder, Jugendliche und Kopfschmerz, abbreviated KiJuKo). The primary objective of this large-scale research project is to identify the psychosocial risk factors for headache in children and adolescents.

A large number of variables were tested in the study. For the purposes of this article, the variables concerning the child's family and leisure activities were selected (Table 2), because the published literature indicates that these factors are involved in headache. Family problems are often said to provoke headache (7, 8); for example, children with frequent headaches report quarreling in the family much more frequently than healthy children of the same age (age-matched controls) (9). Parental behavior when the child complains of headache seems to play a major role as well. Positive or negative reinforcement is given, through which the child learns that illness behavior confers certain advantages or privileges (10). Learning theory implies that reinforcement of this kind leads to the more frequent appearance of headache-related behavior.

Leisure activities also seem to affect the frequency of headache. It has been shown, for example, that children who suffer from headache at least once per month tend to be more active (i.e., are more likely to participate in sports) than children in the control groups without headache (11).

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TABLE 1

Description of the incidence sample

Wave 1 (2003) \ Wave 2 (2004)	Headaches? "No" (none, or fewer than one per month)	Headaches? "Yes" (at least one per month)	Overall
Headaches? "No" (none, or fewer than one per month)	2571 87.1%	381 12.9%	2952 100%
Headaches? "Yes" (at least one per month)	334 38.6%	531 61.4%	865 100%
Overall	2905 76.1%	912 23.9%	3817 100%

n = number of cases; % of total for each row; McNemar p = 0.085; There is no significant change between wave 1 and wave 2; this is consistent with the earlier finding that headaches are highly stable

The relevance of friends and social relationships to psychophysiological health has been pointed out by multiple authors. Children with weekly headaches are said to have fewer friends than children of the same age without headaches (12). Children with headaches, compared to those without, also spend more time per day watching television (9) or using a computer or game console (13).

Each one of these factors can be interpreted as a type of psychosocial stress. Waldie, in a prospective study (14), showed that intense stress during puberty—operationalized with reference to various stressful events, e.g., conflict with parents—increases the probability of migraine in early adulthood. There is thought to be a two-way interaction between stress and headache (15), in which the cause-and-effect relationship remains unclear (16). Headache itself can be experienced as a stressor (17), but a variety of potential stressors can also contribute to the causation of headache.

Research findings on the subject until now do not permit any conclusion as to whether the psychosocial factors studied promote the development of headache, are themselves a consequence of headache symptoms, or possibly both.

The purpose of this article is to study the potential causes of headache with a unidirectional analytical approach. In the long term, the findings of longitudinal studies such as this one may contribute to appropriate modifications in existing prevention programs and therapeutic measures and to the development of new ones.

Methods

This investigation is part of a large-scale, longitudinal epidemiological study (KiJuKo), in which data were obtained in each of four consecutive years (2003–2006) in annual "waves." In this paper, we present results and parent questionnaire responses from the first two waves (2003 and 2004).

The initial acquisition of data was performed by means of a questionnaire sent to the parents and another questionnaire sent to the child (as long as the child was at least 9 years old). A total of 8800 families with a child aged 7 to 14 years were selected at random from the

population of southern Lower Saxony (the districts of Holzminden, Osterode, Göttingen, and Northeim) and the city of Hanover by the registration office and data-processing center for southern Lower Saxony. Thus, a representative sample for the local city and state population was generated. The persons who had participated in the first wave were asked to participate in the second wave in the following year.

The literature was extensively searched to identify potential risk factors, on the basis of which a total of 111 questions were asked in the wave 1 parent questionnaire, concerning the following variable domains:

- Social demography
- Psychosocial factors
- Leisure-time activities
- Health
- Family
- School
- Parental health
- Life events.

Previously tested measuring instruments were incorporated into the question pool as far as this was possible (Table 2). The use of complete questionnaires to operationalize the risk factors was not possible, in view of the need for conciseness and practicality. Instead, items were chosen on the basis of statistical evaluative criteria for each risk factor. It was realized that this procedure would limit the validity and reliability of the results to some extent.

