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Potentially Traumatic Interpersonal Events, Psychological Distress and Recurrent Headaches in Adolescents

A population based study

The HUNT Study

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ARTICLE SUMMARY

Article Focus

- The present study was designed to acquire knowledge of associations between exposure to potentially traumatic interpersonal events and clinically validated measures of the range of recurrent headache disorders experienced in a population-based cohort of adolescents, meeting the criteria of the International Classification of Headache Disorder (ICHD-II).
- Possible mediation through psychological distress was tested specifically.

Key Messages

- Our study suggests a strong, consistent and cumulative relationship between exposure to increasing number of types of interpersonal trauma and recurrent headache, regardless of subtype or frequency of complaints, classified according to the ICHD-II criteria.
- This study indicates that traumatized adolescents experience higher levels of psychological distress than their non-victimized peers, which in turn seem to enhance their susceptibility to chronification of all common recurrent headache disorders. Thus psychological distress may play an important mediating role on the pathway linking victimization to recurrent headache complaints.
- Although prospective studies are needed the observed dependency between interpersonal trauma exposure and highly prevalent psychological and somatic conditions in adolescence challenges the traditional dichotomization of health services.

Strengths and Limitations

- The strengths of this study were the large sample size, the overall high participation rate, the use of a validated headache interview based upon the ICHD (II) criteria, and the opportunity to assess the impact of several types of victimization and confounding factors, within a population-based cohort of adolescents.
- The retrospective, cross-sectional study-design does not allow for causal inference, and findings should thus be interpreted within the given constraints of the study.

ABSTRACT

Context Recurrent headache, cooccurs commonly with psychological distress. Traumatic events could represent important precursors of posttraumatic distress and headache.

Objective To assess the hypothesized association between exposure to potentially traumatic interpersonal events (PTIEs) and recurrent headache across the spectrum of headache complaints experienced by adolescents and examine the potential role of psychological distress as a mediator of this relationship.

Design The Young-HUNT 3 study, 2006–2008, is a population-based, cross-sectional, cohort study of Norwegian youth that includes self-report data on traumatic exposure, psychological distress, and a validated interview on headache.

Setting and Participants A cohort of 10 464 adolescents aged 12–20 years from the Nord-Trøndelag county were invited to participate.

Main Outcome Measures Data from the headache interview served as outcome. Recurrent headache was defined as headache recurring at least monthly during the past year and was further subclassified into monthly, weekly, and daily complaints. Subtypes were classified as tension-type, migraine, migraine with tension-type headache and/or 'other' headache, in accordance with the International Classification of Headache Disorders.

Results The response rate was 73% (7 620). Multiple logistic regression analysis, adjusted for sociodemographics, showed a steady trend of increasing odds for recurrent headache with increasing exposure to PTIEs. The same pattern was reproduced for all frequencies and subtypes of complaints. The direct association between exposure to PTIEs and all recurrent headache disorders decreased after the hypothesized mediator, psychological distress, was

entered into the regression equation. Bootstrap confidence intervals for the magnitude of the attenuation in odds ratio indicated a significant decrease, suggesting mediation by psychological distress.

Conclusions The empirical evidence of a strong, cumulative relationship between victimization and recurrent headache, possibly mediated by posttraumatic psychological distress, indicates a need for integration of somatic and psychological health care of adolescents in prevention, assessment, and treatment of headache. Prospective studies are needed.

Recurrent headache is the most common pain condition during adolescence, and associated with limitations in everyday life, affecting school functioning and relationships with family and peers.[1 2] Prepubertal onset of headache and severe, frequent or persistent complaints, migraine, and co-occurring psychological distress are related to chronification and enduring disability,[3 4] with headache complaints and functional impairment often persisting into adulthood.[5] From early childhood to adolescence there is a marked increase in the prevalence of headache, which is accompanied by an emerging discrepancy between genders, with prevalence stabilizing in boys and increasing gradually throughout adolescence in girls.[6]

Primary tension-type and migraine headaches are by far the most frequent subtypes of recurrent headache in adolescence.[6] Secondary headache disorders are related to other conditions such as medication overuse,[7] infection or trauma, although these partly overlap with the preceding.[8] The etiological pathways leading to onset and chronification of headache disorders are largely unknown,[9] yet recognized as multifactorial, including heredity, age and sex, somatic, psychological and behavioural disorders,[10 11] head injuries,[12] unfavourable lifestyle (such as smoking, inactivity,[13] and inadequacy of sleep[1]), and lack of social and economic resources within families, in schools and societies.[14-16] Despite distinguishing features related to migraine headaches, the primary headaches may in part share pathophysiological mechanisms related to the chronification of disorders,[9 17] reflected in an observed continuum of clinical severity ranging from tension-type complaints, through migraine,[18] to combined migraine with tension-type headache.[19]

Recently researchers have explored the potential role of negative life events on the development of psychosomatic outcomes including headache in adolescence. Positive associations have been found between a range of childhood adversities and headache, including economic hardship,[16] parental separation,[20] poor family environment or neglect,[21] and potentially traumatic events such as disaster,[22] exposure to abuse [23 24], and bullying.[25] A recent population-based study of adolescents has suggested a dose-response relationship between frequency of childhood physical abuse and severe headaches including migraine,[23] supported by findings from a large convenience sample study of adults,[26] and a multicenter study of adult migraineurs, alike.[27] Despite these suggestive findings the evidence for an association between exposure to childhood trauma and recurrent headache is currently debated.[28]

The association between adverse experiences and mood and anxiety disorders in adolescents on the other hand is thoroughly documented.[29] Exposure to interpersonal traumatic events, especially early exposure to abuse, neglect or severe family adversity,[30] witnessing domestic violence,[31] exposure to bullying[32] or sexually-related victimization,[33] is recognized as particularly detrimental, and associated with prolonged trajectories and comorbidity.[25 34] A steady aggravation of psychological distress is further documented in relation to multiple victimization,[35] with findings from high-exposure populations suggesting that cumulative traumatic exposure will, regardless of psychological vulnerability, lead to psychological distress of clinical significance in anyone, although thresholds vary individually.[34 36] These main trends seem to be similar for both sexes.[37] Trauma exposure is generally evenly distributed in childhood, with discrepancies in trauma profiles gradually emerging throughout adolescence, as girls continously experience more sexually-related and close network traumas, whilst boys get gradually more exposed to all

other types of single traumatic events. Generally, trauma-associated psychological distress, is 2-3 times more often reported by adolescent girls in comparison to boys.[37]

Thus, epidemiological evidence of a gradual increase in risk of exposure to traumatic events throughout childhood and adolescence,[33] strongly associated with onset of psychological distress,[30] which again often co-occurs with emerging recurrent headache complaints,[4] imply possible shared causal pathways.[38] Simply put, when adolescents experience something traumatic they get distressed. Further, psychological distress may function as an internal stressor, increasing individual susceptibility to onset and chronification of headache complaints. Thus, mental distress may be an important mediator on the pathway linking trauma to recurrent headache complaints.

Although scientific interest in the associations between exposure to traumatic experiences and headache in adolescents has grown recently, we still lack substantiated insight into whether and eventually how exposure to traumatic events might relate to recurrent headache experienced in the general population.[28] Therefore, the present study was designed to acquire knowledge of associations between exposure to potentially traumatic interpersonal events and clinically validated measures of the range of recurrent headaches experienced in a population-based cohort of adolescents, meeting the International Classification of Headache Disorder criterias (ICHD-II). Possible mediation through psychological distress was tested specifically.

METHODS

From 2006 until 2008, 10464 adolescents were invited to participate in Young-HUNT 3 (http://www.ntnu.edu/hunt/inenglish), which is a population-based, cross-sectional cohort-study of Norwegian youth in Nord-Trøndelag county. The study, which comprises a general health questionnaire, a clinical assessment, and a headache interview, was approved by the Norwegian Regional Committee for Medical and Health Research Ethics. Inclusion was based upon written consent from participants aged 16 years and older and from parents for those under 16, in accordance with Norwegian law.

Participants

In 2006 there were 128 694 inhabitants in Nord-Trøndelag. Over 95% were ethnic Norwegians, the work force was generally well-educated and unemployment was less than 3%. All adolescents (10 464) in the county were invited to the study, 5614 were students in junior high, 4357 in senior high and 493 adolescents were not in school. Non-participation was mainly due to absence from school, or not wanting to participate. In total 8200 (78%) adolescents completed the general health questionnaire; more specifically 85% (4749) of the junior high students, 77% (3336) of the senior high students and 23% (115) of the adolescents not in school. Further, a total of 73% (7620) also completed the interview on headache.

During a school lesson, students completed a self-administered questionnaire containing over 100 health- and lifestyle-related questions, including items on potentially traumatic events, psychological distress, and posttraumatic stress reactions, in addition to background information on family structure and family economy [http://www.ntnu.edu/hunt/data/que].

A validated semi-structured clinical interview was conducted in association with a clinical examination within 1 month of completion of the questionnaire, to assess adolescents' recurring headache complaints according to type and frequency.[39]

Recurrent Headache

All adolescents were asked if they had experienced recurring headache not caused by a cold (infection) or illness within the past 12 months. 'Yes' responders were read two descriptive texts of prototypic complaints for tension-type headache and migraine, in accordance with the International Classification of Headache Disorders criteria, second edition (ICHD-II),[8] and were asked if they recognized either, both or neither descriptions as resembling their own complaints. Thus, the interview differentiated between three types of headache: tension-type and/or migraine (with or without visual aura) and/or 'other' type of headache. The frequency of recurrent headache was labeled as monthly (1–3 days/month), weekly (1–4 days/week), and daily (> 4 days/week). Adolescents reporting 'no recurrent headache' and 'complaints less than monthly' were defined as having 'no recurrent headache', whereas all other headache frequencies were referred to as 'recurrent headache'.[40]

Sociodemography

Information on sex was drawn from the Norwegian National Population Registry, whereas age was calculated by subtracting the date of birth from the date of completion of the questionnaire. The socio-demographic variable 'family structure' was computed from 12 self-reported items on cohabitants and was dichotomized into 'living with both parents' versus 'other' family structures, such as living with a single parent, stepparents, foster

parents, or without guardians.[20 33] The variable 'family economy', based upon a self-reported estimation of family affordance in comparison with most others, categorized as 'above average', 'average' and 'below average', represented the socioeconomic situation, as inequalities in family affluence has previously been shown to be strongly related to inequalities in adolescent health.[16]

Potentially Traumatic Interpersonal Events

A number of potentially traumatic events were screened, among which we identified 5 items as being potentially traumatic interpersonal events (PTIEs), or victimizations. The items were introduced using the following question: Have you ever experienced any of these events? Select one of the following response options: 'No', 'Yes, during the past year', or 'Yes, during lifetime'. The PTIE-related questions in our study were formulated as follows: i) Been subjected to violence (beaten or injured), ii) Seen others being subjected to violence, iii) Been subjected to unpleasant/disagreeable sexual acts by someone approximately your own age, iv) Been subjected to unpleasant/disagreeable sexual acts by an adult, and v) Been threatened or physically harassed by fellow students at school over a period of time. These items were dichotomized into 'No, not experienced' and 'Yes, during lifetime' (combining the two original 'yes' categories).

Psychological Distress

General psychological distress was measured by a five item, short-version instrument, named SCL-5, modified from the Hopkin's Symptom Checklist (HSCL), where every item was measured on a four-point Likert scale.[41] The derived items were introduced as follows: "Below is a list of some problems and complaints. Have you been bothered by any of this during the last 14 days? (Select one alternative: 1 = 'not bothered', 2 = 'a little bothered', 3 =

'quite bothered', and 4 = 'very bothered') 'Been constantly afraid or anxious', 'Felt tense, distressed or restless', 'Felt hopeless when you think about the future', 'Felt dejected or sad' and 'Worried too much about different things?'. A mean score ranging from 1 to 4 was computed. SCL-5 has previously been validated as a screening instrument for mental illness or psychological distress.[42]

Adolescents reporting one or more PTIEs were asked three yes/no questions on posttraumatic stress reactions, derived from the child version of the UCLA PTSD index for DSM-IV,[43] where two items measured current intrusion or reexperience, and one measured current avoidance.

STATISTICS

Descriptive data were presented according to frequency of recurrent headache complaints (Table 1). Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were obtained from logistic regression models that estimated the likelihood of experiencing recurrent headache according to each of the four categories of exposure to PTIEs within a complete case sample of 6787/10464 (65%) adolescents (regression Model 1, Tables 2, 3, 4 and 5). The number of events was summed for each respondent (sum of PTIEs; range, 0–5) and PTIE scores of 3, 4, or 5 were combined in one category (≥ 3). All models included age, sex, family structure, and family economy as covariates, based on a priori reasoning. The main analysis of general recurrent headache was stratified according to sex (Table 2).

Furthermore, we tested mediation by psychological distress. A significant attenuation of the effect-size estimate (OR) for the association between exposure to PTIEs and recurrent headache, when adding psychological distress to the multivariate logistic regression model (regression Model 2 in Tables 2, 3, 4 and 5), may imply a mediating role by psychological

distress.[44] We used bootstrap methods with 10 000 replicated samples to calculate bootstrap percentile 95% CIs for the difference in ORs between the two models (1 – (odds ratio from Model 2 (OR_2)/odds ratio from Model 1 (OR_1)). Confidence intervals not including 1 indicated a significant difference between odds ratios.[45]

Test of proportional odds assumptions across frequencies and subtypes of headache complaints was undertaken, but did not meet the requirement of proportionality in odds relations (supplementary tables A1 and A2 in appendix, online only). Supplementary analysis of group differences within frequencies and subtypes of recurrent headaches, in association to exposure to PTIEs and psychological distress, were assessed in separate logistic regression analyses (supplementary tables A3 and A4 in appendix, online only).

Last, we performed a subgroup, multiple regression analysis of the 1740/6787 (26%) adolescents who were exposed to any PTIEs, to explore whether specific posttraumatic stress reactions served as a potential additional mediator of the relationship between trauma and recurrent headache (Table 5).

Analyses were undertaken using SPSS version 20, in combination with the program R (The R Foundation for Statistical Computing, Vienna, Austria) package boot for bootstrap calculations.

RESULTS

The demographic data are displayed in Table 1.

Table 1. Sociodemographics, Exposure to PTIEs, Psychological Distress, and Headache Type, by Frequency of Headache Complaints (n=7620)*†.

Characteristics	No. of Individuals	No Recurrent Headache	Recurrent Headache			
			Monthly	Weekly	Daily	p value
Female						
Headache, No. (%)	3832	2707 (71)	653 (17)	385 (10)	87 (2)	
TTH		0 (0)	461 (71)	249 (65)	39 (45)	
Migraine, withouh TTH		0 (0)	137 (21)	78 (20)	19 (22)	
Migraine, with TTH		0 (0)	24 (4)	43 (11)	22 (25)	
Migraine, with visual aura	134	0 (0)	64 (10)	54 (14)	16 (18)	
Other headaches		0 (0)	31 (5)	15 (4)	7 (8)	<0.001‖
Age, mean (SD), y	3832	15.8 (1.7)	15.9 (1.7)	16.1 (1.8)	16.0 (1.7)	0.02¶
Family Structure, No. (%)	3798					
Living w/ both parents		1819 (68)	396 (61)	216 (57)	42 (48)	
Other		865 (32)	250 (39)	165 (43)	45 (52)	<0.001‖
Family Economy, No. (%)	3630					
Above average		413 (16)	77 (13)	57 (16)	8 (10)	
Average		1946 (76)	456 (75)	252 (69)	62 (73)	
Below average		215 (8)	74 (12)	55 (15)	15 (18)	<0.001‖
Sum of PTIE‡, No. (%)	3662					
0		2031 (78)	423 (68)	226 (61)	47 (56)	
1		382 (15)	119 (19)	69 (19)	22 (26)	
2		108 (4)	50 (8)	39 (11)	5 (6)	
≥3		68 (3)	28 (5)	35 (9)	10 (12)	<0.001‖
Psychological Distress§, mean (SD)	3740	1.6 (0.5)	1.8 (0.6)	2.0 (0.7)	2.0 (0.7)	<0.001¶
Male						

Headache, No. (%)	3788	3204 (85)	418 (11)	145 (4)	21 (1)	
TTH		0 (0)	324 (78)	98 (68)	13 (62)	
Migraine, without TTH		0 (0)	70 (17)	25 (17)	2 (10)	
Migraine, with TTH		0 (0)	9 (2)	12 (8)	4 (19)	
Migraine, with visual aura	72	0 (0)	47 (11)	23 (16)	2 (10)	
Other headaches		0 (0)	15 (4)	10 (7)	2 (9)	<0.001‖
Age, mean (SD), y	3788	15.8 (1.7)	15.7 (1.7)	15.7 (1.6)	15.8 (2.1)	0.60¶
Family Structure, No. (%)	3748					
Living w/ both parents		2206 (70)	273 (66)	85 (60)	12 (60)	
Other		968 (30)	139 (34)	57 (40)	8 (40)	0.05‖
Family Economy, No. (%)	3465					
Above average		614 (21)	82 (22)	26 (20)	0 (0)	
Average		2107 (72)	262 (69)	89 (67)	12 (63)	
Below average		211 (7)	38 (10)	17 (13)	7 (37)	<0.001‖
Sum of PTIEs‡ No. (%)	3527					
0		2023 (68)	244 (64)	70 (53)	9 (50)	
1		622 (21)	67 (17)	31 (24)	4 (22)	
2		255 (9)	49 (13)	18 (14)	3 (17)	
≥3		95 (3)	23 (6)	12 (9)	2 (11)	<0.001‖
Psychological Distress§, mean (SD)	3617	1.3 (0.4)	1.5 (0.5)	1.5 (0.6)	1.9 (0.7)	<0.001¶

Abbreviations: PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-type headache.

* Recurrent headache is defined as headache ≥ monthly.

† Because of rounding percentages may not total 100.

‡ Exposure to PTIEs is measured as the sum of 5 binary exposure-variables.

§ Range of possible score is 1 to 4.

‖ Pearson Chi square test.

¶ ANONVA, analysis of variance.

Generally, twice as many girls as boys reported recurrent headache and girls reported increasing complaints with increasing age. The prevalence rate of recurrent monthly headache was 22%, including 16% who reported tension-type headache (TTH), and 6% who reported migraines (4.5% reported only migraine and another 1.5% reported migraine with TTH). About two thirds of adolescents with only TTH or migraine reported monthly recurrence, whilst those with combined migraine and TTH headache mostly reported weekly or daily complaints. Despite sex differences in headache prevalence, the socio-demographic distribution of recurrent headache followed similar patterns for both sexes, linking living in 'other' family structures and having a family economy 'below average' with recurrent headaches.

In the present study 26% of girls and 33% of boys reported exposure to one or more types of potentially traumatic events, whilst 4% of both sexes reported 3 or more victimizations. Amongst adolescents reporting no recurrent headache complaints 73% reported no victimizations, whilst 18% reported exposure to one PTIE, and 9% reported exposure to two or more PTIEs. The reported level of exposure to PTIEs seemed to increase across frequencies of headache complaints for both sexes, with the highest victimization observed amongst adolescents with chronic daily headaches, of whom only 55% reported no exposure, 25% reported exposure to 1 PTIE and 20% reported exposure to two or more PTIEs. Mean score for psychological distress was 1.49 (±0.55) (SCL-5), and increasing distress was significantly associated with recurrent headache complaints, as assessed in univariate analysis.

A multiple logistic regression analysis adjusted for sociodemographic factors, revealed a steady trend of increasing odds for recurrent headache with increasing exposure to PTIEs (Table 2, Model 1).

Table 2. Recurrent Headache in Relation to Exposure to PTIEs, Sociodemography and Psychological Distress, by Sex*†‡.