The questionnaires were developed in three pretest phases, according to the procedure recommended by Dillmann (18) for questionnaire implementation (19) (Supplement 1). The first two waves had a total of n = 4159 participants (47.3% of persons initially contacted) (e-Figure 1). At the time of the second wave (2004), the participating children were, on average, 11.25 years old (standard deviation, 2.28 years; range, 8–15 years).

In each of the four waves, the frequency of headaches in the past six months was assigned to one of four categories, on the basis of the parents' responses to the questionnaire:

TABLE 2

Description of the dependent variables of the 2nd wave (criterion) and the tested risk factors of the 1st wave (predictors)

Information given by parents regarding:	Questions and selected, illustrative items	Operationalization
Criterion Frequency of headaches in the past six months	Has your child complained of headaches in the last six months? If answered "yes": "Which of the following is true of your child? My child had headaches in the last six months. . ."	„no“ „yes“ "at least once per week," "at least once per month," "less than once per week"
Predictors and sources		
Age	Your child's date of birth	Day, month, year
Sex	Please indicate the sex of your child	Male, female
Family		
Parents' management of the child's headaches: selected items from the Illness Behavior Encouragement Scale (IBES), Walker & Zeman, 1992 (e7)	The following questions concern what you have done in the last six months when your child had a headache. ("How often have you exempted your child from normal household tasks, such as taking out the garbage, because he/she had a headache?") Internal consistency: $\alpha = 0.74$	6 Items; 5 levels, from "never" to "always"
Family environment Mannheim Parent Interview (Mannheimer Elterninterview, MEI), Esser et al., 1989) (e8)	Please indicate how often each of the following is true of your family ("Are you satisfied with your family's activities together?") Internal consistency: $\alpha = 0.72$	3 Items; 5 levels, from "never" to "always"
Frequency of quarreling Mannheim Parent Interview (Mannheimer Elterninterview, MEI), Esser et al., 1989) (e8)	How often has there been a quarrel in your family in the last three months?	1: every day 2: several times a week 3: about once a week 4: less than once a week 5: never
Leisure-time activities		
Physical exercise Self-Administered Physical Activity Checklist (SAPAC), Prochaska et al., 2002 (e9)	"Bicycling," "tennis," "swimming," "ball games" Internal consistency: $\alpha = 0.67$	10 Items; 0: my child does not participate in this activity 1: less than once a week 2: once or twice a week 3: 3 to 5 times a week 4: more than 5 times a week
Leisure	How often does your child have time to play, or time for himself or herself?	5 levels, from "never" to "always"
Number of friends	How many good friends does your child have?	1: none 2: one 3: more than one (give number)
Television or video watching German Health Interview and Examination Survey for Children and Adolescents (Kinder- und Jugendgesundheitsurvey, [KiGGS], Robert Koch Institute, Lampert et al., 2007) (e10)	How much time per day, on average, does your child spend watching television or videos?	1: more than 4 hours 2: about 3–4 hours 3: about 1–2 hours 4: about 30–60 minutes 5: less than 30 minutes 6: not at all
PC, Internet, Game Boy or Play Station use German Health Interview and Examination Survey for Children and Adolescents (KiGGS), Robert Koch Institute, Lampert et al., 2007 (e10)	How much time per day, on average, does your child spend at the computer, on the Internet, or using a Game Boy or Play Station?	1: more than 4 hours 2: about 3–4 hours 3: about 1–2 hours 4: about 30–60 minutes 5: less than 30 minutes 6: not at all

TABLE 3

Descriptive statistics of the incidence sample (n = 2952)

Variable	Category	Number (n)	Sample (%)
Criterion (Wave 2) Headache frequency	"At least once a week"	78	2.6
	"At least once a month"	303	10.3
	"Less than once a month" ^{*1}	812	27.5
	"No headaches" ^{*1}	1759	59.6
Predictors (Wave 1)			
Age	7 years	524	17.8
	8 years	440	14.9
	9 years	422	14.3
	10 years	397	13.4
	11 years	314	10.6
	12 years	310	10.5
	13 years	292	9.9
	14 years ^{*2}	253	8.6
Sex	Male ^{*1}	1519	51.5
	Female	1433	48.5
Family			
Parents' management of the child's headaches	Never	190	6.4
	Rarely	500	16.9
	Sometimes	317	10.7
	Often	117	4.1
	Always ^{*2}	13	0.4
	No data	1815	61.5
Family environment	Never	2	0.1
	Rarely	108	3.7
	Sometimes	687	23.3
	Often	1720	58.2
	Always ^{*2}	414	14.0
	No data	21	0.7
Frequency of quarreling	0: at most once per week ^{*1}	2701	91.5
	1: more than once per week	229	7.8
	No data	22	0.7
Leisure-time activities			
Physical exercise	0: up to 3-5 times per week ^{*1}	703	23.8
	1: less than once or more than 5 times per week	2138	72.4
	No data	111	3.8
Leisure	0: free time "often" or "always" ^{*1}	2629	89.1
	1: free time "sometimes" or less	300	10.1
	No data	23	0.8
Number of friends	0: more than one good friend ^{*1}	2646	89.6
	1: one good friend, or none	237	8.1
	No data	69	2.3
Television or video watching	0: up to 2 hours per day ^{*1}	2731	92.5
	1: three or more hours per day	197	6.7
	No data	24	0.8
PC, Internet, Game Boy or Play Station use	0: up to 2 hours per day ^{*1}	2839	96.2
	1: three or more hours per day	76	2.6
	No data	37	1.2

^{*1} reference category; non-binary variables were dichotomized after determination of the rounded mean item value;

^{*2} rounded mean item value (considered as a continuous variable); the case numbers vary depending on item-specific missings (non-response to individual questions)

- no headaches,
- less than one episode of headache per month,
- at least one headache episode per month,
- at least one headache episode per week.

In order to make it possible to derive an effective means of predicting whether headaches would develop after one year of follow-up, children were included in the analysis only if they had no headaches in wave 1 (i.e., no headaches or less than one episode of headache per month in the past six months), but reported having headaches one year later in wave 2 (defined as at least one headache episode per month) (Table 1, e-Figure 2).

The criterion (dependent variable) in wave 2 was membership in the group "recurrent headaches: yes" (i.e., at least one headache episode per month), versus "recurrent headaches: no" (i.e., less than one headache episode per month) (Table 1, e-Figure 2).

A further important characteristic of this longitudinal study was the consideration of symptoms that arose even before headaches did. The predictors consisted of various items in the first wave of the parent questionnaire (Table 2), along with age and sex, and were assigned to the categories "Family" and "Leisure Activities."

In the first step of the binary logistic regression analyses, each risk factor was studied individually for its predictive value with respect to the development of headaches occurring at least once per month (20). In preliminary analyses, sex was found to have a significant effect on the new development of headaches ($p = 0.000$; odds ratio = 1.54; 95% confidence interval [CI] 1.24–1.92). Therefore, subsequent evaluations were performed separately for boys and girls.

After this univariate analysis, the variables whose p -values were less than 0.25 were fed into the multiple regression model (20). As the internal consistency values (Cronbach's alpha) were satisfactory (Table 2), an overall score (average item value) was created from the subitems in five-level rating scales. High values represented unfavorable situations. A number of categories were combined because of their content and to achieve adequate case numbers (Table 3).

The odds ratios (OR) given in the Results section are the multiplicative factors that quantify the increased risk of developing headaches if the predictor in question is present (i.e., present to a high degree) as compared to the reference group (in which the predictor is present only to a low degree). For continuous predictors, the OR indicates the increase in the probability of developing headaches when the variable in question changes by one unit. All statistical evaluations were performed with the SPSS 14 program package.

Results

In the second wave (2004), according to the parents' responses to the questionnaire,

- 49.5% (n = 1908) of children had no headaches,
- 26.7% (n = 1029) had only rare headaches,
- 17.1% (n = 659) had headaches at least once per month,

- 6.8% (n = 261) had headaches at least once per week.

Boys and girls differed in the frequency of headache ($\chi^2 = 51.79$, $df = 3$, $p < 0.001$). The prevalence of symptoms occurring weekly was twice as high in girls (Figure 1). The prevalence of monthly and weekly headaches rises with age (Figure 2).