		Recurrent Headache, (n=1514)					
		Female (n=1021)			Male (n=496)		
Variables	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2 /OR_1 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2 /OR_1 (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.46 (1.20-1.78)	1.25 (1.02-1.53)	0.86 (0.82-0.90)	1.04 (0.81-1.34)	0.93 (0.72-1.20)	0.89 (0.85-0.93)
2	496	2.28 (1.69-3.08)	1.73 (1.27-2.36)	0.76 (0.69-0.82)	1.71 (1.25-2.33)	1.41 (1.03-1.94)	0.83 (0.76-0.88)
≥3	252	2.61 (1.82-3.75)	1.69 (1.15-2.47)	0.65 (0.57-0.73)	2.29 (1.49-3.52)	1.57 (1.00-2.47)	0.69 (0.59-0.78)
Overall p-value		<0.001	<0.001		<0.001	0.029	
Age	6787	1.05 (1.00-1.09)	1.02 (0.98-1.07)		0.95 (0.89-1.00)	0.93 (0.87-0.98)	
Family Structure							
Living w/mother and father	4572	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
Other	2215	1.27 (1.09-1.49)	1.22 (1.04-1.43)		1.29 (1.05-1.58)	1.26 (1.03-1.55)	

Family Economy					
Above average	1214	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Average	4966	1.16 (0.94-1.44)	1.23 (0.99-1.53)	0.93 (0.73-1.18)	0.95 (0.75-1.21)
Below Average	607	1.61 (1.19-2.17)	1.41 (1.04-1.92)	1.36 (0.94-1.97)	1.10 (0.75-1.60)
Psychological Distress	6787		1.94 (1.70-2.22)		2.10 (1.72-2.58)

Abbreviations: CI, 95% Confidence Interval; OR_1, Odds Ratio for Regression Model 1; OR_2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are explained in footnotes to Table 1.

† Analyses were restricted to adolescents without missing values, (3494 females and 3293 males).

‡ All regression models are adjusted for age, family structure and family economy. Model 2 is additionally adjusted for psychological distress. Mediation by psychological distress is tested through analysis of ratio of odds ratio (Model 2/Model 1 = OR1 /OR2) with bootstrap 95% percentile confidence intervals presented, 10 000 replications.

The direct effect of exposure to PTIEs decreased after the hypothesized mediator, psychological distress, was entered into the regression equation (Table 2, Model 2). Bootstrap confidence intervals for the magnitude of this attenuation in OR when entering psychological distress in the regression equation $(1 – (OR_2 / OR_1)$ (Model2/1), indicated a significant reduction in ORs. Moreover, the magnitude of attenuation in OR increased with increasing exposure.

Similarly, when investigating the association between trauma exposure and headache by 'monthly', 'weekly', and 'daily' recurrence, respectively, a significant and cumulative association was found (Model 1, Table 3). Further, for all frequencies of recurrent headache as outcomes, we found a significant and cumulative attenuation in ORs when introducing psychological distress as a potential mediator in analyses (Model 2). The associations were significantly stronger between PTIEs and weekly or more frequent headache, as compared to monthly complaints, although differences in strength of associations leveled out when entering psychological distress, as the potential mediator, in the logistic regression analysis (supplementary table A3, online only).

Table 3. Recurrent Headache in Relation to Exposure to PTIEs, by Frequency of Recurrent Headache Complaints*†‡.

		Recurrent Headache, (n=1514)								
		Monthly Headache, (n=942)			Weekly Headache, (n=472)			Daily Headache, (n=100)		
Variables	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2 /OR_1 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2 /OR_1 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2 /OR_1 (CI)
Sum of PTIEs										
0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.17	1.05	0.90	1.40	1.18	0.85	2.03	1.58	0.78
		(0.97-1.41)	(0.87-1.27)	(0.87-0.93)	(1.08-1.81)	(0.91-1.53)	(0.80-0.89)	(1.23-3.36)	(0.95-2.64)	(0.70-0.86)
2	496	1.77	1.46	0.83	2.46	1.78	0.72	1.93	1.17	0.61
		(1.37-2.28)	(1.12-1.90)	(0.78-0.87)	(1.77-3.41)	(1.26-2.50)	(0.65-0.79)	(0.89-4.20)	(0.52-2.63)	(0.48-0.73)
≥3	252	1.74	1.30	0.74	3.80	2.18	0.57	4.53	2.03	0.45
		(1.22-2.48)	(0.90-1.87)	(0.67-0.81)	(2.61-5.54)	(1.45-3.27)	(0.49-0.66)	(2.26-9.07)	(0.95-4.34)	(0.32-0.60)
Overall p-value		<0.001	0.028		<0.001	<0.001		<0.001	0.164	

Sex§	6787	1.89	1.60	3.51	2.62	5.14	3.56	
		(1.64-2.19)	(1.38-1.87)	(2.82-4.37)	(2.09-3.30)	(3.06-8.64)	(2.09-6.07)	
Psychological Distress			1.71		2.24		2.78	
	6787		(1.50-1.95)		(1.90-2.63)		(2.03-3.80)	

Abbreviations: CI, 95% Confidence Interval; OR1, Odds Ratio for Regression Model 1; OR2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents without missing values, (n=6787).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress. Mediation by psychological distress is tested through analysis of ratio of odds ratio (Model2/Model1= OR2 /OR1) with bootstrap 95% percentile confidence intervals presented, 10 000 replications.

§ Male is reference category

The association between exposure to PTIEs and subtypes of recurrent headache followed a similar pattern. Tension-type headache, simple migraine, migraine with tension-type headache, and 'other' headaches were all significantly and cumulatively associated with exposure to PTIEs (Model 1, Table 4). Adding psychological distress as a mediator in regression Model 2 for all four subtypes of recurrent headache yielded

a significant reduction in OR ($1 - OR_2 / OR_1$) for all analyses. The association between traumatic events and recurrent headache was significantly stronger amongst those reporting any migraine in comparison to tension-type headache only (supplementary table A4, online only). This observed difference between groups was mainly driven by a stronger association between exposure to trauma and combined migraine with TTH, as opposed to TTH only. We found no significant differences in associations to victimization between the two groups of migraine only versus combined migraine and TTH headaches.

Table 4. Recurrent Headache in Relation to Exposure to PTIEs, by Type of Headache Complaints*†‡.

		Recurrent Headache, (n=1514)					
		TTH, only (n=1048)			Migraine, only (n=293)		
Variables	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.16 (0.97-1.39)	1.01 (0.84-1.22)	0.87 (0.84-0.90)	1.59 (1.17-2.17)	1.40 (1.02-1.92)	0.88 (0.83-0.92)
2	496	1.71 (1.34-2.20)	1.35 (1.04-1.75)	0.79 (0.74-0.84)	2.26 (1.48-3.44)	1.76 (1.14-2.72)	0.78 (0.69-0.86)
≥3	252	2.12 (1.54-2.92)	1.42 (1.02-1.99)	0.67 (0.60-0.74)	3.39 (2.10-5.48)	2.19 (1.31-3.66)	0.65 (0.54-0.76)
Overall p-value		<0.001	0.034		<0.001	0.003	
Sex§	6787	2.10 (1.83-2.42)	1.71 (1.47-1.97)		3.08 (2.36-4.02)	2.49 (1.88-3.28)	
Psychological distress	6787		1.95 (1.72-2.21)			1.83 (1.49-2.25)	

		Migraine w/ TTH, (n=104)			Other Headache, (n=69)		
Variables	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)
Sum of PTIEs							

0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.64	1.38	0.84	1.62	1.40	0.86
		(0.98-2.76)	(0.82-2.33)	(0.77-0.91)	(0.88-2.97)	(0.76-2.58)	(0.77-0.96)
2	496	3.72	2.46	0.66	3.26	2.45	0.75
		(2.04-6.76)	(1.32-4.60)	(0.54-0.79)	(1.60-6.63)	(1.17-5.11)	(0.59-0.92)
≥3	252	6.08	3.36	0.55	1.69	1.08	0.64
		(3.16-11.70)	(1.66-6.77)	(0.42-0.70)	(0.50-5.68)	(0.31-3.78)	(0.39-0.89)
Overall p-value		<0.001	0.002		0.011	0.113	
Sex§	6787	4.73	3.38		2.94	2.31	
		(2.91-7.68)	(2.05-5.57)		(1.73-5.00)	(1.33-4.01)	
Psychological distress			2.41			1.95	
	6787		(1.77-3.27)			(1.31-2.88)	

Abbreviations: CI, 95% Confidence Interval; OR_1, Odds Ratio for Regression Model 1; OR_2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-type Headache.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents without missing values, (n=6787).

‡ Model 1 is adjusted for sex, age, family structure and family economy. Model 2 is adjusted for psychological distress, sex, age, family structure and family economy. Mediation by psychological distress is evaluated through analysis of ratio of odds ratio (Model 2/Model 1 = OR1 /OR2) with bootstrap 95% percentile confidence intervals presented, 10 000 replications.

§ Male is reference category

Furthermore, in subgroup analysis, investigating the role of posttraumatic stress reactions as a potential additional mediator of the relationship between victimization and recurrent headache, posttraumatic stress independently and significantly attenuated ORs. Nonetheless, the additional contribution of posttraumatic stress, when we also accounted for general psychological distress, was insignificant (Table 5).

Table 5. Recurrent Headache in Relation to Exposure to PTIEs, adjusted for Psychological Distress and Posttraumatic Stress Reactions*†‡.

		Recurrent Headache, (n=487)						
Variables	**No.**	Model 1 OR_1 (CI)	Model 2a OR_2 (CI)	Model 2a /Model 1 OR_2/OR_1, (CI)	Model 2b OR_2 (CI)	Model 2b /Model 1 OR_2/OR_1, (CI)	Model 2**c** OR_2 (CI)	Model 2c /Model 1 OR_2/OR_1, (CI)
Sum of PTIEs								
1	1055	1 [Reference]	1 [Reference]		1 [Reference]		1 [Reference]	
2	459	1.59(1.23-2.05)	1.46(1.13-1.89)	0.92 (0.87-0.96)	1.52(1.18-1.97)	0.96 (0.92-0.99)	1.44(1.11-1.87)	0.91 (0.85-0.96)
≥3	226	2.15(1.57-2.94)	1.69(1.21-2.35)	0.79 (0.71-0.86)	1.91(1.39-2.64)	0.89 (0.82-0.96)	1.63(1.17-2.27)	0.76 (0.67-0.84)
Overall p-value		<0.001	0.001		<0.001		0.002	
Sex§	1740	3.01 (2.40-3.77)	2.44 (1.93-3.10)		2.60 (2.06-3.30)		2.29(1.80-2.92)	
Psychological distress			1.68(1.40-2.01)				1.57(1.30-1.91)	
Posttraumatic Stress Reactions								
0	792				1 [Reference]		1 [Reference]	
1	417				1.13(0.84-1.51)		1.08(0.81-1.45)	
2	298				1.64(1.20-2.24)		1.45(1.05-1.99)	

3	233	1.78(1.26-2.50)	1.36(0.95-1.96)
Overall p-value		0.001	0.100

Abbreviations: CI, 95% Confidence Interval; OR1, Odds Ratio for Regression Model 1; OR2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents exposed to ≥1 PTIE, without missing values for any of the included variables, n=1740 (946 males and 794 females).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2a is additionally adjusted for psychological distress, Model 2b for posttraumatic stress reactions and Model 2c for both psychological distress and posttraumatic stress reactions. Mediation by psychological distress and/or posttraumatic stress reactions is evaluated through analysis of ratios of odds ratios (Model 2a-c/Model 1) with bootstrap 95% percentile confidence intervals presented, 10 000 replications.

§ Male is reference category

DISCUSSION

To our knowledge this is the first population-based study to comprehensively assess associations between exposure to multiple victimization and recurrent headache, meeting the ICHD-II criteria. The main findings were firstly, documentation of a strong and consistent relationship between exposure to potentially traumatic interpersonal events (PTIEs) and recurrent headaches experienced by adolescents, regardless of frequency of complaints. Secondly, a similar, robust pattern was found across all major subtypes of complaints. Thirdly, a cumulative increase in strengths of associations was observed for all frequencies and main subtypes with increasing victimization, indicating a dose-response relationship. Last, the observed dependency between trauma exposure, general psychological distress and all recurrent headaches possibly reflect the role of psychological distress as a mediator on the pathway linking exposure to PTIEs and recurrent headache complaints. This mediating role of psychological distress on the relationship between trauma exposure and recurrent headache consistently amplified with sum of exposure to PTIEs for all frequencies and main subtypes of headache complaints. Posttraumatic stress reactions seemed to play a similar mediating role in subgroup analysis, although adjustment for general distress leveled out it's specific effect. This may indicate that general psychological distress, as measured within this study, to some degree encompassed posttraumatic stress reactions.[42]

The strengths of this study were the large sample size, the overall high participation rate, the use of a validated headache interview based upon the International Classification of Headache Disorder (II) criteria,[39] and the opportunity to assess the impact of several types of victimization and confounding factors, within a population based cohort of adolescents.

Although our findings indicate that exposure to trauma may be a causal factor in the chronification of headache disorders, our retrospective, cross-sectional study-design did not allow for causal inference, and findings should thus be interpreted within the given constraints of the study.

The lower participation and response rate among adolescents who were out of school, and among those in senior high school compared with junior high school, represent a possible selection bias. We also found that young adolescents, boys, and adolescents not living with both parents were less likely to respond to the items regarding victimization. These possible selection biases may have led to an underestimation of the associations.[46] A validated, comprehensive measure of trauma exposure would have strengthened the study, as would a validated measure of headache related functional impairment.[24]

Prevalence rates of recurrent headache, including frequencies and subtypes of complaints, were in large unchanged in comparison with national headache prevalence rates from 1995-1997,[47] and in the lower range of aggregated international estimates.[6] As previously documented prevalence rates were doubled in girls as compared to boys, rose steadily with age throughout adolescence in females, whilst flattening out in males,[6] and were higher in adolescents reporting psychological distress,[2 4 10 19] living without both parents,[20] or within family economies below average.[2 16] Although overall comparison of traumatization across measures and populations is difficult the observed prevalence rates and patterns of distribution of exposure in our study complied with that reported elsewhere, although in the lower range.[28 33] Regarding levels of psychological distress screening estimates were in correspondence with previous national and international findings.[42 48]

Our main finding of a strong, consistent and cumulative relationship between exposure to interpersonal trauma and recurrent headache in a general adolescent population, complies with recent but scarce evidence provided by cross-sectional population studies of adolescents, of which two studies used the ICHD-II criteria.[14 21 23 25] Further results are in coherence with one population-based,[49] two clinical,[27 50] and another two convenience-sample[26 51] retrospective, cross-sectional studies of adults, of which one used the ICHD-II criteria.[27] Apart from one adolescent study which examined girls only,[14] and the adult convenience sample study,[26] the sample-size in these studies were smaller in comparison to the present study. Generally the adolescent studies assessed exposure to one type of trauma exposure only, whilst the adult studies looked specifically at child abuse and family dysfunction.

In regard to the question of temporality of associations, a large cohort study using follow-up data over 12 years of adolescent and adult Canadians recently found childhood adversity and depression to be significant predictors of adult migraine.[38] Additionally, observational, prospective, convenience sample studies of adolescents exposed to bullying lend evidence to the more general relationship between victimization and psychosomatic complaints, although headache measurements in these studies were too imprecise to draw more specific conclusions of associations.[52-54] Taken together, scarce evidence suggests that victimization may be an important factor on the causal pathway leading to onset and chronification of headache disorder.

Amongst the observed relationships between trauma exposure and main subtypes of headache migraine was most strongly linked to victimization. This discrepancy between tension-type headache and migraine seemed to be explained largely by the stronger association between trauma exposure and combined migraine with tension-type complaints.

These findings may reflect a pattern where exposure to interpersonal trauma predispose for more severe headache complaints, and comorbidity in the form of multiple types of pains,[55] reflecting a similar pattern as that observed in the relationship between trauma exposure and psychopathology.[29] Such an interpretation complies with previous findings that both migraines in general, and combined migraines and tension-type headaches specifically, tend to be clinically more severe and disabling in comparison to other primary headache disorders.[18 19] On the other hand the observed discrepancies in strength of associations between PTIEs and subtypes of headaches may be an artefact of underlying chronification of complaints, as combined migraine and tension-type headache was more often experienced weekly or daily as opposed to migraine or TTH only which mostly recurred monthly.

In this study we found psychological distress to be one plausible mediator via which traumatic experiences may increase the risk of chronification of headache complaints in adolescents. This finding complies with current pathophysiological understanding, where violence as an environmental stressor, may acutely or over time overwhelm, exhaust and further dysregulate the stress response system.[56] Pathological effects, such as recurrent headache, though initially induced by external trauma, may largely be related to persistence of physiological distress functioning as an internal stressor that triggers cerebral sensitization and hypersensitivity through alterations of shared neuroendoimmunological pathways of emotion and pain, which in turn may lead to hyperalgesia and chronification of headache disorders.[3 9 17 57] Future interdisciplinary studies need to explore these suggested pathways to enable tailored interventions.

Sex differences in the strength of associations between PTIEs and recurrent headache may be related to the gender-biased qualitative differences of reported PTIEs, such as girls

being more prone to sexual abuse and exposure within their social networks.[37] Such exposure is associated with worse health outcomes, which are possibly related to the developmental stage at the time of abuse, proximity to the perpetrator, and the persistence and severity of the abuse.[31 58] Other possible mechanisms may be related to developmental biological differences, or sociocultural gender role expectations affecting reaction patterns,[59] predisposing girls to internalizing as opposed to externalizing behaviour, which in turn increase their susceptibility of experiencing persistent chronic pain.[60]

Conclusion and implications

Our main findings comply with essential features of current theoretical models of developmental psychopathology,[61] recurrent pain [60] and chronic pediatric headache [3 17] that underscore the need for a biopsychosocial approach to understand adverse health outcomes in childhood. Knowing that recurrent headaches are amongst the most common causes of disability in adults and adolescents alike,[1 18] substantiated empirical evidence of a strong, consistent and cumulative relationship between exposure to trauma, psychological distress and recurrent headache, regardless of subtype, demands for further investigation. [23] We are currently at a stage where we recognize that childhood trauma, abuse and adversities do little good for psychological and somatic health and development, and yet we lack valid, distinct and precise knowledge to guide public health interventions and clinical practice. Thus, primarily there is a need for more comprehensive, interdisciplinary research, preferably prospective, using valid measurements of risk factors and clinically applicable outcome-measures, aiming to identify underlying gene-environment interactions or biopsychosocial causal pathways as targets of tailored prevention and intervention. Secondly,

from a more general public health perspective, the observed dependency between trauma exposure and highly prevalent psychological and somatic conditions challenges the traditional dichotomization of health services, requiring establishment and maintenance of low-threshold, local health services directed toward adolescents that integrate psychological and somatic needs.[62-64]

CONTRIBUTORSHIP

Contributors: SØS carried out the data processing, analysed the data, drafted and revised the paper. She is the guarantor. GD and JAZ contributed to the intergration of the headache interview, measures of victimization and posttraumatic distress in the Young-HUNT3 Study. GD and ST wrote the original study protocol, applied for and received the grant for the study, and further participated in the epidemiological modelling, analysis and writing of the manuscript. TWL contributed to the statistical analysis. JAZ participated in the design of the study and helped to write the manuscript. All authors have read and approved the final version of the manuscript.

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COMPETING INTERESTS/DISCLOSURE

None declared. Synne Ø.Stensland, Grete Dyb, Siri Thoresen, Tore Wentzel-Larsen and John-Anker Zwart report no competing interests. All authors have completed the BMJ declaration of competing interests and the Unified Competing Interest form (available on request from the corresponding author) and declare that S. Stensland has support from The Norwegian Council for Mental Health, The Norwegian ExtraFoundation for Health and Rehabilitation for the submitted work; (2) none have relationships with companies that might have an interest in the submitted work in the previous 5 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) the authors have no non-financial interests that may be relevant to the submitted work.

ACCESS AND INTEGRITY OF ALL AUTHORS

All authors had full access to all of the data (including statistical reports and tables) in the study and can take full responsibility for the integrity of the data and the accuracy of the data analysis.

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ETHICS APPROVAL

Inclusion was based upon written consent from participants aged 16 years and older and from parents for those under 16, in accordance with Norwegian law. This study was approved by the Norwegian Regional Committee for Medical and Health Research Ethics.

DATA SHARING STATEMENT

Data are available from the HUNT study http://www.huntbiosciences.com/Cohorts/Diabetes/The-HUNT-Bio-And-Databank The general health questionnaire and headache interview used in the study are accessible from the HUNT bio-and databank (http://www.ntnu.edu/hunt/data/que). There is no additional data available.

THE ORIGINAL STUDY PROTOCOL

The original study protocol is accessible from the corresponding author, and may be translated from Norwegian to English on request .