In the binary logistic regression analyses for the evaluation of the potential effect of the individual risk factors (bivariate analyses) on the incidence of recurrent headaches, the significant factors for boys were found to be the family environment, the frequency of quarreling, and the amount of free time (Table 4). Each model controlled for the effect of age, which was found to be irrelevant ($p > 0.05$) in all cases.

The results of the overall model for boys indicate the importance of frequent quarreling in the family and of the child's free time as relevant influential factors. Boys who experienced a family quarrel more than once per week were 1.8 times as likely to have headaches than those who experienced a family quarrel only once per week or less (Table 4). Free time seems to play an even more important role: Boys who only sometimes had time for themselves were 2.1 times as likely to develop headaches (Table 4). Age was found to have no significant effect in the multivariate model as well ($p = 0.211$; OR = 1.05; 95% CI = 0.97–1.13).

In the bivariate analyses, the only significant factors for the development of headaches in girls were parental behavior when the child complained of headache and the number of friends. For girls, unlike boys, age was found to be an influential factor, although the odds ratios for the effect of age were in a very low range (1.030 to 1.091). Age thus seems to have no more than a weak effect on the development of headaches.

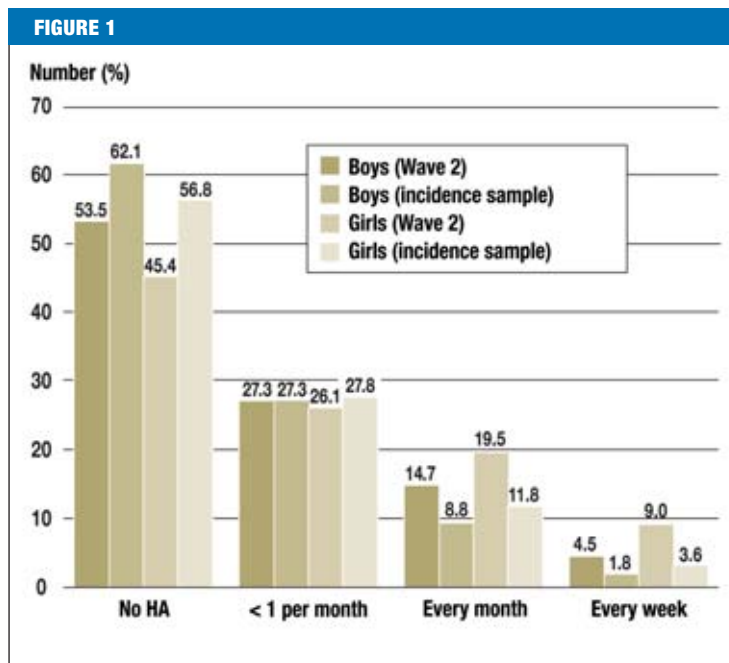
When both variables were considered together in a multivariate model, it turned out that, in fact, only parental behavior had an effect on the development of headaches in girls. Girls whose parents behaved unfavorably (i.e., with positive or negative reinforcement) when they complained of headache had 1.3 times the risk of developing headaches at one year (Table 4). Age was not found to be a relevant influential factor in the multivariate model ($p = 0.471$; OR = 1.03; 95% CI = 0.95–1.13).

Discussion

In line with previous research findings, a number of the variables mentioned were found to be risk factors for the new development of headaches in children (depending on sex) one year after the initial survey. For boys, the frequency of quarreling in the family and the amount of free time available were significant factors for the development of recurrent headaches; for girls, the significant factor was parental behavior tending to reinforce their daughters' headache symptoms.

These results can be considered in the context of other research findings on the subject, as follows:

This study, like other studies, revealed no association between physical activity and headache (17).



The percentage of children of each sex who had weekly, monthly, or less than monthly headaches, or no headaches at all, in Wave 2 (n = 3857; information given by parents) in comparison to the incidence sample (new occurrence of headaches in Wave 2; n = 2952; information given by parents); HA, headache

Larsson and Sund (21) showed that a reduction of leisure-time activities is associated with frequent headaches. The present study shows that, for boys, the amount of free time indeed has an effect on the development of headaches. Adequate free time thus seems to be a protective factor against headache.

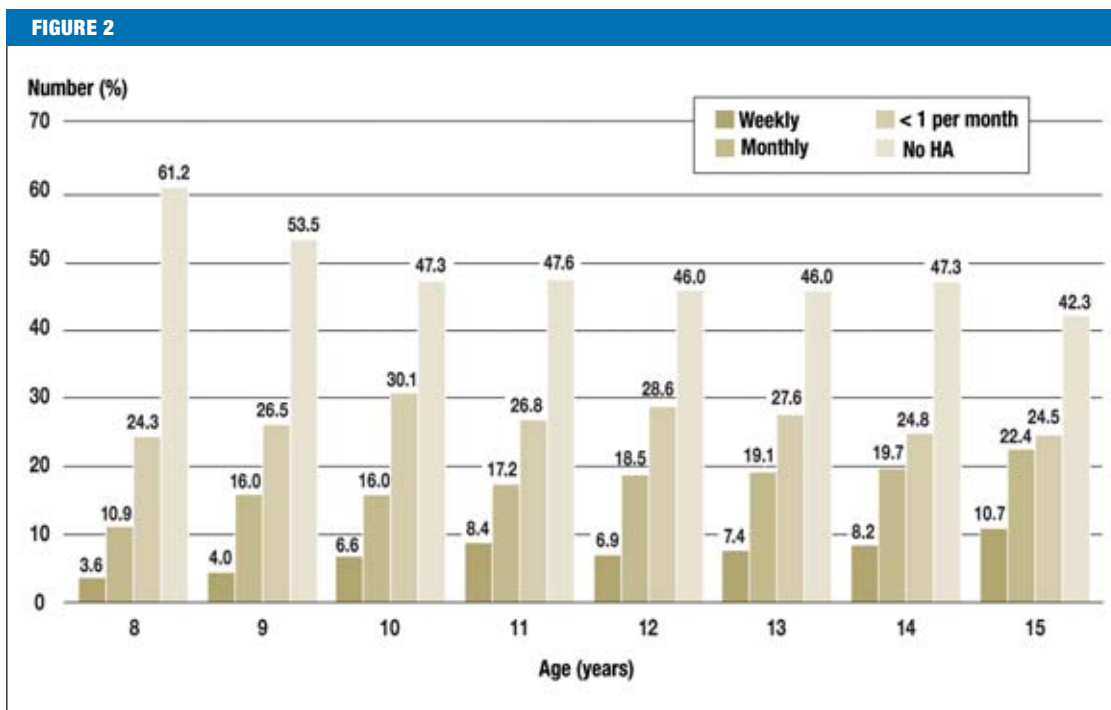
Even though friends have often been described as having a relevant (protective) effect on the development of headaches (12), the present study found an effect only in girls, and only in the bivariate analyses; in the overall model, this factor loses its predictive value. This finding is in accordance with that of Gordon et al. (17). Even though children with headaches spend more time each day watching television than children without headaches (9), our analysis found this behavior to have a significant effect only in boys, and only when considered individually. When it was considered together with other variables, its effect was no longer significant. In a study of younger children, Aromaa et al. (22) found that the frequency of television-watching at age 5 was not predictive for the development of headaches by age 6. The findings of the present study are consistent with this.

In contrast to the findings of Oksanen et al. (13), we did not find the daily use of a personal computer or game console to have a significant effect on the development of headaches in children.

Overview

As a cautiously drawn conclusion from the findings reported above, it seems reasonable to advise parents to

The percentage of children who had weekly, monthly, or less than monthly headaches, or no headaches at all, in Wave 2, segregated by age group (n = 3857; information given by parents)



make sure that their children have adequate time for themselves. The deleterious effect of an overfilled agenda on children's psychophysiological health (and that of adults as well) is well known from many studies. Furthermore, frequent family quarrels also seem to promote the development of headaches in boys.