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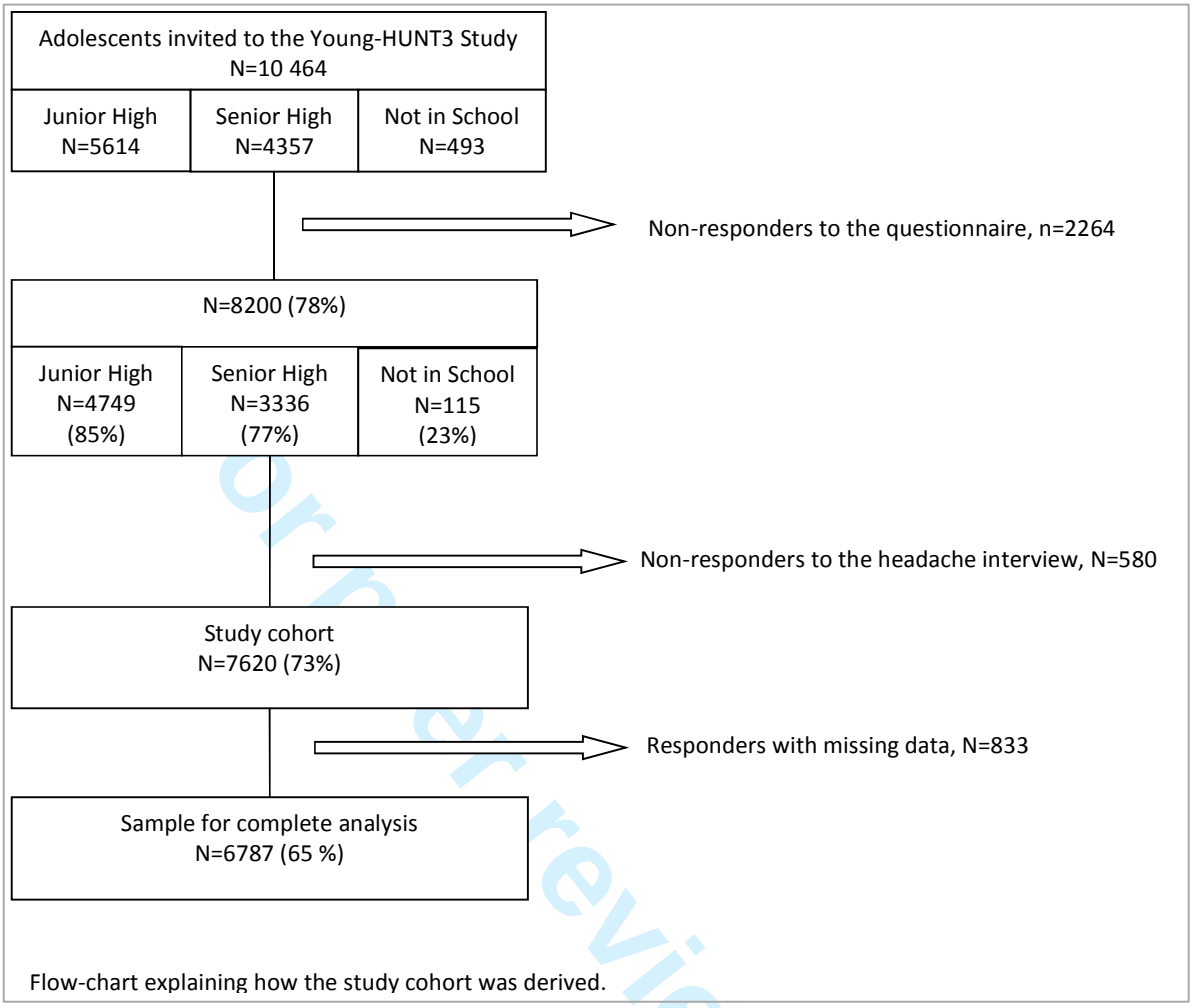

Flow-chart explaining how the study cohort was derived.

APPENDIX

PROPORTIONAL ODDS ASSUMPTIONS

Statistics

The proportional odds assumption between degree of victimization and differing levels of headache frequencies, was assessed through three independent logistic regression analysis (Appendix. Table A1).

Table A1. Test of proportional odds assumption across frequencies of headache complaints, n=6787.

		No headache v ≥monthly recurrent headache N=1514		≤ monthly headache v ≥weekly recurrent headache N=572		≤weekly headache v ≥daily recurrent headache N=100	
Variables	**No.**	Model 1 OR (CI)	Model 2 OR (CI)	Model 1 OR (CI)	Model 2 OR (CI)	Model 1 OR (CI)	Model 2 OR (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	1250	1.28 (1.09-1.49)	1.11 (0.95-1.30)	1.44 (1.14-1.80)	1.22 (0.96-1.53)	1.91 (1.17-3.12)	1.56 (0.95-2.57)
2	496	1.96 (1.59-2.43)	1.55 (1.25-1.94)	2.12 (1.57-2.86)	1.56 (1.14-2.13)	1.53 (0.71-3.29)	1.02 (0.46-2.24)
≥3	252	2.51 (1.91-3.31)	1.66 (1.24-2.22)	3.53 (2.53-4.93)	2.13 (1.49-3.05)	3.40 (1.73-6.69)	1.85 (0.90-3.80)
Overall p-value		<0.001	<0.001	<0.001	<0.001	0.002	0.176
Psychological Distress	*6787*		2.00 (1.79-2.23)		2.16 (1.87-2.49)		2.27 (1.68-3.07)

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio

[a] Study definitions and measures are defined in footnotes to Table 1.

[b] Analyses were restricted to adolescents without missing values, ($n_{monthly}$=942, n_{weekly}=472, n_{daily}=100).

[c] All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

On the basis of previous findings suggesting a clinical severity gradient across subtypes of primary headaches, ranging from tension-type headache, through migraine,(29) to combined migraine with TTH,(7) we also tested the proportional odds assumption of associations between exposure to PTIEs and headache, by subtype, in three subsequent logistic regression analysis (Appendix. Table A2).

Table A2. Assessment of proportional odds assumption across subtypes of *primary* headache complaints, n=6718.

		No recurrent headache v TTH or migraine with or without TTH		No/TTH v migraine only and migraine with TTH		No/TTH/migraine,only v migraine with TTH	
Variables	**No.**	Model 1 OR (CI)	Model 2 OR (CI)	Model 1 OR (CI)	Model 2 OR (CI)	Model 1 OR (CI)	Model 2 OR (CI)
Sum of PTIEs							
0	*4750*	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	*1234*	1.26 (1.08-1.48)	1.10 (0.94-1.29)	1.54 (1.18-2.01)	1.37 (1.04-1.79)	1.57 (0.94-2.62)	1.37 (0.82-2.30)
2	*485*	1.91 (1.54-2.37)	1.50 (1.20-1.88)	2.32 (1.64-3.27)	1.84 (1.29-2.63)	3.13 (1.74-5.63)	2.29 (1.25-4.22)
≥3	*249*	2.54 (1.92-3.35)	1.67 (1.24-2.23)	3.29 (2.23-4.85)	2.25 (1.49-3.40)	4.40 (2.32-8.34)	2.66 (1.34-5.30)
Overall p-value		<0.001	<0.001	<0.001	<0.001	<0.001	0.010
Psychological Distress	*6718*		1.99 (1.78-1.23)		1.74 (1.46-2.06)		1.98 (1.47-2.67)

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio

[a] Study definitions and measures are defined in footnotes to Table 1.

[b] Analyses were restricted to adolescents without missing values, and either no recurrent headache or primary headaches (69 cases with other headaches excluded (n_{TTH}=1048, $n_{migraine, only}$=293, $n_{migraine\ w/TTH}$=104)).

[c] All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

Results regarding proportional odds assumption

Logistic regression analysis assessing the proportional odds assumptions related to headache frequency and subtype of headache, respectively, did not meet the requirement of proportionality in odds relations. Test of parallel lines and ordinal logistic regression analysis were therefore not performed.

SUPPLEMENTARY TABLES.

Between groups comparison of risk of recurrent headache

Table A3. Assessment of Differences in Association Between Varying Frequencies of Recurrent Headache Complaints in Relation to Exposure to PTIEs and Psychological Distress*†‡.

		Recurrent headache, n=1514							
		Monthly vs. Weekly			Weekly vs. Daily			Monthly vs. Daily	
Variables	**No.**	Model 1 OR (CI)	Model 2 OR (CI)	**No.**	Model 1 OR (CI)	Model 2 OR (CI)	**No.**	Model 1 OR (CI)	Model 2 OR (CI)
Sum of PTIEs									
0	908	[Reference]	[Reference]	334	[Reference]	[Reference]	684	[Reference]	[Reference]
1	269	1.15 (0.86-1.54)	1.07 (0.80-1.44)	117	1.47 (0.86-2.52)	1.42 (0.83-2.45)	202	1.62 (0.97-2.72)	1.39 (0.82-2.35)
2	147	1.36	1.20	63	0.75	0.70	100	1.08	0.84

		(9.94-1.98)	(0.82-1.76)		(0.33-1.67)	(0.31-1.58)		(0.49-2.38)	(0.37-1.89)
≥3	90	2.20	1.79	58	1.30	1.11	56	2.61	1.84
		(1.40-3.46)	(1.12-2.86)		(0.62-2.72)	(0.51-2.43)		(1.24-5.48)	(0.85-3.98)
Overall p-value		0.005	0.100		0.346	0.390		0.041	0.264
Psychological	1414		1.45	572		1.24	1042		1.97
Distress			(1.19-1.76)			(0.88-1.74)			(1.40-2.78)
p-value			<0.001			0.221			<0.001

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio, PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents with recurrent headache without missing values, (n=1514 (nmonthly=942, nweekly=472, ndaily=100)).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

Table A4. Assessment of Differences in Association Between Varying Subtypes of Primary Recurrent Headache Complaints in Relation to Exposure to PTIEs and Psychological Distress*†‡.

		Recurrent Primary headache, n=1445									
		TTH vs. Migraine, only		Migraine, only vs. Migraine w/TTH		TTH vs. Migraine w/TTH		TTH vs. Any Migraine			
Variables	**No.**	Model 1 OR (CI)	Model 2 OR (CI)	**No.**	Model 1 OR (CI)	Model 2 OR (CI)	**No.**	Model 1 OR (CI)	Model 2 OR (CI)	**No.**	Model 1 OR (CI)	Model 2 OR (CI)
Sum of PTIEs												
0	872	[Reference]	[Reference]	22 9	[Reference]	[Reference]	747	[Reference]	[Reference]	92 4	[Reference]	[Reference]
1	256	1.32 (0.94-1.84)	1.31 (0.94-1.84)	84	1.08 (0.60-1.94)	1.04 (0.57-1.88)	216	1.47 (0.86-2.50)	1.36 (0.80-2.33)	27 8	1.34 (0.99-1.81)	1.31 (0.97-1.78)
2	128	1.35 (0.83-2.05)	1.30 (0.82-2.05)	46	1.68 (0.83-3.38)	1.50 (0.73-3.08)	114	2.17 (1.17-4.01)	1.92 (1.02-3.59)	14 4	1.49 1.01-2.20)	1.44 (0.97-2.14)

≥3	85	1.64	1.63	38	1.71	1.38	75	2.74	2.21	99	1.89	1.77
		(0.98-2.75)	(0.95-2.79)		(0.77-3.81)	(0.59-3.22)		(1.39-5.39)	(1.10-4.47)		(1.20-2.95)	(1.11-2.81)
Overall p-value		0.132	0.172		0.357	0.674		0.007	0.064		0.009	0.035
Psychologica	134		1.01	39		1.35	115		1.46			1.11
l Distress	1		(0.81-1.27)	7		(0.93-1.97)	2		(1.05-2.02)			(0.91-1.36)
p-value			0.991			0.115			0.023			0.313

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio, PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents with recurrent headache without missing values, (n=1514 (nTTH=1048, nmigraine, only=293, nmigraine w/TTH=104)).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

The STROBE checklist* for the manuscript: Potentially Traumatic Interpersonal Events, Psychological Distress and Recurrent Headaches in Adolescents A population based study The HUNT Study

The authors have aimed to adhere to the STROBE statements, in order to ensure transparency and the highest possible quality of data handling and presentation (1).

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	5-6
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	7-9
Objectives	3	State specific objectives, including any pre-specified hypotheses	9
Methods			11
Study design	4	Present key elements of study design early in the paper	10
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	10, 13-14 and supplemental flow-chart
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11-13
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	11-13
Bias	9	Describe any efforts to address potential sources of bias	10 (we were unable to to reach non-respondents, but have aimed for a transparent report of potential biases, including flowchart attached)

Study size	10	Explain how the study size was arrived at	10, 13-14 and supplemental flow-chart
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	13-14
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	13-14
		(*b*) Describe any methods used to examine subgroups and interactions	14
		(*c*) Explain how missing data were addressed	14
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	13-14
		(*e*) Describe any sensitivity analyses	Not done
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13-14
		(b) Give reasons for non-participation at each stage	10, 13-14
		(c) Consider use of a flow diagram	Attached
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	16-18
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	Not applicable
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	Not applicable
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	Not applicable
		Cross-sectional study—Report numbers of outcome events or summary measures	16-28
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	16-28
		(*b*) Report category boundaries when continuous variables were categorized	16-28
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	26-28
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplemental file
Discussion			
Key results	18	Summarise key results with reference to study objectives	29
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	29-30

Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	29-33
Generalisability	21	Discuss the generalisability (external validity) of the study results	29-33
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	36

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting.
The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/).
Information on the STROBE Initiative is available at www.strobe-statement.org .

1. von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007 Oct 335(7624):806-8.

Young HUNT

ADOLESCENT SECTION OF THE HEALTH STUDY IN NORD-TRØNDELAG, HUNT

It's your turn to participate in the Nord-Trøndelag Health Study (**HUNT**)!

We hope you have read the information brochure about YOUNG HUNT that you took home with you and have decided to participate!

Read the informed consent form that is inside the questionnaire and check that it is your name that is on it. Mark it as to whether you will participate or not, sign it and hand it in to the teacher.

Your name should NOT be on your questionnaire!

Put an X in the boxes ∀ that you think apply to you. Answer the best you can! If there are questions that you do not want to answer, skip them.

When you are finished, put the questionnaire in the envelope you have been given, seal it and give the envelope to the teacher. Do this even if you haven't finished the questionnaire.

All your answers will be treated in the strictest of confidence!

No one at school is allowed to see your answers.

If you wish to speak to someone about the study, speak to the Young HUNT nurse when she visits your school or ring HUNT Research Centre (see back of questionnaire).

Good Luck and Thank You!

2

Date of questionnaire completion ____/_____20____

1. For those who are in Junior High School: **What type of plans do you have regarding your studies in High School?**

High School academic studies ∀ High School vocational studies ∀ Don't know ∀

2. What type of plans do you have regarding continued studies? (Put one or more Xs)

* College or university for 4 years or more ..... ∀
* Other vocational training ..... ∀
* No plans ..... ∀
* College or university less than 4 years ..... ∀
* Don't know..... ∀

WHERE YOU LIVE

3. What type of housing do you live in? (Only one X)

* Single-family house ..... ∀
* Row house/2-4 family housing ..... ∀
* Flat in block/flat ..... ∀
* Farm w/ animal husbandry..... ∀
* Farm w/out animal husbandry ..... ∀
* Other housing ..... ∀

4. Who do you currently live with? (Put one or more Xs)

* Mother ..... ∀
* Father ..... ∀
* 1-2 siblings .... ∀
* 3 or more siblings..... ∀
* Foster parents ..... ∀
* Adoptive parents ..... ∀
* Grandparents/other..... ∀
* Spouse/partner..... ∀

* Mother's new husband or partner ∀ * Friends…….. ∀

* Father's new wife or partner…… ∀ * Alone/in a rented room…….. ∀

5. If your mother and father do not live together, who do you live with?

Mostly my mother ∀ Mostly my father ∀ Equal time at both parents ∀

6. Are there pets living in your home?

No …… ∀ Yes, other animals with fur ……. ∀

Yes, cat …… ∀ Yes, bird …… ∀

Yes, dog …….. ∀ Yes, other …… ∀

3

YOUR HEALTH

7. How is your health at the moment? (One X)

* Poor …….. ∀ *Good…….. ∀

* Not so good …….. ∀ * Very good…… ∀

8. Are you disabled in any of these ways? (Put an X for each line)

No A little Somewhat Severely

* Motor impairment (movement) ∀ ∀ ∀ ∀

* Vision impairment ∀ ∀ ∀ ∀

* Hearing impairment ∀ ∀ ∀ ∀

* Impairment due to physical illness ∀ ∀ ∀ ∀

* Impairment due to mental health problems ∀ ∀ ∀ ∀

9. Have you had any of these ailments in the past 12 months: (Put an X for each line)

Not at all A little Much

* Palpitation ∀ ∀ ∀

* Constipation ∀ ∀ ∀

* Diarrhoea ∀ ∀ ∀

* Alternating constipation and diarrhoea ∀ ∀ ∀

* Bloating ∀ ∀ ∀

* Nausea ∀ ∀ ∀

ALLERGIES

10. Do you have allergies? Yes ∀ No ∀ Don't know ∀

If Yes, **what do you think you are allergic to?** (One or more Xs)

* Grass/trees ∀ * Dogs ∀ * Food ∀

* House dust ∀ * Cats ∀ * Other ∀

* Horses ∀ * Don't know ∀

11. Has a doctor given you any allergy tests (blood tests, skin tests)**?**

Yes ∀ No ∀ Don't know ∀

If Yes, **what did you have an allergic reaction to?** (One or more Xs)

4

* Nothing ∀ * Dog ∀ * Food ∀

* Grass/trees ∀ * Cat ∀ * Other ∀

* House dust ∀ * Horse ∀ * Don't know ∀

RESPIRATORY TRACT

12. Have you ever had wheezing or whistling in the chest?

Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 15

13. Have you had wheezing or whistling in the chest in the past 12 months?

Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 15

14. How many attacks of wheezing have you had in the past 12 months?

None ∀ 1 to 3 ∀ 4 to 12 ∀ More than 12 ∀

****

15. Do you have or have you had asthma? Yes ∀ No ∀

If YES, **has a doctor said that you have/have had asthma?** Yes ∀ No ∀

16. In the past 12 months has your chest sounded wheezy during or after exercise?

Yes ∀ No ∀

17. In the last 12 months have you had a dry cough at night apart from a cough associated a cold or chest infection?

Yes ∀ No ∀

NASAL PROBLEMS

18. In the past 12 months, have you had a problem with sneezing or a runny or blocked nose when you did not have a cold or the flu?

Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 21

19. Has this nose problem been accompanied by itchy-watery eyes?

Yes ∀ No ∀

20. How much did this nose problem interfere with your daily activities? (One X)

Not at all ∀ A little ∀ A moderate amount ∀ A lot ∀

5

21. Have you ever had hay fever or nasal allergies? Yes ∀ No ∀

RASHES

22. Have you had an itchy rash during the last 12 months? Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 25

23. Have you had this itchy rash in the following places: the folds of your elbow (inside), back of your knees, on the front of your ankles, under your buttocks or around your neck, ears or eyes? Yes ∀ No ∀

24. How often on the average has this itchy rash kept you awake at night? (One X)

Not at all ∀ Less often than 1 night a week ∀ 1 night or more a week ∀

25. Have you ever had eczema? Yes ∀ No ∀

If Yes, has a doctor said that you have/ have had "atopic eczema"? Yes ∀ No ∀

ACNE

26. Have you had problems with acne? Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION **31**

27. Where was the acne? (Put one or more Xs)

Forehead…….. ∀ Cheeks…….. ∀ Shoulders…….. ∀ Other places…….. ∀

Nose…….. ∀ Chest…….. ∀ Back…….. ∀

28. How much has the acne bothered you? Very much ∀ Much ∀ A little ∀ Not at all ∀

Only one X

29. Have you used non-prescription creams, skin astringents or other similar products to get rid of the acne? (bought at the drug store or other shop, not prescribed by a doctor)

Yes ∀ No ∀

If Yes, has it helped? One X No ∀ Some ∀ Yes ∀

30. Have you been to a doctor because of acne? Yes ∀ No ∀

If Yes, did the doctor recommend any of the following treatments? (Put an X for each line)

- Topical treatment (ex: creams or liquid solutions) ……. Yes ∀ No ∀
- Antibiotic tablets (tetracycline) …….. Yes ∀ No ∀
- Roaccutan tablets …… Yes ∀ No ∀

If Yes, did this treatment help? (One X) No ∀ Some ∀ Yes ∀

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31. How often have you had any of the below listed pain during the last 3 months? (Without having injured yourself or having a known illness that is the reason for the pain)

Look at the figure and put an X for each line

IF YOU ANSWERED "NEVER OR SELDOM" FOR EVERYTHING, SKIP TO QUESTION 34

If you have had pain during the last 3 months,

32. Does anything on the below list apply to you? (Put an X for each line):

	Yes	No
* Pain makes it difficult to fall asleep……..	∀	∀
* Pain disturbs my sleep at night. ……..	∀	∀
* Pain makes it difficult to sit in class. ……	∀	∀
* Pain makes it difficult for me to walk more than one kilometre. …… ……..	∀	∀
* Because of pain I have problems in gym class. ……..	∀	∀

33. All things considered, has pain made it difficult to do daily activities? (Put an X for each line)

	No	Yes, sometimes	Yes, often
* At school ……	∀	∀	∀
* In leisure time ……	∀	∀	∀

If you answered Yes, **what type of pain makes daily activities difficult?** *(One or more Xs)*

Headache/migraine ∀ Stomach pain ∀ Muscular/skeletal pain ∀ Other pain ∀

Never or seldom
About once a month
About once a week
More than once a week
Almost every

day
A. Headache/migraine
B. Neck/ shoulder pain
C. Pain in the upper back
D. Pain in the lower back/buttocks
E. Pain in chest
F. Stomach pain
G. Pain in left arm
H. Pain in right arm
I. Pain in left leg
J. Pain in right leg
Other pain

PAIN

7

OTHER ILLNESSES

34. Has a doctor diagnosed you with: (Put an X for each line) Yes No

* Epilepsy ..... ∀ ∀
* Diabetes ..... ∀ ∀
* Migraine ..... ∀ ∀
* Juvenile arthritis ..... ∀ ∀
* Other illnesses that have lasted longer than 3 months ..... ∀ ∀

MEDICINE USE

35. How often in the last 3 months have you taken non-prescription medicine for any of the below listed complaints? (medicine not prescribed by a doctor, for example bought at a store or pharmacy) (Put an X for each line)

	Never or less	1 day a week	2 days a week	3 days a week	4 days a week or more
* Headache/migraine	∀	∀	∀	∀	∀
* Muscle/joint pain	∀	∀	∀	∀	∀
* Back pain	∀	∀	∀	∀	∀
* Stomach pain	∀	∀	∀	∀	∀
* Other	∀	∀	∀	∀	∀

36. Do you take any medicine that was prescribed for you by a doctor? Yes ∀ No ∀

37. Do you take/use any of these medicines or dietary supplements? (Put an X for each line)

	Never	Sometimes	Almost daily
* Iron tablets	∀	∀	∀
* Laxative tablets	∀	∀	∀
* Vitamins	∀	∀	∀
* Cod-liver oil	∀	∀	∀
* Homeopathic medicine, herbal medicine	∀	∀	∀
* Other	∀	∀	∀

TOBACCO

38. Does anyone you live with smoke at home? (One or more Xs)

* No, nobody ∀ * Yes, my mother ∀ * Yes, a sibling ∀

* Yes, my father ∀ * Yes, other people ∀

39. Have you tried smoking? (at least one cigarette) Yes ∀ No ∀

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IF YOU ANSWERED "NO", SKIP TO QUESTION 43

40. Do you smoke? (Put an X in the appropriate box and write in the number of cigarettes. A package of
loose tobacco equals approx. 50 cigarettes)

∀ Yes, I smoke about _____ cigarettes daily.

∀ Yes, I smoke occasionally, but not daily.

∀ No, not anymore, but previously I smoked occasionally.

∀ No, not anymore, but previously I smoked about _____cigarettes daily.

∀ No, I don't smoke.

IF YOU ANSWERED "NO, I DON'T SMOKE", SKIP TO QUESTION 44

41. If you smoke or have smoked daily:

* How old were you when you began smoking daily? _____ years old
* If you quit smoking daily, how old were you when you quit? _____ years old

42. If you smoke or have smoked occasionally:

* How old were you when you began smoking occasionally? _____ years old
* How many days have you smoked in the last month? _____ number of days

(Write 0 if you have not smoked in the past month)

* About how many cigarettes have you smoked in the last month? _____ number of cigarettes

(Write 0 if you have not smoked in the past month)

* If you quit smoking occasionally, how old were you when you quit? _____ years old

43. How many of your friends smoke? None ∀ A few ∀ Almost all ∀

(One X)

****

44. Do you use or have you used snuff, chewing tobacco or similar products? (One X)

No, never ∀ Yes, but have quit ∀ Yes, sometimes ∀ Yes, everyday ∀

IF YOU ANSWERED "NO, NEVER", SKIP TO QUESTION 50

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45. If you use or have used snuff/chewing tobacco:

* How old were you when you began using snuff/chewing tobacco? _____ years old
* If you stopped using snuff/chewing tobacco, how old were you when you stopped? _____years old
* How many boxes/bags of snuff/chewing tobacco do you use/have you used a week? _____ number of boxes/bags

(Write 0 if you use less than one box a month

46. If you smoke cigarettes and use snuff, which did you start first?

(One X)

∀ Snuff ∀ About the same time (within 3 months)

∀ Cigarettes ∀ Don't remember

47. Did you start using snuff to try to quit smoking or to smoke less?

(One X)

∀ No ∀ Yes, to quit smoking ∀ Yes, to smoke less

48. How many of your friends use snuff/chewing tobacco? (One X)

None ∀ A few ∀ Almost all ∀

****

49. Have you ever tried hash, marijuana or other drugs? (One X) Yes ∀ No ∀

If Yes, **How old were you the first time?** _____ years old

50. Do you have friends or acquaintances who use drugs? Yes ∀ No ∀

SPORTS AND EXERCISE

51. Not during the average school day: **How many days a week do you play sports or exercise to the point where you breathe heavily and/or sweat?** (*Only one X*)

* Everyday ∀ * Less often than once a week ∀
* 4-6 days a week ∀ * Less often than once a month ∀
* 2-3 days a week ∀ * Never ∀
* 1 day a week ∀

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52. Not during the average school day: **How many hours a week do you play sports or exercise to the point where you breathe heavily and/or sweat?** (*Only one X*)

None ∀ * About 2-3 hours ∀
About ½ hour ∀ * About 4-6 hours ∀
About 1-1½ hours ∀ * 7 or more hours ∀

53. Think about the past 7 days: How many hours did you spend sitting in an average day?
(This could be the time spent sitting at the computer, doing homework, at friends, reading and TV watching
(include times both sitting and laying down for the last two). Count the times at school and in your leisure
time.) _____Number of hours

54. Do you work out/train at a health club? Yes ∀ No ∀

55. How often have you done/participated in any of the following activities/sports the past 12 months? (Put an X for each line)

	Never	Less than 1 x a week	Once a week	Several x a week
* Endurance sports (ex: running, cross-country skiing, cycling, swimming)	∀	∀	∀	∀
* Team sports (ex: football, volleyball, handball, ice hockey, squash)	∀	∀	∀	∀
* Aesthetic sports (ex: dance, gymnastics, aerobics)	∀	∀	∀	∀
* Strength sports (ex: weightlifting, wrestling, bodybuilding)	∀	∀	∀	∀
* Martial arts/combat sports (ex: judo, karate, taekwondo, boxing)	∀	∀	∀	∀
* Technical sports (ex: riding, track sports, alpine skiing, ski jumping, snowboard, skate boarding)	∀	∀	∀	∀
* Adrenaline sports (ex: white water rafting, mountain climbing, paragliding)	∀	∀	∀	∀
* Jogging or racewalking/hiking	∀	∀	∀	∀
* Other	∀	∀	∀	∀

56. If you haven't been involved in any of these activities/sports in the past 12 months, but did so previously, how old were you when you stopped? ____ years old

57. Do you participate in sports competitions? (One X)

Yes ∀ No, but I used to compete ∀ No ∀

ALCOHOL

58. Have you ever tried drinking alcohol? (Meaning alcoholic beer, wine, hard liquor or moonshine)

Yes ∀ No ∀ Don't know ∀

If Yes, **do you sometimes drink alcohol now?** Yes ∀ No ∀
IF YOU ANSWERED NO, SKIP TO QUESTION 66
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59. How old were you when you began drinking (more than a sip)**?** _____ years old
60. Have you ever drunk so much alcohol that you felt intoxicated (drunk)?
(One X)
* No, never ……. ∀ * Yes, 4-10 times …….. ∀
* Yes, once …… ∀ * Yes, 11-25 times …….. …… ∀
* Yes, 2-3 times …… ∀ * Yes, more than 25 times ..... ∀
61. About how much beer, wine or hard liquor do you usually drink during two weeks?
Don't
count alcohol free beer. Write 0 if you do not drink alcohol.
Beer..... number of 1/2 bottles Hard liquor, liqueurs..... number of glasses (approx. 1/2 dl)
Wine..... number of glasses (approx. 1 dl) Moonshine ..... number of glasses (approx. 1/2 dl)
Alcopop …… number of bottles
62. How often do you currently drink alcohol? (One X)
* Every week or more often …… ∀
* Every other week …….. ∀
* More seldom than every other week, but more often than once a month …… ∀
* Once a month or more seldom than once a month ……..…….... ∀
* Never …….. ∀
63. On which days during the week do you most often drink alcohol? (One or more Xs)
I do not drink ∀ Fridays/Saturdays ∀ Other days of the week ∀
64. Have you ever seen either of your parents intoxicated? (One X)
* Never …….. ∀ * A few times during the year …… ∀
* A few times …… ∀ * A few times a month …… ∀
* A few times a week …… ∀
12
MEALS AND EATING HABITS
65. How often do you usually eat these meals? *(Put an X for each line)*
Every- 4-6 days 1-3 days Seldom
day a week a week or never
* Breakfast ∀ ∀ ∀ ∀
* Lunch ∀ ∀ ∀ ∀
* Dinner (warm) ∀ ∀ ∀ ∀
* Supper/evening snack ∀ ∀ ∀ ∀
66. Are you trying to lose weight? (*One X)*
No, I'm comfortable with my weight ∀ No, but I need to lose weight ∀ Yes ∀
67. What do you usually eat at school? (*One X)*
Packed lunch ∀ Buy food at the cafeteria ∀ Do not eat lunch at school ∀
68. Below are listed things that concern your eating habits. (Put an X for each line*)*
Never Seldom Often Always
* When I first begin eating, it is difficult to stop. ∀ ∀ ∀ ∀
* I vomit after I have eaten. ∀ ∀ ∀ ∀
* I spend too much time thinking about food. ∀ ∀ ∀ ∀

* I feel that food controls my life. ∀ ∀ ∀ ∀
* When I eat, I cut my food up in small pieces. ∀ ∀ ∀ ∀
* It takes me longer than others to finish a meal. ∀ ∀ ∀ ∀
* Other people think I'm too thin. ∀ ∀ ∀ ∀
* I feel that others pressure me to eat. ∀ ∀ ∀ ∀

69. How often do you usually drink the following? (Put an X for each line)

	Seldom/ never	1-6 glasses a week	1 glass a day	2-3 glasses a day	4 glass or more a day
* Cola/soda/still soft drinks w/ sugar……	∀	∀	∀	∀	∀
* Cola/soda/still soft drinks w/out sugar…	∀	∀	∀	∀	∀
* Whole milk/kefir/yoghurt……	∀	∀	∀	∀	∀
* Low fat milk or yoghurt/cultured milk…….	∀	∀	∀	∀	∀
* Skim milk (sour/sweet) ..……	∀	∀	∀	∀	∀
* Fruit juice ……	∀	∀	∀	∀	∀
* Water …… ……	∀	∀	∀	∀	∀

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70. How often do you usually eat the following foods? (Put an X for each line)

	Several times a day everyday	Once a day	Every week but not everyday	Less often than every week	Never
* Whole grain bread/crispbread ……	∀	∀	∀	∀	∀
* Oily fish (salmon, trout, mackerel)……	∀	∀	∀	∀	∀
* Fruit……..	∀	∀	∀	∀	∀
* Vegetables ……..	∀	∀	∀	∀	∀
* White cheese ……	∀	∀	∀	∀	∀
* Potato chips and such ……	∀	∀	∀	∀	∀
* Candy, chocolate, other sweets……..…..	∀	∀	∀	∀	∀

71. What type of fat do you usually use on bread? (One X)

Butter/hard margarine ∀ Soft/low fat margarine ∀ Liquid margarine/Oil ∀ Don't use any ∀

72. Do you consider yourself: (One X)

* Very fat …… ∀ * Thin…… ∀
* Chubby …… ∀ * Very thin…….. ∀
* About the same as others…… ∀

HOW THINGS ARE GOING FOR YOU

73. Thinking about your life at the moment, would you say that you by and large are satisfied with life, or are you mostly dissatisfied? (One X)

* Very satisfied …….. ∀ * Somewhat dissatisfied …… ∀
* Satisfied…….. …….. ∀ * Dissatisfied …….. ∀
* Somewhat satisfied …….. ∀ * Very dissatisfied …….. ∀
* Neither satisfied nor dissatisfied ∀

74. Do you feel, for the most part, strong and fit or tired and worn out? (One X)

* Very strong and fit …….. ∀ * Somewhat tired and worn out.. ∀

* Strong and fit …….. ∀ * Tired and worn out……. ∀

* Somewhat strong and fit …….. ∀ * Very tired and worn out …. ∀

* Somewhere in between …… ∀

75. Would you say you are usually cheerful or downhearted (sad)? (One X)

* Very downhearted (sad) …….. ∀ * Somewhat cheerful …….. ∀

* Downhearted (sad) …….. ∀ * Cheerful …….. ∀

* Somewhat downhearted (sad) ……. ∀ * Very cheerful …….. ∀

* Some of both ……... ∀

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76. Below is a list of some problems. Have you been bothered by any of these in the last 14 days? (Put an X for each line)

	Not bothered	A little bothered	Quite bothered	Very bothered
* Been constantly afraid and anxious ……	∀	∀	∀	∀
* Felt tense or uneasy ……	∀	∀	∀	∀
* Felt hopelessness when you think of the future ……..	∀	∀	∀	∀
* Felt dejected or sad ……	∀	∀	∀	∀
* Worried too much about various things ……	∀	∀	∀	∀

77. How do you see yourself? Put an X in a box for each sentence below indicating whether you agree or disagree in how it relates to you. (Put an X for each line)

	Strongly Agree	Agree	Disagree	Strongly disagree
* I take a positive attitude toward myself…….	∀	∀	∀	∀
* I certainly feel useless at times……..	∀	∀	∀	∀
* I feel I do not have much to be proud of……..	∀	∀	∀	∀
* I feel that I am a person of worth, at least on an equal plane with others…..……	∀	∀	∀	∀

78. How often do you experience the reactions that are described below?

(Put an X for each line)	Never	Seldom	Some-times	Often	Always
* I feel anxious and don't know what to do in an embarrassing situation ……	∀	∀	∀	∀	∀
* I feel anxious when I am with others and have to do something while they watch me do it *(ex: be in a play, play music, sports)* ……..	∀	∀	∀	∀	∀
* I feel anxious when I have to speak or read aloud in front of a group of people ……	∀	∀	∀	∀	∀
* Before I go someplace where I'm going to be with people (*ex: a party, school, football game*) I sweat, my heart beats fast and/or I get a headache or stomach ache ……	∀	∀	∀	∀	∀
* Before I go to a party or someplace with other people I think about what could go wrong *(ex: that I make mistakes, seem dumb and/or…what if they see how frightened I am!)* ……	∀	∀	∀	∀	∀

* I feel anxious and don't know what to do
when I'm in a new situation …… ∀ ∀ ∀ ∀ ∀

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79. How have you thought and felt about yourself and about your family in the past month?

(Put an X for each line)

	Totally agree	Agree	Average	Disagree	Totally disagree
* I easily make others feel comfortable around me ……..	∀	∀	∀	∀	∀
* In my family we share views of what is important in life....	∀	∀	∀	∀	∀
* I easily find new friends ……..……..	∀	∀	∀	∀	∀
* I feel comfortable with my family ……..	∀	∀	∀	∀	∀
* I am good at talking to new people ……..……	∀	∀	∀	∀	∀
* My family view the future as positive, even when very sad things happen……..	∀	∀	∀	∀	∀
* I always find something fun to talk about……..	∀	∀	∀	∀	∀
* In my family we support each other… ……	∀	∀	∀	∀	∀

81. Have you during the past month:

(Put an X for each line)	Almost every night	Often	Some-times	Never
* Had difficulty falling asleep in the evening	∀	∀	∀	∀
* Woke too early and couldn't fall asleep again	∀	∀	∀	∀

82. Have any of the following things happened to you? *(Put an X for each line)*

	No	Yes, last year	Yes, in my life
* That someone in your family has been seriously ill……..	∀	∀	∀
* Death of a loved one…….. ……..	∀	∀	∀
* A catastrophe (fire, avalanche, tidal wave, hurricane, etc.)……	∀	∀	∀
* A serious accident (ex: a very serious car accident) ……	∀	∀	∀
* Been violently hurt (beaten or injured) ……	∀	∀	∀
* Seen others violently hurt ……	∀	∀	∀
* Been put in sexually uncomfortable/abusive situations by someone about your age ……	∀	∀	∀
* Been put in sexually uncomfortable/abusive situations by an adult……	∀	∀	∀
* Been threatened or physically harassed by other students at school for a long time……	∀	∀	∀
* Received painful or frightening treatment at the hospital while being treated for an illness or injury……	∀	∀	∀
* Experienced something else that was very frightening, dangerous or violent……	∀	∀	∀

IF YOU ANSWERED NO TO ALL THE ABOVE, SKIP TO QUESTION 86

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If you have experienced any of the above in question 82:

83. Do you still think very much about what happened? Yes ∀ No ∀

If Yes, **do you have frightening thoughts, see images or hear sounds from the actual**

experience even when you don't want to? Yes ∀ No ∀

84. When something reminds you about what happened do you become distant, afraid or sad?

Yes ∀ No ∀

85. Do you try to avoid talking about it, thinking about it or feel any feelings about what happened?

Yes ∀ No ∀

86. If it was an injury or accident, do you have physical (bodily) late complications/problems from this? Yes ∀ No ∀

LEISURE TIME

87. How many teams or clubs are you part of? (for example: sports team, boy/girl scouts, band, etc.)

None ∀ One ∀ Two or more ∀

88. How often have you done any of these activities in the past week?

(Put an X for each line)

	None	Once	2-3 times	4 times or more
* Visited someone you know	∀	∀	∀	∀
* Was visited at home	∀	∀	∀	∀
* Read a book, magazine, comic book	∀	∀	∀	∀
* Listened to music	∀	∀	∀	∀
* Played an instrument	∀	∀	∀	∀
* Was out with friends for more than two hours in a row	∀	∀	∀	∀
* Was at a meeting or training with a club/team	∀	∀	∀	∀
* Did a hobby	∀	∀	∀	∀
* Did homework for more than one hour	∀	∀	∀	∀
* Watched TV/DVD	∀	∀	∀	∀
* Played a computer/TV game	∀	∀	∀	∀
* Played, chatted or surfed the internet	∀	∀	∀	∀
* Was at the library	∀	∀	∀	∀
* Went to the movies	∀	∀	∀	∀
* Was at a cafe or a meeting place for people your age	∀	∀	∀	∀
* Was in a play, theatre	∀	∀	∀	∀
* Did photography/film	∀	∀	∀	∀
* Went to a concert	∀	∀	∀	∀
* Went to watch a sport event, game	∀	∀	∀	∀
* Sang in a chore	∀	∀	∀	∀

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89. **If you normally do some of the below listed activities, how long do you usually do so each time?** (Put an X for each line)

Less ½ -1 More than

than ½ hour hour 1 hour

* Watch TV/DVD …….. ∀ ∀ ∀

* Play computer/TV games…….. ∀ ∀ ∀

* Play, chat or surf the internet ……..…… ∀ ∀ ∀

* Listen to music……..…. ∀ ∀ ∀

90. Do you have a mobile phone? Yes ∀ No ∀

If Yes:

* How long do you usually talk on your mobile phone a day? _____Number of minutes
* How many text/picture messages do you usually get a day? _____ Number of messages
* How many text/picture messages do you send a day? _____Number of messages

FAMILY AND FRIENDS

91. About how many close friends do you have? (Include those you can speak confidentially with and who help you when you need help. Do not include people you live with, but other relatives should be included.) (One X)

None ∀ One ∀ Two or more ∀

92. Do you have a steady boyfriend/girlfriend? Yes ∀ No, not now, but before ∀ No ∀

93. Are your parents separated or divorced, or have they lived separately for more than one year? *(X the appropriate box and write in your age where necessary)*

∀ No

∀ Yes, they lived separately or were separated when I was _____ years old, but they later moved back together again.

∀ Yes, they were divorced or separated when I was ____ years old.

94. How well off do you think your family is compared to most others? (One X)

About the same as most others ∀ Better financial situation ∀ Worse financial situation ∀

95. Has there been or is there much arguing in your family? (One X)

No ∀ Yes, the past 12 months ∀ Yes, previously ∀

96. How good is the relationship you have with your immediate family? (Put an X for each line of the family members you have. If you have more than one sibling, think about the sibling you have the best relationship to.)