Girls seem to react more sensitively than boys to their parents' behavior when they complain of headache. Unfavorable parental reactions to their daughters' headaches may lead to the daughters reporting headaches more frequently, if they can thereby obtain certain privileges (e.g., staying home rather than going to school, a type of negative reinforcement) or more parental attention (positive reinforcement). These parental reactions should be precisely observed and analyzed so that they can be taken into account by the treating physician or psychologist.

A particular positive feature of the "KiJuKo" study is the longitudinal acquisition and evaluation of data. Currently available data from cross-sectional analyses show an association of headaches in children with headaches in their parents, as well as with other bodily symptoms in the children (23); influential factors of these types deserve to be further studied in longitudinal analyses. It should also be borne in mind that the present report concerns the findings of follow-up at 1 year. It may be assumed that some variables will manifest a significant effect only after longer latencies.

As mentioned at the beginning of this article, a causal relationship in the opposite direction would have been both conceivable and explicable. From a psychosomatic perspective, for example, it might be argued that unexpressed emotions in the family and the result-

ing chronic tension ought to lead to headaches in children, so that quarreling might have a cathartic effect and actually reduce the child's risk of developing headaches. Such possibilities will need to be considered in further, bidirectional analyses. When interpreting the results of the present study, one must bear in mind that the questionnaire response rates were not very satisfactory, which lessens the general applicability of the findings.

The present study did not distinguish among different types of headache (migraine, tension-type headache). Some authors have criticized the procedure in which responses to a questionnaire are used to draw conclusions about a diagnosis, and have insisted that interviews ought to be conducted (24). Furthermore, different types of headache frequently have overlapping symptoms and are, therefore, thought to share a common pathogenesis, so that the drawing of distinctions among types of headache might be questionable in any case (25). For these reasons, the present study focused on the frequency of headache. Other researchers argue for additional consideration of pain intensity or of the degree of impairment resulting from headache, matters which this article does not address.

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Conflict of interest statement

The authors declare that they have no conflict of interest as defined by the guidelines of the International Committee of Medical Journal Editors.

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TABLE 4

Results of binary logistic regressions

Bi- and univariate analyses				Comprehensive model		
Variables	Significance (p-value)	Odds ratio (OR)	95% confidence interval (CI)	Significance (p-value)	Odds ratio (OR)	95% confidence interval (CI)
Boys (n = 1434)						
Family						
Parental behavior relating to child's headache	0.365	1.11	0.89–1.39	–	–	–
Family environment	0.005	1.39	1.10–1.74	0.068	1.26	0.98–1.61
Frequency of quarreling	0.006	2.00	1.22–3.29	0.033	1.78	1.05–3.02
Leisure-time activities						
Physical exercise	0.130	1.38	0.97–2.09	0.341	1.23	0.80–1.88
Leisure	0.006	4.91	1.57–15.29	0.003	2.12	1.29–3.48
Good friends	0.311	1.32	0.77–2.27	–	–	–
TV/Video	0.194	0.61	0.29–1.29	0.213	0.62	0.29–1.32
PC/Game Boy	0.433	1.33	0.65–2.70	–	–	–
Girls (n = 541)						
Family						
Parental behavior relating to child's headache	0.049	1.23	1.00–1.52	0.039	1.25	1.01–1.55
Family environment	0.286*	1.11	0.91–1.36	–	–	–
Frequency of quarreling	0.461*	1.22	0.72–2.05	–	–	–
Leisure-time activities						
Physical exercise	0.789*	0.95	0.67–1.35	–	–	–
Leisure	0.987*	0.99	0.28–3.47	–	–	–
Good friends	0.019*	1.75	1.10–2.80	0.076	1.88	0.94–3.78
TV/Video	0.627*	1.15	0.66–2.00	–	–	–
PC/Game Boy	0.602*	1.54	0.31–7.74	–	–	–

Analysis of individual variables and adjusted multivariate model (method: inclusion), segregated by sex for the prediction of the occurrence of at least one headache per month after one year, controlled by age

*Age, as a control variable, has a significant effect (p<0.05). Odds ratio (OR): the multiplicative factor by which the probability that a child in the indicated group will have headaches after one year increases, in relation to the corresponding reference group (reference). Boldface type: significant findings