	Very good	Good	Not so good	Bad *
Mother ……	∀	∀	∀	∀
* Father ……	∀	∀	∀	∀
* Sibling ……	∀	∀	∀	∀
* Stepmother or stepfather……	∀	∀	∀	∀

97. Do you often feel lonely? (One X)

* Very often …… ∀ * Seldom …….. ∀

* Often …….. ∀ * Very seldom or never…….. ∀

* Sometimes …… ∀

SCHOOL

98. Do any of the following things happen to you at school, or have any of them happened?

(Put an X for each line)

	Never	Some-times	Often	Very often
* Have difficulties concentrating during class	∀	∀	∀	∀
* Think that gym or art is fun	∀	∀	∀	∀
* Think other classes are fun	∀	∀	∀	∀
* Argue with the teacher	∀	∀	∀	∀
* Look forward to going to school	∀	∀	∀	∀
* Skip school	∀	∀	∀	∀
* Understand what is being taught	∀	∀	∀	∀
* Have fun during recess/break time	∀	∀	∀	∀
* Are satisfied with your test results	∀	∀	∀	∀
* Have fistfights	∀	∀	∀	∀
* Are reprimanded by the teacher	∀	∀	∀	∀
* Cannot manage to be calm/sit still during class	∀	∀	∀	∀
* Become bored or dissatisfied	∀	∀	∀	∀
* Receive help for reading or writing problems	∀	∀	∀	∀
* Are called a negative name by students for a long time	∀	∀	∀	∀
*Are snubbed/excluded by the students for a long time	∀	∀	∀	∀

HEALTH SERVICES

99. During the last 12 months have you been to: (Put an X for each line)

	Yes	No
* General practitioner (family doctor, doctor outside the hospital).....	∀	∀
* Doctor at the hospital ……	∀	∀
* Child health care clinic run by nurses……..	∀	∀
* School health services ……	∀	∀
* Psychologist ……	∀	∀
* Physiotherapist ……	∀	∀
* Chiropractor ……	∀	∀
* Other practitioner (naturopath, reflexologist, laying on of hands, healer, psychic, etc.).....	∀	∀

100. Have you been admitted to the hospital during the past 12 months?

Yes ∀ No ∀

101. How often have you been absent from school due to illness during the last 12 months?

Less than 1 week ∀ 1-2 weeks ∀ More than 2 weeks ∀

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PHYSICAL DEVELOPMENT

Below are some questions about physical changes that occur through adolescence.

102. During the teenage years there are periods where one grows quickly (growing spurt). Have you noticed that your body has grown quickly (become taller)? (One X)

* No, I have not begun to grow …… ∀

* Yes, I have barely begun a growing spurt …… ∀

* Yes, I've clearly begun a growing spurt …… ∀

* Yes, it seems that I'm finished with growing spurts …… ∀

103. Concerning hair on your body (under your arms and your crotch/groin)? Would you say
that the hair on your body has: (One X)

* Not begun to grow yet …… ∀

* Barely begun to grow …… ∀

* Quite clearly begun to grow …… ∀

* It seems that my body hair has grown in …… ∀

104. When you look at yourself, do you think that you are physically maturing/have physically matured earlier or later than others your own age? (One X)

* Much earlier …… ∀ * A little bit later …… ∀

* Earlier ……. …… ∀ * Later …… ∀

* A little bit earlier…… ∀ * Much later …… ∀

* The same as others …… ∀

QUESTIONS FOR BOYS

105. Has your voice begun to change? (One X)

* No, hasn't begun yet …… ∀

* Yes, has just barely begun …… ∀

* Yes, has clearly begun …… ∀

* It seems my voice has finished changing …… ∀

106. Has facial hair begun to grow (moustache or beard)? (One X)

* No, hasn't begun yet …… ∀

* Yes, has just barely begun …… ∀

* Yes, has clearly begun …… ∀

* Yes, I have quite a lot of facial hair …… ∀

QUESTIONS FOR GIRLS

107. Have you begun to develop breasts? (One X)

* No, haven't begun yet …… ∀ * Yes, have quite clearly begun …… ∀

* Yes, have barely begun …… ∀ * It seems my breasts are fully developed …… ∀

108. Have you begun menstruating (gotten your period)? Yes ∀ No ∀

IF YOU ANSWERED "NO", GO TO PAGE 22

109. How old were you when you first began menstruating?

I was _____years old and _____months.

110. How many times have you menstruated in the last 12 months? _____ times

111. How long is it usually between your menstruation periods? (From the first day of a period to the
first day of the next period)

Less than 3 weeks ∀ 3-4 weeks ∀ More than 4 weeks ∀

112. Have you ever missed (not gotten) your period for several months after a regular period?
(without being pregnant)? (One X)

*Yes, 2-5 mos. …….. ∀ * Yes, more than 1 year …….. ∀

*Yes, 6-12 mos. …… ∀ * No, never ……..…….. ∀

113. Have you ever taken birth control pills or the mini-pill?

Yes, I take them now ∀ Yes, I took them before ∀ No ∀

If Yes:

How old were you when you first began taking birth control pills/mini-pills? _____ years old

How long in total have you taken birth control pills/mini-pills? _____ years old

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FOR STUDENTS IN HIGH SCHOOL

These questions are only to be answered by High School students.

114. During the last year, have you often felt that you pressured yourself or continuously pushed yourself?

Yes ∀ No ∀ Don't know ∀

115. Do you feel that you are constantly short of time, even in your everyday tasks?

* Always, or almost always …… ∀

* Sometimes …… ∀

* Never…… ∀

116. Have you ever had thoughts about taking your own life? Yes No

117. Have you ever used anabolic steroids or other performance enhancing drugs? Yes No

118. Have you ever had sexual intercourse? Yes ∀ No ∀

If Yes, **How old were you the first time? _____** years old

119. For GIRLS: Have you ever become pregnant when you did not want to be?

Yes ∀ No ∀

120. For BOYS: Have you ever gotten a girl pregnant without intending to?

Yes ∀ No ∀ Don't know ∀

For BOTH boys and girls:

If Yes,

How old were you when this happened? ____ years old

Was the result an abortion? Yes ∀ No ∀ Don't know ∀

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COMMENTS

If you have time, you could write here about what you think is important, but was not asked about in this questionnaire. What are your thoughts about being young these days? What do feel can be improved upon concerning health and wellbeing for youth of today?

Thank you for your contribution ☺

Sincerely,

Turid Lingaas Holmen, førsteamanuensis/barnelege

Ung-HUNT leder

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Telefon: 74075180__

HUNT 3
Declaration of Consent form + 2nd to last page of the brochure

Consent

Participation in HUNT 3 and other public health studies is voluntary. The information from the health study cannot be used for research without the consent of the participants. You will be asked to sign a declaration of consent when you participate. Information and samples that you give will be stored for an indefinite time period. In the future it may be used in studies that as of yet have not been planned provided the studies are in accordance with laws and regulations.
In the future, you will be informed about new research projects that use HUNT data. This information can be found at www.hunt.ntnu.no, and in addition, once a year written information will be sent out to the public. There will also be media coverage about some of the research projects.
You can, at any time after the health study, withdraw your consent and ask that the data about you is deleted or that your blood and urine samples be destroyed. If you wish to withdraw your consent, contact HUNT Research Centre, Neptunveien 1, 7650 Verdal, Telephone 74 07 51 80, Fax 74 07 51 81 or their e-mail: hunt@medisin.ntnu.no. We will respect your wishes to not use your information in specific research projects if you request this.

New Consent

If in the future we need your information for new types of research questions not described in this brochure, it may be necessary to ask for a new declaration of consent. If this is the case, we will send you a letter. You may also be asked for a new consent in the eventuality of a collaboration with a private company in genetic research. The research of this type of collaboration must also adhere to public laws and regulations. Under no circumstances will blood or other biological material be sold.

Personal Information Protection and Security

All information that you give to HUNT 3 will be handled with respect to personal information protection and your private life and in accordance with the laws and regulations. As soon as information, blood samples and/or urine samples are collected, they are stored without being labelled using the identity of the donor. Researchers who later use the information do not have access to names, birthdates or personal identification numbers. All employees associated with the health study have an obligation of confidentiality.
The Data Inspectorate supervises to ensure that the laws and regulations concerning the storage and use of health care information are followed. HUNT 3 is licensed by the The Data Inspectorate.

Ethical Approval

All research projects must be approved by an ethical committee. The committee is an independent agency that evaluates the ethical aspect of research projects. HUNT 3 has been approved by The Regional Committee for Medical Research Ethics, Mid-Norway. All future research projects that use data from HUNT must gain approval from the committee.

HUNT Databank

HUNT databank contains information collected during HUNT 1, 2 and 3 by means of questionnaires, examinations and analyses of blood and urine samples. If you participated in HUNT 1 and 2, your information will be compared to information in HUNT 3. Genetic material is stored at the HUNT biobank. The goal of the biobank is that in the future it will be possible to take out samples, perform various analyses and compare it to the results of other

data from the HUNT databank. In this way there will be continuously more data to be put into the databank.
When researchers receive data from the HUNT databank there are no names, birthdates or other identifiable characteristics with the data, so they do not know who gave the information.
Comparing Information from other Registers
For certain research projects it may be necessary to compare data from HUNT with other public records, for example The Norwegian Prescription Database, The Birth Register, The Cancer Register and The Cause of Death Register. HUNT data may also be compared to other registers/databases at Statistics Norway (SSB), for example concerning the environment, population, education, income, public contribution, employment and other situations that may have an effect on health.
In addition, it may also be relevant to obtain diagnosis information, for example hip fracture, heart attack, stroke or lung illnesses from primary health care, the hopitals in Nord-Trøndelag or St. Olavs hospital. Some projects may compare information of parents, children, siblings and grandparents if they have participated in HUNT.
All these comparisons require consent and/or approval from the applicable agencies, for example The Regional Committee for Medical Research Ethics, The Data Inspectorate, The Public Health Department or Social Security. All information will be handled with respect to personal information protection and your private life and in accordance with the laws and regulations. No researchers will know who gave the information.

Compensation
There is very little risk that participation will lead to injury. If this should occur, compensation can be applied for through The Norwegian System of Compensation to Patients (NPE). NPE facilitates compensation applications for patients who have been injured in the public health care service system.
Young HUNT
All adolescents in the age group 13 to 19 years old in Nord-Trøndelag are invited to participate in Young HUNT. The project will take place at their schools, with the filling out of the questionnaire and clinical examinations occurring during school hours. Adolescents and their parents will receive information about Young HUNT through the school.

Declaration of consent for use of health information in research
The Nord-Trøndelag Health Study 2006-2008 (HUNT3)
In the brochure I received I have read about the health study's content and intent, and I have been given the opportunity to ask questions.

I consent to participating in the study.

Place, date time

_____ _____
Name Date of Birth

January 4, 2013

Mrs. Synne Øien Stensland
Norwegian Centre for Violence and Traumatic Stress Studies Kirkeveien 166 (building 48) Oslo 0881 Norway

RE: Potentially Traumatic Interpersonal Events, Psychological Distress, and Recurrent Headaches in Adolescents

Dear Mrs. Stensland:

Thank you for allowing us to review your work. Unfortunately, we cannot accept your manuscript for publication in JAMA Pediatrics. We receive a large number of manuscripts each year and cannot accept them all. Our decision is based on comments of one outside reviewer as well as review of the manuscript by one or more of the editors, and discussions of the manuscript by the editorial staff. Our decision reflects not only methodological quality, but also our assessment of the contribution the manuscript makes to advances in pediatrics and the care of children.

Since acceptance or rejection reflects the priorities of the journal and the opinions of our reviewers and editors, lack of acceptance does not necessarily imply that the manuscript is unsuitable for publication elsewhere.

We are enclosing the reviewer comments that we hope will be useful to you.

Sincerely yours,

Alain Joffe, MD, MPH, FAAP
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As part of the continuing evolution of the JAMA Network, I am pleased to announce that the Archives of Pediatrics & Adolescent Medicine is now JAMA Pediatrics as of January 2013.

REVEIWER COMMENTS

(We received no comments from Reviewer #1.)

Reviewer #2 (Remarks to the Author):

Overall, this paper is well written and examines an interesting topic. I have some suggestions, that if addressed, would strengthen the manuscript.

However, I would add that any research on trauma that does not consider reactions to trauma as a key mediator is not useful at this stage in our knowledge about the consequence of traumatic exposure because most exposed individuals experience no lasting adverse consequences. Unless the investigators can also report on posttraumatic disorders such as PTSD and depression, this article does not make a significant contribution to the field.

Reviewer #2 (Remarks to the Author (Specific)):

Introduction:

It would be helpful if the authors provided a clearer motivation for their specific focus on interpersonal traumatic events, rather than trauma more broadly.

A brief explanation of the different types of headaches (e.g., migraine, tension-type, etc) would be beneficial for those who are unfamiliar with this literature.

Methods:

I am unfamiliar with the authors' measure of socioeconomic status. Have other studies used this measure (and if so, could you include a citation)? How should we interpret the adolescent's perceived relative SES compared to their peers? Was there a measure of parent education in the questionnaire?

How many traumatic events were included in the survey instrument that were not interpersonal traumatic events? Can the authors give the reader a few examples as to what these were?

What was the timeframe used to measure psychological distress? Because traumatic events are measured as "lifetime" events and the authors are testing mediation, how can the authors be sure that that the psychological distress occurred after the event? If there is an issue with temporal ordering with these measures, this should be addressed as a limitation.

It would be helpful if the authors provided a clearer description of the derivation of the analytic sample when moving from the sample size that responded to the headache questionnaire (N=7,620) to the sample size used in the regression analysis (N=6,787). In other words, could you describe how many observations were dropped due to missingness on each covariate.

Can the authors provide a stronger justification for the stratification of analyses in Table 1 and 2 by gender (especially because the results in these tables are quite dense)?

Do the authors have a citation for their method used to test mediation? (i.e., bootstrapping the difference in ORs between the models, and using a threshold of 0.10-0.20 as evidence of mediation)

Discussion:

I was very interested in the prevalence of recurrent headaches in this sample, and think it would be helpful for the authors to provide some comparison of these prevalence estimates to those of other

surveys and populations. Are these estimates low or high compared to other populations? I was surprised that they were so high given the author's description of the population of this county (relatively high levels of education and low unemployment).

Potentially Traumatic Interpersonal Events, Psychological Distress and Recurrent Headache in a Population-based Cohort of Adolescents
The HUNT Study

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Potentially Traumatic Interpersonal Events, Psychological Distress and Recurrent Headache in a Population-based Cohort of Adolescents

The HUNT Study

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Key words (MeSH): Adolescent, Crime, Bullying, Mental disorders, Headache disorders, (Public Health)

WORD COUNT AND TABLES

Text only: 3948 words

Abstract: 291 words

Tables: 4 (+ 2 additional for online publication only (A1 and A2))

Image: Flowchart attached as supplementary file

ARTICLE SUMMARY

Article Focus

- The main focus was to examine, in a population-based cohort of adolescents, the associations between exposure to potentially traumatic interpersonal events (PTIEs) and migraine and tension-type headaches, meeting the International Classification of Headache Disorders (ICHD-II) criteria.

Further, we aimed to assess the impact of psychological distress on the relationship between PTIEs and recurrent headache. **Key Messages**

- Our study suggests a strong and consistent relationship between exposure to potentially traumatic interpersonal events (PTIEs), and prevalence of ICHD-II defined migraine and tension-type headache, in a population-based cohort study of adolescents.
- Exposure to increasing numbers of types of PTIEs was consistently associated with higher prevalence of all assessed subtypes and frequencies of headache, indicating a dose-response relationship.

Adolescents exposed to PTIEs, reported higher levels of psychological distress than their non-victimized peers. Further, adjustment for experienced psychological distress consistently, and significantly, attenuated strength of associations between PTIEs and recurrent headache. **Strengths and Limitations**

- The strengths of this study were the large sample size, the overall high participation rate, the use of a validated headache interview, based upon the ICHD (II) criteria, and the opportunity to assess the impact of multiple potentially traumatic interpersonal events and confounding factors, within a population-based cohort of adolescents.

- The retrospective, cross-sectional study-design did not allow for causal inference, or differentiation between mediational and confounding effects. Findings should be interpreted within the given constraints of the study.

ABSTRACT

Context Recurrent headache co-occurs commonly with psychological distress, such as anxiety or depression. Potentially traumatic interpersonal events (PTIEs) could represent important precursors of both psychological distress and recurrent headache in adolescents.

Objective To assess the hypothesized association between exposure to PTIEs and recurrent migraine and tension-type headache in adolescents, and further examine the potential impact of psychological distress on this relationship.

Design The Young-HUNT 3 study, 2006–2008, is a population-based, cross-sectional, cohort study of Norwegian youth that includes self-report data on exposure to potentially traumatic events, psychological distress, and a validated interview on headache.

Setting and Participants A cohort of 10 464 adolescents aged 12–20 years from the Nord-Trøndelag county were invited to participate.

Main Outcome Measures Data from the headache interview served as outcome. Recurrent headache was defined as headache recurring at least monthly during the past year, and sub classified into monthly, weekly, and daily complaints. Subtypes were classified as tension-type headache (TTH), migraine, migraine with TTH and/or non-classifiable headache, in accordance with the International Classification of Headache Disorders, (ICHD-II).

Results The response rate was 73% (7 620). Multiple logistic regression analysis, adjusted for sociodemographics, showed consistently significant associations between exposure to PTIEs

and recurrent headache, regardless of frequency or subtype of headache. Increasing exposure to PTIEs was associated with higher prevalence of recurrent headache, indicating a dose response relationship.. The strength of associations between exposure to PTIEs and all recurrent headache disorders significantly attenuated when psychological distress was entered into the regression equation.

Conclusions The empirical evidence of a strong and cumulative relationship between exposure to PTIEs, psychological distress and recurrent headache indicates a need for integration of somatic and psychological healthcare-services for adolescents, in prevention, assessment, and treatment of recurrent headache. Prospective studies are needed.

Recurrent headache is the most common pain condition during adolescence, and associated with limitations in everyday life, affecting school functioning and relationships with family and peers.[1 2] Prepubertal onset of headache, high pain intensity, migraine, and co-occurring psychological distress is related to chronification and disability, in childhood and adolescence.[1 3 4] Further, headache-related disability at diagnosis seems to be predictive of headache-related functional impairment decades later.[5]

From early childhood to adolescence there is a marked increase in the prevalence of headache, which is accompanied by an emerging discrepancy between genders. Prevalence tend to stabilize in boys, and increase gradually throughout adolescence in girls.[6]

Primary tension-type and migraine headaches are by far the most frequent subtypes of recurrent headache in adolescence.[6] Secondary headache disorders are related to other conditions, such as medication overuse,[7] infection, or trauma, although these partly overlap with the preceding.[8] The etiological factors, and pathways leading to onset and chronification of headache disorders, are largely unknown,[9] yet recognized as multifactorial, including; heredity, age and sex, somatic, psychological and behavioural disorders,[10 11] head injuries,[12] unfavourable lifestyle (such as smoking, inactivity,[13] and inadequacy of sleep[1]), and lack of social and economic resources within families, in schools and societies.[14-16] Despite distinguishing features related to migraine headaches, the primary headaches may in part share pathophysiological mechanisms, related to the chronification of disorders,[9 17] reflected in an observed continuum of clinical severity, ranging from tension-type complaints, through migraine,[18] to combined migraine with tension-type headache.[19]

Recently researchers have explored the potential role of negative life events on the development of psychosomatic outcomes, including headache, in adolescence. Positive

associations have been found between a range of childhood adversities and headache, including; economic hardship,[16] parental separation,[20] poor family environment or neglect,[21] and potentially traumatic events such as disaster,[22] exposure to abuse [23 24], and bullying.[25] A recent population-based study of adolescents has suggested a dose-response relationship between frequency of childhood physical abuse and severe headaches, including migraine,[23] supported by findings from a large convenience sample study of adults,[26] and a multicentre study of adult migraineurs, alike.[27] Despite these suggestive findings the evidence for an association between exposure to childhood trauma and recurrent headache is currently debated.[28]

The association between adverse experiences and mood and anxiety disorders in adolescents, on the other hand, is thoroughly documented.[29] Exposure to severe family adversity, or potentially traumatic interpersonal events (PTIEs), especially early exposure to abuse or neglect[30] witnessing domestic violence,[31] exposure to bullying[32] or sexually-related victimization,[33] is recognized as particularly detrimental, and associated with prolonged trajectories and comorbidity.[25 34] A steady aggravation of psychological distress is further documented in relation to exposure to multiple types of PTIEs.[35] Findings from high-exposure populations suggest that exposure to PTIEs will, regardless of psychological vulnerability, lead to psychological distress of clinical significance in anyone, although thresholds vary individually.[34 36] These main trends seem to be similar for both sexes.[37]

During childhood PTIE-exposure is generally evenly distributed. , followed by emerging sex-related discrepancies in patterns of distribution of PTIEs during adolescence. Adolescent girls continuously experience more sexually-related and close-network PTIEs, whilst boys get

gradually more exposed to all other types of single events. Posttraumatic stress reactions are generally reported 2-3 times more often by adolescent girls, in comparison to boys.[37]

Current epidemiological evidence of a gradual increase in risk of exposure to PTIEs throughout childhood and adolescence,[33] strongly associated with onset of psychological distress,[30] which again often co-occur with emerging recurrent headache complaints,[4] imply possible shared causal pathways.[38] We therefore need to study associations between the exposure to PTIEs, psychological distress and recurrent headache in adolescents.[28] The present study was designed to acquire knowledge of associations between exposure to PTIEs and ICHD-II defined migraine and tension-type headache, in a population-based cohort of adolescents. The impact of psychological distress upon the relationship between exposure to PTIEs and recurrent headache was tested specifically.

METHODS

The Young-HUNT 3 Study, (http://www.ntnu.edu/hunt/inenglish), is a population-based, cross-sectional cohort-study of Norwegian youth in Nord-Trøndelag county, conducted between 2006 and 2008, in which 10464 adolescents were invited to participate.[39] The study, which comprises a general health questionnaire, a clinical assessment, and a headache interview, was approved by the Norwegian Regional Committee for Medical and Health Research Ethics. Inclusion was based upon written consent from participants aged 16 years and older and from parents for those under 16, in accordance with Norwegian law.

Participants

In 2006 there were 128 694 inhabitants in Nord-Trøndelag. Over 95% were ethnic Norwegians, the work force was generally well-educated and unemployment was less than 3%. All adolescents in the county, within an age-range qualifying for attendance in junior or senior high-school, were invited to the study. Of the 10 464 invited adolescents, 5614 were students in junior high, 4357 in senior high, and 493 adolescents were not in school. Most adolescents were from 13 through 18 years old, although age ranged from 12-20. Non-participation was mainly due to lack of enrolment, absenteeism, or participation in class activities outside school. In total 8200 (78%) adolescents completed the general health questionnaire; more specifically 85% (4749) of the junior high students, 77% (3336) of the senior high students and 23% (115) of the adolescents not in school. Further, a total of 73% (7620) also completed the interview on headache.

During a school lesson, students completed a self-administered questionnaire containing over 100 health- and lifestyle-related questions, including items on potentially traumatic

events, psychological distress, and posttraumatic stress reactions, in addition to background information on family structure and family economy [http://www.ntnu.edu/hunt/data/que]. Within 1 month of completion of the questionnaire, a validated semi-structured clinical headache interview was conducted..[40]

Recurrent Headache

All adolescents were asked if they had experienced recurring headache not caused by a cold (infection) or illness within the past 12 months. 'Yes' responders were read two descriptive texts of prototypic complaints for tension-type headache (TTH) and migraine. They were asked if they recognized either, both or neither descriptions as resembling their own complaints. Thus, the interview differentiated between three types of headache: tension-type and/or migraine and/or non-classifiable headache. The frequency of recurrent headache was labelled as monthly (1–3 days/month), weekly (1–4 days/week), and daily (> 4 days/week). Adolescents reporting 'no recurrent headache' and 'headache less than monthly' were defined as having 'no recurrent headache', whereas all other headache frequencies were referred to as 'recurrent headache'. This recognition-based headache assessment has previously been validated against extensive semi-structured interviews by neurologists,[40] in accordance with the International Classification of Headache Disorders criteria, second edition (ICHD-II).[8]

Sociodemography

Information on sex was drawn from the Norwegian National Population Registry, whereas age was calculated by subtracting the date of birth from the date of completion of the

questionnaire. The socio-demographic variable 'family structure' was computed from 12 self-reported items on cohabitants, and was dichotomized into 'living with both parents' versus 'other' family structures, such as; living with a single parent, stepparents, foster parents, or without guardians.[20 33] The variable 'family economy', based upon a self-reported estimation of family affordance in comparison with most others, categorized as 'above average', 'average' and 'below average', represented the socioeconomic situation, as inequalities in family affluence has previously been shown to be strongly related to inequalities in adolescent health.[16]

Potentially Traumatic Interpersonal Events

In this study potentially traumatic interpersonal events (PTIEs) were defined as social interactions where an individual is subjected to intentional threats, use of physical force or power, that may cause immediate or long-term adverse health outcomes. Exposure encompasses both direct and indirect (witnessing) subjection to PTIEs. A number of potentially traumatic events were screened for, among which we identified 5 items as being potentially traumatic interpersonal events (PTIEs). The items were introduced using the following question: Have you ever experienced any of these events? Select one of the following response options: 'No', 'Yes, during the past year', or 'Yes, during lifetime'. The PTIE-related questions in our study were formulated as follows: i) Been subjected to violence (beaten or injured), ii) Seen others being subjected to violence, iii) Been subjected to unpleasant/disagreeable sexual acts by someone approximately your own age, iv) Been subjected to unpleasant/disagreeable sexual acts by an adult, and v) Been threatened or physically harassed by fellow students at school over a period of time. These items were

dichotomized into 'No, not experienced' and 'Yes, during lifetime' (combining the two original 'yes' categories).

Psychological Distress

General psychological distress was measured by a five item, short-version instrument, named SCL-5, modified from the 25 item Hopkins's Symptom Checklist (HSCL) subscale on anxiety and depression,, measured on a four-point Likert scale.[41] The derived items were introduced as follows: "Below is a list of some problems and complaints. Have you been bothered by any of this during the last 14 days? (Select one alternative: 1 = 'not bothered', 2 = 'a little bothered', 3 = 'quite bothered', and 4 = 'very bothered') 'Been constantly afraid or anxious', 'Felt tense, distressed or restless', 'Felt hopeless when you think about the future', 'Felt dejected or sad' and 'Worried too much about different things?'. A mean score ranging from 1 to 4 was computed. SCL-5 has previously been validated as a screening instrument for mental illness or psychological distress.[42]

Adolescents reporting one or more PTIEs were asked three yes/no questions on posttraumatic stress reactions, derived from the child version of the UCLA PTSD index for DSM-IV,[43] where two items measured current intrusion or re-experience, and one measured current avoidance.

STATISTICS

Descriptive data were presented according to frequency of recurrent headache complaints (Table 1). Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were obtained from logistic regression models that estimated the likelihood of experiencing recurrent headache according to each of the four categories of exposure to PTIEs within a complete case sample of 6787/10464 (65%) adolescents (regression Model 1, Tables 2, 3 and

4).[44] The number of types of PTIEs was summed for each respondent (range, 0–5), and PTIE scores of 3, 4, or 5 were combined in one category (≥ 3). All models included age, sex, family structure, and family economy as covariates, based on a priori reasoning. The main analysis of general recurrent headache was stratified according to sex (Table 2).

Furthermore, we tested whether adjustment for psychological distress significantly altered the estimated strength of associations between PTIEs and recurrent headache. The magnitude and significance of the alteration in ORs was assessed by bootstrapping, a general procedure for computing confidence intervals without making distributional assumptions.[45] . [44] Specifically we used bootstrap methods with 10 000 replicated samples to calculate bootstrap percentile 95% CIs for the ratio between ORs, in the two models (odds ratio from Model 2 (OR_2)/odds ratio from Model 1 (OR_1). Bootstrap estimated confidence intervals not including 1 indicated a significant difference between the two models. Estimated CIs above 1 would indicate a significant strengthening of the association, whilst CIs below 1 indicated attenuation in the strength of the relationship between PTIEs and recurrent headache, after adjustment for psychological distress. Lack of power, due to low numbers, or measurement uncertainties, on the other hand, would make the ORs less reliable and the CIs wider, but would not make the ORs systematically closer to, or further from, the value 1.

In supplementary logistic regression analyses we assessed potential differences in strength of associations between exposure to PTIEs and monthly, weekly and daily headache, respectively. Followed by analysis of differences in strength of associations between PTIE exposure and headache by subtypes; TTH, migraine without TTH and migraine with TTH (supplementary tables A1 and A2 in appendix, online only).

Last, we performed a subgroup, multiple regression analysis, assessing the relationship between PTIEs and recurrent headache, with and without adjustment for posttraumatic stress reactions, within the1740/6787 (26%) adolescents exposed to any PTIEs. Furthermore we repeated analysis, with inclusion of the measure for psychological distress (SCL-5). Analyses were undertaken using SPSS version 20, in combination with the program R (The R Foundation for Statistical Computing, Vienna, Austria) package boot for bootstrap calculations.

RESULTS

The demographic data are displayed in Table 1.

Table 1. Headache Type, Sociodemographics, Exposure to PTIEs, and Psychological Distress, by Frequency of Recurrent Headache, in 7620 adolescents.*†

		No Recurrent Headache	Recurrent Headache			
			Monthly	Weekly	Daily	
Variables	n	N (%)/ mean (SD)	N (%)/ mean (SD)	N (%)/ mean (SD)	N (%)/ mean (SD)	p value
		Female				
Headache	3832	2707 (71)	653 (17)	385 (10)	87 (2)	
TTH		-	461 (71)	249 (65)	39 (45)	
Migraine, without TTH		-	137 (21)	78 (20)	19 (22)	
Migraine, with TTH		-	24 (4)	43 (11)	22 (25)	
Non-classifiable		-	31 (5)	15 (4)	7 (8)	<0.001‖
Age, in years	3832	15.8 (1.7)	15.9 (1.7)	16.1 (1.8)	16.0 (1.7)	0.016¶
Family Structure	3798					
Living w/both parents		1819 (68)	396 (61)	216 (57)	42 (48)	
Other		865 (32)	250 (39)	165 (43)	45 (52)	<0.001‖
Family Economy	3630					
Above average		413 (16)	77 (13)	57 (16)	8 (10)	
Average		1946 (76)	456 (75)	252 (69)	62 (73)	
Below average		215 (8)	74 (12)	55 (15)	15 (18)	<0.001‖
Sum of PTIE‡,	3662					
0		2031 (78)	423 (68)	226 (61)	47 (56)	
1		382 (15)	119 (19)	69 (19)	22 (26)	
2		108 (4)	50 (8)	39 (11)	5 (6)	

≥3		68 (3)	28 (5)	35 (9)	10 (12)	<0.001‖
Psychological Distress§	3740	1.6 (0.5)	1.8 (0.6)	2.0 (0.7)	2.0 (0.7)	<0.001¶
Male						
Headache	3788	3204 (85)	418 (11)	145 (4)	21 (1)	
TTH		-	324 (78)	98 (68)	13 (62)	
Migraine, without TTH		-	70 (17)	25 (17)	2 (10)	
Migraine, with TTH		-	9 (2)	12 (8)	4 (19)	
Non-classifiable		-	15 (4)	10 (7)	2 (9)	<0.001‖
Age, in years	3788	15.8 (1.7)	15.7 (1.7)	15.7 (1.6)	15.8 (2.1)	0.596¶
Family Structure	3748					
Living w/both parents		2206 (70)	273 (66)	85 (60)	12 (60)	
Other		968 (30)	139 (34)	57 (40)	8 (40)	0.047‖
Family Economy	3465					
Above average		614 (21)	82 (22)	26 (20)	0 (0)	
Average		2107 (72)	262 (69)	89 (67)	12 (63)	
Below average		211 (7)	38 (10)	17 (13)	7 (37)	<0.001‖
Sum of PTIEs‡	3527					
0		2023 (68)	244 (64)	70 (53)	9 (50)	
1		622 (21)	67 (17)	31 (24)	4 (22)	
2		255 (9)	49 (13)	18 (14)	3 (17)	
≥3		95 (3)	23 (6)	12 (9)	2 (11)	<0.001‖
Psychological Distress§	3617	1.3 (0.4)	1.5 (0.5)	1.5 (0.6)	1.9 (0.7)	<0.001¶

Abbreviations: PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-Type headache

* Recurrent headache is defined as headache ≥ monthly

† Because of rounding percentages may not total 100

‡ Exposure to PTIEs is measured as the sum of 5 binary variables

§ Range of possible score is 1 to 4

‖ Pearson Chi square test

¶ ANONVA, analysis of variance

Generally, twice as many girls as boys reported recurrent headache. Amongst girls 20% reported TTH and 8% reported migraine (with or without TTH), whilst 11% of boys reported TTH and 3% reported migraine. Prevalence increased with age in girls, but not in boys. . About two thirds of adolescents with only TTH or migraine reported monthly recurrence, whilst those with combined migraine and TTH headache mostly reported weekly or daily complaints. Despite sex differences in headache prevalence, the socio-demographic distribution of recurrent headache followed similar patterns for both sexes, linking living in 'other' family structures and having a family economy 'below average' with recurrent headache.

In the present study 26% of girls and 33% of boys reported exposure to one or more types of PTIEs, whilst 4% of both sexes reported exposure to 3 or more. Adolescents without recurrent headache reported the lowest exposure to PTIEs, with 73% reporting no exposure, 18% reporting exposure to one, and 9% reporting exposure to two or more PTIEs.. Whereas the highest degree of PTIE exposure was observed amongst adolescents with daily headache, of whom only 55% reported no exposure, 25% reported exposure to 1, and 20% reported exposure to two or more PTIEs. Mean score for psychological distress was 1.49 (±0.55) (SCL-5), and increasing distress was significantly associated with recurrent headache, as assessed in univariate analysis.

A multiple logistic regression analysis, adjusted for sociodemographic factors, revealed a steady trend of increasing odds for recurrent headache with increasing exposure to PTIEs (Table 2, Model 1). The strength of associations between exposure to PTIEs and recurrent headache consistently and significantly decreased after psychological distress was entered into the regression equation (Table 2, Model 2), as assessed in analysis of ratio of odds ratio

with bootstrap 95% percentile CIs. Moreover, the magnitude of attenuation in ORs seemed to increase with increasing exposure to PTIEs.

Table 2. Recurrent Headache in Relation to Exposure to PTIEs and Psychological Distress, by Sex.*†‡

		Recurrent Headache (n=1514)			
		Female (n=1021)		**Male** (n=496)	
		Model 1	Model 2	Model 1	Model 2
Variables	n	OR_1 (CI)	OR_2 (CI)	OR_1 (CI)	OR_2 (CI)
Sum of PTIEs					
0	4789	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	1250	1.46 (1.20-1.78)	1.25 (1.02-1.53)	1.04 (0.81-1.34)	0.93 (0.72-1.20)
2	496	2.28 (1.69-3.08)	1.73 (1.27-2.36)	1.71 (1.25-2.33)	1.41 (1.03-1.94)
≥3	252	2.61 (1.82-3.75)	1.69 (1.15-2.47)	2.29 (1.49-3.52)	1.57 (1.00-2.47)
Overall p-value		<0.001	<0.001	<0.001	0.029
Psychological Distress	6787		1.94 (1.70-2.22)		2.10 (1.72-2.58)

Abbreviations: CI, 95% Confidence Interval; OR_1 and OR_2, Odds Ratio for Regression Model 1 and Model 2, respectively; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are explained in footnotes to Table 1.

† Analyses are restricted to adolescents no missing values for all included variables (3494 females and 3293 males).

‡ Both regression models are adjusted for age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

Similarly, the associations between exposure to PTIEs and headache by 'monthly', 'weekly', and 'daily' recurrence, respectively, were all significant and cumulative (Model 1, Table 3). For all frequencies of recurrent headache as outcomes, we observed a significant attenuation in ORs, with inclusion of psychological distress in the logistic regression analyses (Model 2). We found a stronger relationship between exposure to PTIEs and weekly, or more frequent, headache, compared to monthly headache. This difference in strength of associations levelled out when adjusting for psychological distress (supplementary table A1, online only).

Table 3. Recurrent Headache by Frequency, in Relation to Exposure to PTIEs, Sex and Psychological Distress.*†‡

		Recurrent Headache (n=1514)					
		Monthly (n=942)		**Weekly** (n=472)		**Daily** (n=100)	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Variables	n	OR_1 (CI)	OR_2 (CI)	OR_1 (CI)	OR_2 (CI)	OR_1 (CI)	OR_2 (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	1250	1.17 (0.97-1.41)	1.05 (0.87-1.27)	1.40 (1.08-1.81)	1.18 (0.91-1.53)	2.03 (1.23-3.36)	1.58 (0.95-2.64)
2	496	1.77 (1.37-2.28)	1.46 (1.12-1.90)	2.46 (1.77-3.41)	1.78 (1.26-2.50)	1.93 (0.89-4.20)	1.17 (0.52-2.63)
≥ 3	252	1.74 (1.22-2.48)	1.30 (0.90-1.87)	3.80 (2.61-5.54)	2.18 (1.45-3.27)	4.53 (2.26-9.07)	2.03 (0.95-4.34)
Overall p-value		<0.001	0.028	<0.001	<0.001	<0.001	0.164
Sex§	6787	1.89 (1.64-2.19)	1.60 (1.38-1.87)	3.51 (2.82-4.37)	2.62 (2.09-3.30)	5.14 (3.06-8.64)	3.56 (2.09-6.07)
Psychological Distress	678 7		1.71 (1.50-1.95)		2.24 (1.90-2.63)		2.78 (2.03-3.80)

Abbreviations: CI, 95% Confidence Interval; OR_1 and OR_2, Odds Ratio for Regression Model 1and Model 2, respectively; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses are restricted to adolescents without missing values, (n=6787).

‡ Both models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

§ Male is reference category

The association between exposure to PTIEs and subtypes of recurrent headache followed a similar consistently significant and cumulative pattern for all assessed subtypes of recurrent headache; including tension-type headache (TTH), migraine without TTH, migraine with TTH, and non-classifiable headache. (Model 1, Table 4). Adding psychological distress in regression Model 2, for all four subtypes of recurrent headache yielded a significant reduction in ORs for all analyses. The association between PTIEs and recurrent headache was significantly stronger amongst adolescents reporting any migraine (with or without TTH), in comparison to adolescents reporting TTH only (supplementary table A2, online only). This observed difference between subtypes, seemed to be mainly driven by a stronger association between exposure to PTIEs and migraine with TTH, as opposed to TTH only. We found no significant difference in associations between victimization and the two groups of

Table 4. Recurrent Headache by Type, in Relation to Exposure to PTIEs, Sex and Psychological Distress.*†‡

		Recurrent Headache (n=1445)					
		TTH (n=1048)		**Migraine without TTH** (n=293)		**Migraine with TTH** (n=104)	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Variables	n	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	1250	1.16 (0.97-1.39)	1.01 (0.84-1.22)	1.59 (1.17-2.17)	1.40 (1.02-1.92)	1.64 (0.98-2.76)	1.38 (0.82-2.33)
2	496	1.71 (1.34-2.20)	1.35 (1.04-1.75)	2.26 (1.17-2.17)	1.76 (1.14-2.72)	3.72 (2.04-6.76)	2.46 (1.32-4.60)
≥3	252	2.12 (1.54-2.92)	1.42 (1.02-1.99)	3.39 (2.10-5.48)	2.19 (1.31-3.66)	6.08 (3.16-11.70)	3.36 (1.66-6.77)
Overall p-value		<0.001	0.034	<0.001	0.003	<0.001	0.002
Sex§	6787	2.10 (1.83-2.42)	1.71 (1.47-1.97)	3.08 (2.36-4.02)	2.49 (1.88-3.28)	4.73 (2.91-7.68)	3.38 (2.05-5.57)
Psychological distress	6787		1.95 (1.72-2.21)		1.83 (1.49-2.25)		2.41 (1.77-3.27)

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio; PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-type Headache.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents without missing values, (n=6787). Data for analysis of non-classifiable recurrent headache (n=69) is not presented.

‡ Model 1 is adjusted for sex, age, family structure and family economy. Model 2 is adjusted for psychological distress, sex, age, family structure and family economy.

§ Male is reference category

Furthermore, in subgroup analysis, investigating the impact of posttraumatic stress reactions on the relationship between exposure to PTIEs and recurrent headache, posttraumatic stress reactions independently and significantly attenuated ORs. The contribution of posttraumatic stress reactions became insignificant when we additionally adjusted for general psychological distress.