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ORIGINAL ARTICLE

Risk Factors for Headache in Children

Jennifer Gaßmann, Nuria Vath, Hester van Gessel, Birgit Kröner-Herwig

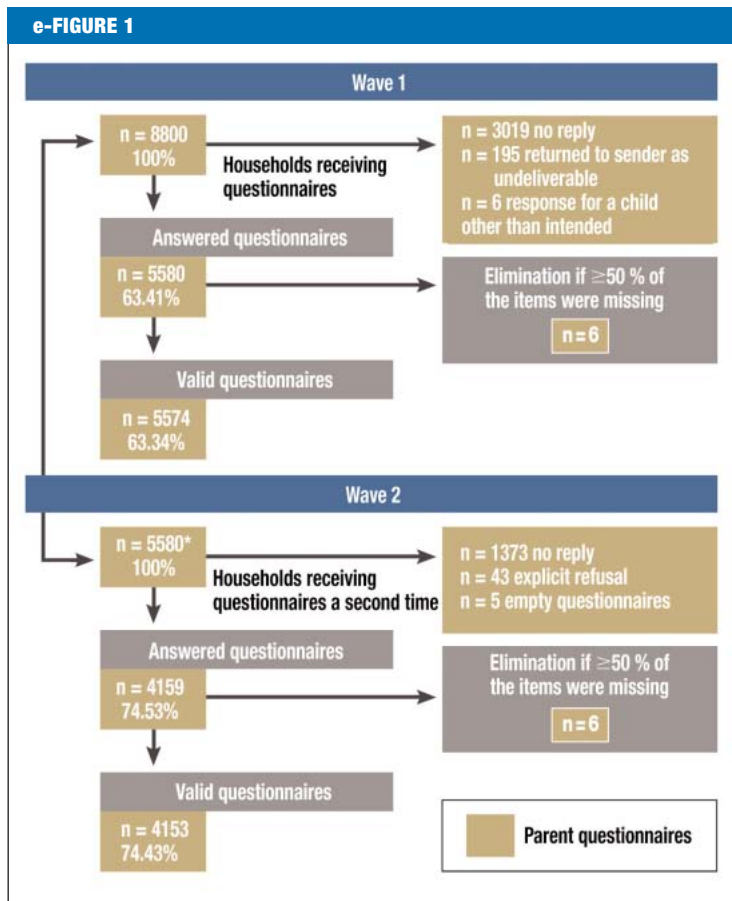
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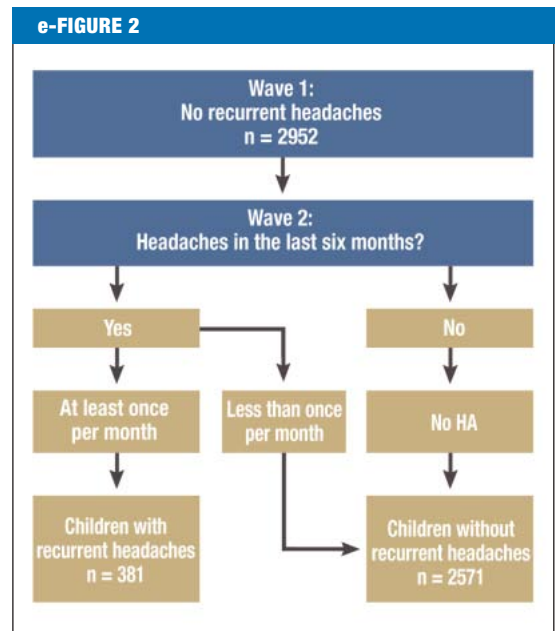
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Flowchart—Description of the sample (returned questionnaires and non-responders)

* Persons who had completed the questionnaires in wave 1 received further questionnaires in the subsequent waves. The case numbers vary because some participants explicitly refused to continue their participation. Other reasons for non-response included that the child in question was out of the country, or acutely ill, and therefore temporarily unable to complete the questionnaire; these children participated once again in later waves. The final number of evaluable cases depended on the responses to individual questions and may, therefore, be significantly lower (modified from e11).



Study design—Group formation by classification of children with and without recurrent headaches, depending on information given by parents concerning their children's frequency of headaches; HA, headache