DISCUSSION

To our knowledge this is the first population-based study to comprehensively assess associations between exposure to multiple potentially traumatic interpersonal events (PTIEs) and recurrent headache, meeting the ICHD-II criteria. The study documents a strong and consistent relationship between exposure to PTIEs and recurrent headache experienced by adolescents. The association was observed for both monthly, weekly and daily headache, although significantly stronger for weekly or more frequent complaints. A similar, robust pattern was found between exposure to PTIEs and ICHD-II defined tension-type headache (TTH), migraine without TTH, migraine with TTH, and non-classifiable headache. Increasing exposure to PTIEs was associated with higher prevalence of all assessed frequencies and subtypes of recurrent headache, indicating a dose-response relationship. Furthermore, adjustment for psychological distress lead to a consistent and significant decrease in strength of associations between exposure to PTIEs and all frequencies and subtypes of recurrent headache. Posttraumatic stress reactions seem to play a similar role, although adjustment for general distress levelled out its specific effect. This may indicate that general psychological distress, as measured within this study; encompass posttraumatic stress reactions, as found in a recent study of comorbidity in adolescents.[46]

The strengths of this study were the large sample size, the overall high participation rate, the use of a validated headache interview based upon the International Classification of Headache Disorder (II) criteria,[40] and the opportunity to assess the impact of several types of PTIEs and confounding factors, within a population based cohort of adolescents. Importantly, the retrospective, cross-sectional study-design did not allow for causal inference, or differentiation between confounding and mediational effects. Findings should thus be interpreted within the given constraints of the study. The lower participation- and

response-rate among adolescents not enrolled in school, and among those in senior high school compared with junior high school, represent a possible selection bias. Additionally, young adolescents, boys, and adolescents not living with both parents were less likely to respond to the PTIE items. This missing-pattern may represent another source of selection bias. The most prominent observed selection-bias within this study is the high non-response amongst adolescents not enrolled in school, which may have . led to an underestimation of the associations.[47]Our measures of PTIEs lack event-specific information on relationship to perpetrator, severity, frequency, duration and recency of exposure,[48] and commonly occurring PTIEs, such as emotional abuse, peer relational victimization and cyber-bullying were not addressed.[49 50] The above mentioned uncertainties, related to the measurement of PTIEs, may have affected the observed strengths of associations. Furthermore, analysis on an additional outcome-measure of headache-related functional impairment would, most probably, have strengthened associations.[24] Despite these, accounted for, potential selection-biases and measurement uncertainties, it is likely that the main findings can be generalized to other adolescent populations.

Prevalence rates of recurrent headache, including frequencies and subtypes of complaints, were in large unchanged in comparison with national headache prevalence from 1995-1997,[51] and within the lower range of aggregated international estimates.[6] Further, the observed patterns of distribution of recurrent headache in this study, in relation to sex, age, [6] sociodemography[2 16 20] and psychological distress[2 4 10 19] complied with previous epidemiological documentation. Likewise, the observed prevalence of exposure to PTIEs in our study was within the lower range, and distribution followed similar patterns, to that observed in comparable studies, although comparison across measures and populations is difficult.[28 33] Regarding levels of psychological distress screening estimates were in correspondence with prior national and international findings.[42 46]

Our main findings substantiate recent but scarce evidence provided by cross-sectional population-based studies of adolescents, of a significant association between exposure to PTIEs and headache. Two of these studies used the ICHD-II criteria.[14 21 23 25] Further, results are in coherence with one population-based,[52] two clinical,[27 53] and another two convenience-sample[26 54] retrospective, cross-sectional studies of adults, of which one used the ICHD-II criteria.[27] Apart from one adolescent study which examined girls only,[14] and the adult convenience sample study,[26] the sample-sizes in these studies were smaller, than in the present study. Generally, the adolescent studies assessed exposure to one type of PTIEs only, whilst the adult studies looked specifically at child abuse and family dysfunction.

Concerning temporality of associations, a large cohort study using follow-up data over 12 years of adolescent and adult Canadians recently found childhood adversity and depression to be significant predictors of adult migraine.[38] Additionally, observational, prospective, convenience sample studies of adolescents exposed to bullying lend evidence to the more general relationship between victimization and psychosomatic complaints, although headache measurements in these studies were too imprecise to draw more specific conclusions of associations.[49 55 56] Taken together, some evidence suggests that PTIEs may be important factors on the causal pathway leading to onset and chronification of headache disorder.

Amongst the observed relationships, between exposure to PTIEs and main subtypes of headache, migraine was most strongly linked to exposure. The observed stronger association between PTIEs and migraine, as opposed to TTH, seemed to be explained in large by the stronger association between exposure to PTIEs and combined headache (migraine with TTH). This may indicate that exposure to PTIEs predispose for more severe and complex

head pains,[57] reflecting a similar pattern as that observed in the relationship between PTIE-exposure and comorbidity of psychiatric disorders.[29] Such an interpretation complies with previous findings that both migraines in general and combined migraines specifically, tend to be clinically more severe and disabling, compared to TTH only.[18 19] On the other hand, the observed discrepancies in strength of associations may be an artefact of underlying chronification of complaints, as migraine with TTH was more often experienced weekly or daily, as opposed to migraine or TTH only, which mostly recurred monthly.

Our findings suggest that psychological distress may play an important role as a confounder, or a mediator. A mediating role would comply with current pathophysiological understanding, where violence as an environmental stressor, may acutely or over time overwhelm, exhaust and further dysregulate the stress response system.[58] Pathological effects, such as recurrent headache, though initially induced by external trauma, may largely be related to persistence of physiological distress, functioning as an internal stressor that triggers cerebral sensitization and hypersensitivity through alterations of shared neuroendoimmunological pathways of emotion and pain, which in turn may lead to hyperalgesia and chronification of headache disorders.[3 9 17 59] Future interdisciplinary studies need to explore these suggested mechanisms to delineate etiological pathways, and further enable tailored interventions.

Sex differences in the strength of associations between PTIEs and recurrent headache may be related to the gender-biased qualitative differences of reported PTIEs, such as girls being more prone to sexual abuse and exposure within their social networks.[37] Such exposure is associated with worse health outcomes, which are possibly related to the developmental stage at the time of abuse, proximity to the perpetrator, and the persistence and severity of the abuse.[31 60] Other possible mechanisms may be related to developmental biological differences, or sociocultural gender role expectations affecting reaction patterns,[61] predisposing girls to internalizing as opposed to externalizing

behaviour, which in turn increase their susceptibility of experiencing persistent chronic pain.[62]

Conclusion and implications

Our main findings comply with essential features of current theoretical models of developmental psychopathology,[63] recurrent pain[62] and chronic paediatric headache[3 17 64] that underscore the need for a biopsychosocial approach to understand adverse health outcomes in childhood. Knowing that recurrent headaches are amongst the most common causes of disability in adults and adolescents alike,[1 18] substantiated empirical evidence of a strong, consistent and cumulative relationship between exposure to PTIEs, psychological distress and recurrent headache, regardless of subtype, demands for further investigation.[23] We are currently at a stage where we recognize that childhood victimization and adversities do little good for psychological and somatic health and development, and yet we lack valid, distinct and precise knowledge to guide public health interventions and clinical practice. Thus, primarily there is a need for more comprehensive, interdisciplinary research, preferably prospective, using valid measurements of risk factors and clinically applicable outcome-measures, aiming to identify underlying gene-environment interplay, or biopsychosocial causal pathways, as targets of tailored prevention and intervention. Secondly, from a more general public health perspective, the observed dependency between exposure to PTIEs and highly prevalent psychological and somatic conditions challenges the traditional dichotomization of health services, requiring establishment and maintenance of low-threshold, local health services directed toward adolescents that integrate and accommodate psychological and somatic needs.[64-67]

CONTRIBUTORSHIP

Contributors: SØS carried out the data processing, analyzed the data, drafted and revised the paper. She is the guarantor. GD and JAZ contributed to the integration of the headache interview, measures of victimization and posttraumatic distress in the Young-HUNT3 Study. GD and ST wrote the original study protocol, applied for and received the grant for the study, and further participated in the epidemiological modeling, analysis and writing of the manuscript. TWL contributed to the statistical analysis. JAZ participated in the design of the study and helped to write the manuscript. All authors have read and approved the final version of the manuscript.

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COMPETING INTERESTS/DISCLOSURE

None declared. Synne Øien Stensland, Grete Dyb, Siri Thoresen, Tore Wentzel-Larsen and John-Anker Zwart report no competing interests. All authors have completed the BMJ declaration of competing interests and the Unified Competing Interest form (available on request from the corresponding author) and declare that S. Stensland has support from The Norwegian Council for Mental Health, The Norwegian Extra Foundation for Health and Rehabilitation for the submitted work; (2) none have relationships with companies that might have an interest in the submitted work in the previous 5 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) the authors have no non-financial interests that may be relevant to the submitted work.

ACCESS AND INTEGRITY OF ALL AUTHORS

All authors had full access to all of the data (including statistical reports and tables) in the study and can take full responsibility for the integrity of the data and the accuracy of the data analysis.

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ETHICS APPROVAL

Inclusion was based upon written consent from participants aged 16 years and older and from parents for those under 16, in accordance with Norwegian law. This study was approved by the Norwegian Regional Committee for Medical and Health Research Ethics.

DATA SHARING STATEMENT

Data are available from the HUNT study http://www.huntbiosciences.com/Cohorts/Diabetes/The-HUNT-Bio-And-Databank. The general health questionnaire and headache interview used in the study are accessible from the HUNT bio-and databank (http://www.ntnu.edu/hunt/data/que). There is no additional data available.

THE ORIGINAL STUDY PROTOCOL

The original study protocol is accessible from the corresponding author, and may be translated from Norwegian to English on request.

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Potentially Traumatic Interpersonal Events, Psychological Distress and Recurrent Headache~~s~~ in a Population-based Cohort of Adolescents

~~A population based study~~

The HUNT Study

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Image: Flowchart attached as supplementary file

ARTICLE SUMMARY

Article Focus

- The main focus was to examine, in a population-based cohort of adolescents, the associations between exposure to potentially traumatic interpersonal events (PTIEs) and migraine and tension-type headaches, meeting the International Classification of Headache Disorders (ICHD-II) criteria.
- ~~The present study was designed to acquire knowledge of associations between exposure to potentially traumatic interpersonal events and clinically validated measures of the range of recurrent headache disorders experienced in a population-based cohort of adolescents, meeting the criteria of the International Classification of Headache Disorder (ICHD-II).~~
- ~~Possible mediation through~~ Further, we aimed to assess the impact of psychological distress on the relationship between PTIEs and recurrent headache. ~~psychological distress was tested specifically.~~

Key Messages

- Our study suggests a strong and consistent relationship between exposure to potentially traumatic interpersonal events (PTIEs), and prevalence of ICHD-II defined migraine and tension-type headache, in a population-based cohort study of adolescents.
- Exposure to increasing numbers of types of PTIEs was consistently associated with higher prevalence of all assessed subtypes and frequencies of headache, indicating a dose-response relationship.
- Adolescents exposed to PTIEs, reported higher levels of psychological distress than their non-victimized peers. Further, adjustment for experienced psychological

distress consistently, and significantly, attenuated strength of associations between PTIEs and recurrent headache. ~~Our study suggests a strong, consistent and cumulative relationship between exposure to increasing number of types of interpersonal trauma and recurrent headache, regardless of subtype or frequency of complaints, classified according to the ICHD-II criteria.~~

- ~~This study indicates that traumatized adolescents experience higher levels of psychological distress than their non-victimized peers, which in turn seem to enhance their susceptibility to chronification of all common recurrent headache disorders. Thus psychological distress may play an important mediating role on the pathway linking victimization to recurrent headache complaints.~~
- ~~Although prospective studies are needed the observed dependency between interpersonal trauma exposure and highly prevalent psychological and somatic conditions in adolescence challenges the traditional dichotomization of health services.~~

Strengths and Limitations

- The strengths of this study were the large sample size, the overall high participation rate, the use of a validated headache interview, based upon the ICHD (II) criteria, and the opportunity to assess the impact of ~~several types~~multiple potentially traumatic interpersonal events ~~of victimization~~ and confounding factors, within a population-based cohort of adolescents.
- The retrospective, cross-sectional study-design ~~does not allow for causal inference,~~ did not allow for causal inference, or differentiation between mediational and confounding effects. F~~and f~~indings should ~~thus~~ be interpreted within the given constraints of the study.

ABSTRACT

Context Recurrent ~~headache,~~headache co-occurs commonly with psychological distress, such as anxiety or depression. Potentially t~~T~~raumatic interpersonal events (PTIEs) could represent important precursors of ~~posttraumatic~~ both psychological distress and recurrent headache in adolescents.

Objective To assess the hypothesized association between exposure to ~~potentially traumatic interpersonal events (~~PTIEs~~)~~ and recurrent migraine and tension-type headache in ~~across the spectrum of headache complaints experienced by~~ adolescents, and f~~ and~~urther examine the ~~potential~~potential impact of ~~role of~~ psychological distress ~~as a mediator of~~on this relationship.

Design The Young-HUNT 3 study, 2006–2008, is a population-based, cross-sectional, cohort study of Norwegian youth that includes self-report data on exposure to potentially traumatic ~~exposure~~events, psychological distress, and a validated interview on headache.

Setting and Participants A cohort of 10 464 adolescents aged 12–20 years from the Nord-Trøndelag county were invited to participate.

Main Outcome Measures Data from the headache interview served as outcome. Recurrent headache was defined as headache recurring at least monthly during the past year, and ~~was further subclassified~~sub classified into monthly, weekly, and daily complaints. Subtypes were classified as tension-type headache (TTH), migraine, migraine with ~~tension-type headache~~TTH and/or ~~'other'~~non-classifiable headache, in accordance with the International Classification of Headache Disorders, (ICHD-II).

Results The response rate was 73% (7 620). Multiple logistic regression analysis, adjusted for sociodemographics, showed consistently significant associations between exposure to PTIEs

and recurrent headache, regardless of frequency or subtype of headache. ~~a steady trend of increasing odds for recurrent headache with i~~Increasing exposure to PTIEs was associated with higher prevalence of recurrent headache, indicating a dose response relationship. ~~The same pattern was reproduced for all frequencies and subtypes of complaints~~. ~~The~~ The direct strength of associations between exposure to PTIEs and all recurrent headache disorders significantly ~~decreased after the hypothesized mediator, attenuated~~ when psychological distress~~,~~ was entered into the regression equation. ~~Bootstrap confidence intervals for the magnitude of the attenuation in odds ratio indicated a significant decrease, suggesting mediation by psychological distress.~~

Conclusions The empirical evidence of a strong~~,~~ and cumulative relationship between ~~victimization~~ exposure to PTIEs, psychological distress and recurrent headache~~, possibly mediated by posttraumatic psychological distress,~~ indicates a need for integration of somatic and psychological health-care services ~~of~~ for adolescents, in prevention, assessment, and treatment of recurrent headache. Prospective studies are needed.

Recurrent headache is the most common pain condition during adolescence, and associated with limitations in everyday life, affecting school functioning and relationships with family and peers.[1 2] Prepubertal onset of headache, high pain intensity, migraine, and co-occurring psychological distress is related to chronification and disability, in childhood and adolescence.[1 3 4] Further, headache-related disability at diagnosis seems to be predictive of headache-related functional impairment decades later.[5] ~~Prepubertal onset of headache and severe, frequent or persistent complaints, migraine, and co-occurring psychological distress are related to chronification and enduring disability, with headache complaints and functional impairment often persisting into adulthood.~~ From early childhood to adolescence there is a marked increase in the prevalence of headache, which is accompanied by an emerging discrepancy between genders. ~~, with P~~prevalence tend to ~~stabilizing~~ stabilize in boys, and ~~increasing~~ increase gradually throughout adolescence in girls.[6]

Primary tension-type and migraine headaches are by far the most frequent subtypes of recurrent headache in adolescence.[6] Secondary headache disorders are related to other conditions, such as medication overuse,[7] infection, or trauma, although these partly overlap with the preceding.[8] The etiological factors, and pathways leading to onset and chronification of headache disorders, are largely unknown,[9] yet recognized as multifactorial, including; heredity, age and sex, somatic, psychological and behavioural disorders,[10 11] head injuries,[12] unfavourable lifestyle (such as smoking, inactivity,[13] and inadequacy of sleep[1]), and lack of social and economic resources within families, in schools and societies.[14-16] Despite distinguishing features related to migraine headaches, the primary headaches may in part share pathophysiological mechanisms, related to the chronification of disorders,[9 17] reflected in an observed continuum of clinical severity,

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ranging from tension-type complaints, through migraine,[18] to combined migraine with tension-type headache.[19]

Recently researchers have explored the potential role of negative life events on the development of psychosomatic outcomes, including headache, in adolescence. Positive associations have been found between a range of childhood adversities and headache, including; economic hardship,[16] parental separation,[20] poor family environment or neglect,[21] and potentially traumatic events such as disaster,[22] exposure to abuse [23 24], and bullying.[25] A recent population-based study of adolescents has suggested a dose-response relationship between frequency of childhood physical abuse and severe headaches, including migraine,[23] supported by findings from a large convenience sample study of adults,[26] and a ~~multicenter~~multicentre study of adult migraineurs, alike.[27] Despite these suggestive findings the evidence for an association between exposure to childhood trauma and recurrent headache is currently debated.[28]

The association between adverse experiences and mood and anxiety disorders in adolescents, on the other hand, is thoroughly documented.[29] Exposure to severe family adversity, or potentially traumatic interpersonal ~~traumatic~~ events (PTIEs), especially early exposure to abuse, or neglect ~~or severe family adversity,~~[30] witnessing domestic violence,[31] exposure to bullying[32] or sexually-related victimization,[33] is recognized as particularly detrimental, and associated with prolonged trajectories and comorbidity.[25 34] A steady aggravation of psychological distress is further documented in relation to ~~multiple victimization~~exposure to multiple types of PTIEs.,[35] ~~with findings~~ Findings from high-exposure populations suggest~~ing~~ that ~~cumulative traumatic~~ exposure to PTIEs will, regardless of psychological vulnerability, lead to psychological distress of clinical significance

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in anyone, although thresholds vary individually.[34 36] These main trends seem to be similar for both sexes.[37]

During childhood PTIE-~~Trauma~~ exposure is generally evenly ~~distributed~~ distributed~~in childhood,~~. ~~with~~ , followed by emerging sex-related discrepancies in ~~trauma~~ patterns of distribution of PTIEs ~~profiles gradually emerging throughout~~ during adolescence.~~,~~ Adolescent~~as~~ girls continuously experience more sexually-related and ~~close network~~close-network ~~traumas~~PTIEs, whilst boys get gradually more exposed to all other types of single ~~traumatic events~~events. ~~Generally, trauma-associated psychological distress, is~~ Posttraumatic stress reactions are generally reported 2-3 times more often ~~reported~~ by adolescent girls, in comparison to boys.[37]

~~Thus, e~~Current epidemiological evidence of a gradual increase in risk of exposure to ~~traumatic events~~PTIEs throughout childhood and adolescence,[33] strongly associated with onset of psychological distress,[30] which again often co-occur~~s~~ with emerging recurrent headache complaints,[4] imply possible shared causal pathways.[38] ~~Simply put, when adolescents experience something traumatic they get distressed. Further, psychological distress may function as an internal stressor, increasing individual susceptibility to onset and chronification of headache complaints. Thus, mental distress may be an important mediator on the pathway linking trauma to recurrent headache complaints.~~

We therefore need to study associations between the exposure to PTIEs, psychological distress and recurrent headache in adolescents.~~Although scientific interest in the associations between exposure to traumatic experiences and headache in adolescents has grown recently, we still lack substantiated insight into whether and eventually how exposure to traumatic events might relate to recurrent headache experienced in the general~~

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population.[28] Therefore, theThe present study was designed to acquire knowledge of associations between exposure to potentially traumatic interpersonal eventsPTIEs and ICHD-II defined migraine and tension-type headache, clinically validated measures of the range of recurrent headaches experienced in a population-based cohort of adolescents., meeting the International Classification of Headache Disorder criterias (ICHD-II). Possible mediation through The impact of psychological distress upon the relationship between exposure to PTIEs and recurrent headache was tested specifically.

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METHODS

The Young-HUNT 3 Study, ~~From 2006 until 2008, 10464 adolescents were invited to participate in Young-HUNT 3~~ (http://www.ntnu.edu/hunt/inenglish), ~~which~~ is a population-based, cross-sectional cohort-study of Norwegian youth in Nord-Trøndelag county, conducted between 2006 and 2008, in which 10464 adolescents were invited to participate.[39] The study, which comprises a general health questionnaire, a clinical assessment, and a headache interview, was approved by the Norwegian Regional Committee for Medical and Health Research Ethics. Inclusion was based upon written consent from participants aged 16 years and older and from parents for those under 16, in accordance with Norwegian law.

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Participants

In 2006 there were 128 694 inhabitants in Nord-Trøndelag. Over 95% were ethnic Norwegians, the work force was generally well-educated and unemployment was less than 3%. All adolescents ~~(10 464)~~ in the county, within an age-range qualifying for attendance in junior or senior high-school, were invited to the study~~,~~. Of the 10 464 invited adolescents, 5614 were students in junior high, 4357 in senior high, and 493 adolescents were not in school. Most adolescents were from 13 through 18 years old, although age ranged from 12-20. Non-participation was mainly ~~due to absence from school~~due to lack of enrolment, absenteeism, or participation in class activities outside school~~, or not wanting to participate~~. In total 8200 (78%) adolescents completed the general health questionnaire; more specifically 85% (4749) of the junior high students, 77% (3336) of the senior high students and 23% (115) of the adolescents not in school. Further, a total of 73% (7620) also completed the interview on headache.

During a school lesson, students completed a self-administered questionnaire containing over 100 health- and lifestyle-related questions, including items on potentially traumatic events, psychological distress, and posttraumatic stress reactions, in addition to background information on family structure and family economy [http://www.ntnu.edu/hunt/data/que]. ~~A validated semi-structured clinical interview was conducted in association with a clinical examination.~~ W~~w~~ithin 1 month of completion of the questionnaire, a validated semi-structured clinical headache interview was conducted.~~to assess adolescents' recurring headache complaints according to type and frequency~~.[40]

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Recurrent Headache

All adolescents were asked if they had experienced recurring headache not caused by a cold (infection) or illness within the past 12 months. 'Yes' responders were read two descriptive texts of prototypic complaints for tension-type ~~headache~~ headache (TTH) and migraine. ~~, in accordance with the International Classification of Headache Disorders criteria, second edition (ICHD-II), and~~ They were asked if they recognized either, both or neither descriptions as resembling their own complaints. Thus, the interview differentiated between three types of headache: tension-type and/or migraine ~~(with or without visual aura)~~ and/or ~~'other'~~non-classifiable ~~type of~~ headache. The frequency of recurrent headache was labelled as monthly (1–3 days/month), weekly (1–4 days/week), and daily (> 4 days/week). Adolescents reporting 'no recurrent headache' and '~~complaints~~ headache less than monthly' were defined as having 'no recurrent headache', whereas all other headache frequencies were referred to as 'recurrent headache'.~~[42]~~ This recognition-based headache assessment has previously been validated against extensive semi-structured interviews by neurologists,[40]

in accordance with the International Classification of Headache Disorders criteria, second edition (ICHD-II).[8]

Sociodemography

Information on sex was drawn from the Norwegian National Population Registry, whereas age was calculated by subtracting the date of birth from the date of completion of the questionnaire. The socio-demographic variable 'family structure' was computed from 12 self-reported items on cohabitants, and was dichotomized into 'living with both parents' versus 'other' family structures, such as; living with a single parent, stepparents, foster parents, or without guardians.[20 33] The variable 'family economy', based upon a self-reported estimation of family affordance in comparison with most others, categorized as 'above average', 'average' and 'below average', represented the socioeconomic situation, as inequalities in family affluence has previously been shown to be strongly related to inequalities in adolescent health.[16]

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Potentially Traumatic Interpersonal Events

In this study potentially traumatic interpersonal events (PTIEs) were defined as social interactions where an individual is subjected to intentional threats, use of physical force or power, that may cause immediate or long-term adverse health outcomes. Exposure encompasses both direct and indirect (witnessing) subjection to PTIEs. A number of potentially traumatic events were screened for, among which we identified 5 items as being potentially traumatic interpersonal events (PTIEs)~~, or victimizations~~. The items were introduced using the following question: Have you ever experienced any of these events? Select one of the following response options: 'No', 'Yes, during the past year', or 'Yes, during lifetime'. The PTIE-related questions in our study were formulated as follows: i) Been

subjected to violence (beaten or injured), ii) Seen others being subjected to violence, iii) Been subjected to unpleasant/disagreeable sexual acts by someone approximately your own age, iv) Been subjected to unpleasant/disagreeable sexual acts by an adult, and v) Been threatened or physically harassed by fellow students at school over a period of time. These items were dichotomized into 'No, not experienced' and 'Yes, during lifetime' (combining the two original 'yes' categories).

Psychological Distress

General psychological distress was measured by a five item, short-version instrument, named SCL-5, modified from the 25 item ~~Hopkin's~~Hopkins's Symptom Checklist (HSCL) subscale on anxiety and depression, ~~where every~~ item ~~was~~ measured on a four-point Likert scale.[41] The derived items were introduced as follows: "Below is a list of some problems and complaints. Have you been bothered by any of this during the last 14 days? (Select one alternative: 1 = 'not bothered', 2 = 'a little bothered', 3 = 'quite bothered', and 4 = 'very bothered') 'Been constantly afraid or anxious', 'Felt tense, ~~-~~distressed or restless', 'Felt hopeless when you think about the future', 'Felt dejected or sad' and 'Worried too much about different things?'. A mean score ranging from 1 to 4 was computed. SCL-5 has previously been validated as a screening instrument for mental illness or psychological distress.[42]

Adolescents reporting one or more PTIEs were asked three yes/no questions on posttraumatic stress reactions, derived from the child version of the UCLA PTSD index for DSM-IV,[43] where two items measured current intrusion or ~~reexperience~~re-experience, and one measured current avoidance.

STATISTICS

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Descriptive data were presented according to frequency of recurrent headache complaints (Table 1). Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were obtained from logistic regression models that estimated the likelihood of experiencing recurrent headache according to each of the four categories of exposure to PTIEs within a complete case sample of 6787/10464 (65%) adolescents (regression Model 1, Tables 2, 3 and ~~, 4 and 5~~).[44] The number of types of ~~event~~PTIEs ~~s~~ was summed for each respondent (~~sum of PTIEs;~~ range, 0–5), and PTIE scores of 3, 4, or 5 were combined in one category (≥ 3). All models included age, sex, family structure, and family economy as covariates, based on a priori reasoning. The main analysis of general recurrent headache was stratified according to sex (Table 2).

Furthermore, we tested ~~mediation by~~whether adjustment for psychological distress significantly altered the estimated strength of associations between PTIEs and recurrent headache. The magnitude and significance of the alteration in ORs was assessed by bootstrapping, a general procedure for computing confidence intervals without making distributional assumptions.[45] ~~psychological distress. A significant attenuation of the effect size estimate (OR) for the association between exposure to PTIEs and recurrent headache, when adding psychological distress to the multivariate logistic regression model (regression Model 2 in Tables 2, 3, 4 and 5), may imply a mediating role by psychological distress.~~[44] Specifically w~~W~~e used bootstrap methods with 10 000 replicated samples to calculate bootstrap percentile 95% CIs for the ~~difference in~~ratio between ORs, ~~ORs between~~ in the two models ~~(1 –~~(odds ratio from Model 2 (OR_2)/odds ratio from Model 1 (OR_1)~~)~~. Bootstrap estimated c~~C~~onfidence intervals not including 1 indicated a significant difference between ~~odds ratios~~ the two models. Estimated CIs above 1 would indicate a significant strengthening of the association, whilst CIs below 1 indicated attenuation in the strength of

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the relationship between PTIEs and recurrent headache, after adjustment for psychological distress. Lack of power, due to low numbers, or measurement uncertainties, on the other hand, would make the ORs less reliable and the CIs wider, but would not make the ORs systematically closer to, or further from, the value 1.

~~Test of proportional odds assumptions across frequencies and subtypes of headache complaints was undertaken, but did not meet the requirement of proportionality in odds relations (supplementary tables A1 and A2 in appendix, online only).~~ In s~~S~~upplementary logistic regression analys~~e~~is we assessed ~~of group~~ potential differences in strength of associations between exposure to PTIEs and monthly, weekly and daily headache, respectively. ~~within frequencies and~~Followed by analysis of differences in strength of associations between PTIE exposure ~~-~~and headache by subtypes; ~~-~~TTH, migraine without TTH and migraine with TTH ~~of recurrent headaches, in association to exposure to PTIEs and psychological distress, were assessed in separate logistic regression analyses~~ (supplementary tables A1~~3~~ and A2~~4~~ in appendix, online only).

Last, we performed a subgroup, multiple regression analysis, assessing the relationship between PTIEs and recurrent headache, with and without adjustment for posttraumatic stress reactions, within ~~of~~ the 1740/6787 (26%) adolescents ~~who were~~ exposed to any PTIEs. ~~, to explore whether specific posttraumatic stress reactions served as a potential additional mediator of the relationship between trauma and recurrent headache (Table 5).~~ Furthermore we repeated analysis, with inclusion of the measure for psychological distress (SCL-5).

Analyses were undertaken using SPSS version 20, in combination with the program R (The R Foundation for Statistical Computing, Vienna, Austria) package boot for bootstrap calculations.

RESULTS

The demographic data are displayed in Table 1.

Table 1. Headache Type, Sociodemographics, Exposure to PTIEs, and Psychological Distress, by Frequency of Recurrent Headache, in 7620 adolescents.*†

		No Recurrent Headache	Recurrent Headache			
			Monthly	Weekly	Daily	
		N (%)/	N (%)/	N (%)/	N (%)/	
Variables	n	mean (SD)	mean (SD)	mean (SD)	mean (SD)	p value
		Female				
Headache	3832	2707 (71)	653 (17)	385 (10)	87 (2)	
TTH		-	461 (71)	249 (65)	39 (45)	
Migraine, without TTH		-	137 (21)	78 (20)	19 (22)	
Migraine, with TTH		-	24 (4)	43 (11)	22 (25)	
Non-classifiable		-	31 (5)	15 (4)	7 (8)	<0.001‖
Age, in years	3832	15.8 (1.7)	15.9 (1.7)	16.1 (1.8)	16.0 (1.7)	0.016¶
Family Structure	3798					
Living w/both parents		1819 (68)	396 (61)	216 (57)	42 (48)	
Other		865 (32)	250 (39)	165 (43)	45 (52)	<0.001‖
Family Economy	3630					
Above average		413 (16)	77 (13)	57 (16)	8 (10)	
Average		1946 (76)	456 (75)	252 (69)	62 (73)	
Below average		215 (8)	74 (12)	55 (15)	15 (18)	<0.001‖
Sum of PTIE‡,	3662					
0		2031 (78)	423 (68)	226 (61)	47 (56)	
1		382 (15)	119 (19)	69 (19)	22 (26)	
2		108 (4)	50 (8)	39 (11)	5 (6)	

≥3		68 (3)	28 (5)	35 (9)	10 (12)	<0.001‖
Psychological Distress§	3740	1.6 (0.5)	1.8 (0.6)	2.0 (0.7)	2.0 (0.7)	<0.001¶
		Male				
Headache	3788	3204 (85)	418 (11)	145 (4)	21 (1)	
TTH		-	324 (78)	98 (68)	13 (62)	
Migraine, without TTH		-	70 (17)	25 (17)	2 (10)	
Migraine, with TTH		-	9 (2)	12 (8)	4 (19)	
Non-classifiable		-	15 (4)	10 (7)	2 (9)	<0.001‖
Age, in years	3788	15.8 (1.7)	15.7 (1.7)	15.7 (1.6)	15.8 (2.1)	0.596¶
Family Structure	3748					
Living w/both parents		2206 (70)	273 (66)	85 (60)	12 (60)	
Other		968 (30)	139 (34)	57 (40)	8 (40)	0.047‖
Family Economy	3465					
Above average		614 (21)	82 (22)	26 (20)	0 (0)	
Average		2107 (72)	262 (69)	89 (67)	12 (63)	
Below average		211 (7)	38 (10)	17 (13)	7 (37)	<0.001‖
Sum of PTIEs‡	3527					
0		2023 (68)	244 (64)	70 (53)	9 (50)	
1		622 (21)	67 (17)	31 (24)	4 (22)	
2		255 (9)	49 (13)	18 (14)	3 (17)	
≥3		95 (3)	23 (6)	12 (9)	2 (11)	<0.001‖
Psychological Distress§	3617	1.3 (0.4)	1.5 (0.5)	1.5 (0.6)	1.9 (0.7)	<0.001¶

Abbreviations: PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-Type headache

* Recurrent headache is defined as headache ≥ monthly

† Because of rounding percentages may not total 100

‡ Exposure to PTIEs is measured as the sum of 5 binary variables

§ Range of possible score is 1 to 4

‖ Pearson Chi square test

¶ ANONVA, analysis of variance

Table 1. Sociodemographics, Exposure to PTIEs, Psychological Distress, and Headache Type, by Frequency of Headache Complaints (n=7620)*†.

Characteristics	No. of Individuals	No Recurrent Headache	Recurrent Headache			p value
			Monthly	Weekly	Daily	
Female						
Headache, No. (%)	3832	2707 (71)	653 (17)	385 (10)	87 (2)	
TTH		0 (0)	461 (71)	249 (65)	39 (45)	
Migraine, withouh TTH		0 (0)	137 (21)	78 (20)	19 (22)	
Migraine, with TTH		0 (0)	24 (4)	43 (11)	22 (25)	
Migraine, with visual aura	134	0 (0)	64 (10)	54 (14)	16 (18)	
Other headaches		0 (0)	31 (5)	15 (4)	7 (8)	<0.001‖
Age, mean (SD), y	3832	15.8 (1.7)	15.9 (1.7)	16.1 (1.8)	16.0 (1.7)	0.02¶
Family Structure, No. (%)	3798					
Living w/ both parents		1819 (68)	396 (61)	216 (57)	42 (48)	
Other		865 (32)	250 (39)	165 (43)	45 (52)	<0.001‖
Family Economy, No. (%)	3630					
Above average		413 (16)	77 (13)	57 (16)	8 (10)	
Average		1946 (76)	456 (75)	252 (69)	62 (73)	
Below average		215 (8)	74 (12)	55 (15)	15 (18)	<0.001‖
Sum of PTIE†, No. (%)	3662					
0		2031 (78)	423 (68)	226 (61)	47 (56)	
1		382 (15)	119 (19)	69 (19)	22 (26)	
2		108 (4)	50 (8)	39 (11)	5 (6)	
≥3		68 (3)	28 (5)	35 (9)	10 (12)	<0.001‖
Psychological Distress§, mean (SD)	3740	1.6 (0.5)	1.8 (0.6)	2.0 (0.7)	2.0 (0.7)	<0.001¶
Male						

Headache, No. (%)	3788	3204 (85)	418 (11)	145 (4)	21 (1)	
TTH		0 (0)	324 (78)	98 (68)	13 (62)	
Migraine, without TTH		0 (0)	70 (17)	25 (17)	2 (10)	
Migraine, with TTH		0 (0)	9 (2)	12 (8)	4 (19)	
Migraine, with visual aura	72	0 (0)	47 (11)	23 (16)	2 (10)	
Other headaches		0 (0)	15 (4)	10 (7)	2 (9)	<0.001‖
Age, mean (SD), y	3788	15.8 (1.7)	15.7 (1.7)	15.7 (1.6)	15.8 (2.1)	0.60¶
Family Structure, No. (%)	3748					
Living w/ both parents		2206 (70)	273 (66)	85 (60)	12 (60)	
Other		968 (30)	139 (34)	57 (40)	8 (40)	0.05‖
Family Economy, No. (%)	3465					
Above average		614 (21)	82 (22)	26 (20)	0 (0)	
Average		2107 (72)	262 (69)	89 (67)	12 (63)	
Below average		211 (7)	38 (10)	17 (13)	7 (37)	<0.001‖
Sum of PTIEs†¨No. (%)	3527					
0		2023 (68)	244 (64)	70 (53)	9 (50)	
1		622 (21)	67 (17)	31 (24)	4 (22)	
2		255 (9)	49 (13)	18 (14)	3 (17)	
≥3		95 (3)	23 (6)	12 (9)	2 (11)	<0.001‖
Psychological Distress§, mean (SD)	3617	1.3 (0.4)	1.5 (0.5)	1.5 (0.6)	1.9 (0.7)	<0.001¶

Abbreviations: PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-type headache.

* Recurrent headache¨is defined as headache ≥ monthly.

‡¨Because of rounding percentages may not total 100.

† Exposure to PTIEs is measured as the sum of 5 binary exposure variables.

§¨Range of possible score is 1 to 4.

‖ Pearson Chi-square test.

¶ ANONVA, analysis of variance.

Generally, twice as many girls as boys reported recurrent headache. Amongst girls 20% reported TTH and 8% reported migraine (with or without TTH), whilst 11% of boys reported TTH and 3% reported migraine. Prevalence increased with age in girls, but not in boys. ~~and girls reported increasing complaints with increasing age. The prevalence rate of recurrent monthly headache was 22%, including 16% who reported tension-type headache (TTH), and 6% who reported migraines (4.5% reported only migraine and another 1.5% reported migraine with TTH)~~. About two thirds of adolescents with only TTH or migraine reported monthly recurrence, whilst those with combined migraine and TTH headache mostly reported weekly or daily complaints. Despite sex differences in headache prevalence, the socio-demographic distribution of recurrent headache followed similar patterns for both sexes, linking living in 'other' family structures and having a family economy 'below average' with recurrent headache~~s~~.

In the present study 26% of girls and 33% of boys reported exposure to one or more types of ~~potentially traumatic events~~PTIEs, whilst 4% of both sexes reported exposure to 3 or more ~~victimizations~~. AAmongst adolescents ~~reporting no~~without recurrent headache ~~complaints~~ reported the lowest exposure to PTIEs, with 73% report~~inged~~ no ~~victimizations~~exposure, ~~whilst~~ 18% report~~inged~~ exposure to one ~~PTIE~~, and 9% report~~inged~~ exposure to two or more PTIEs. ~~The reported level of exposure to PTIEs seemed to increase across frequencies of headache complaints for both sexes, with the~~. Whereas the highest degree of ~~victimization~~ PTIE exposure was observed amongst adolescents with ~~chronic~~ daily headache~~s~~, of whom only 55% reported no exposure, 25% reported exposure to 1, ~~PTIE~~ and 20% reported exposure to two or more PTIEs. Mean score for psychological distress was 1.49 (±0.55) (SCL-5), and increasing distress was significantly associated with recurrent headache ~~complaints~~, as assessed in univariate analysis.

A multiple logistic regression analysis, adjusted for sociodemographic factors, revealed a steady trend of increasing odds for recurrent headache with increasing exposure to PTIEs (Table 2, Model 1). The strength of associations between exposure to PTIEs and recurrent headache consistently and significantly decreased after psychological distress was entered into the regression equation (Table 2, Model 2), as assessed in analysis of ratio of odds ratio with bootstrap 95% percentile CIs. Moreover, the magnitude of attenuation in ORs seemed to increase with increasing exposure to PTIEs.

Table 2. Recurrent Headache in Relation to Exposure to PTIEs and Psychological Distress, by Sex.*†‡

		Recurrent Headache (n=1514)			
		Female (n=1021)		**Male** (n=496)	
		Model 1	Model 2	Model 1	Model 2
Variables	n	OR_1 (CI)	OR_2 (CI)	OR_1 (CI)	OR_2 (CI)
Sum of PTIEs					
0	4789	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	1250	1.46 (1.20-1.78)	1.25 (1.02-1.53)	1.04 (0.81-1.34)	0.93 (0.72-1.20)
2	496	2.28 (1.69-3.08)	1.73 (1.27-2.36)	1.71 (1.25-2.33)	1.41 (1.03-1.94)
≥3	252	2.61 (1.82-3.75)	1.69 (1.15-2.47)	2.29 (1.49-3.52)	1.57 (1.00-2.47)
Overall p-value		<0.001	<0.001	<0.001	0.029
Psychological Distress	6787		1.94 (1.70-2.22)		2.10 (1.72-2.58)

Abbreviations: CI, 95% Confidence Interval; OR_1 and OR_2, Odds Ratio for Regression Model 1 and Model 2, respectively; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are explained in footnotes to Table 1.

† Analyses are restricted to adolescents no missing values for all included variables (3494 females and 3293 males).

‡ Both regression models are adjusted for age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

Table 2. Recurrent Headache in Relation to Exposure to PTIEs, Sociodemography and Psychological Distress, by Sex*†‡.

		Recurrent Headache, (n=1514)					
		Female (n=1021)			Male (n=496)		
Variables	No.	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2/OR_1 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2/OR_1 (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.46 (1.20-1.78)	1.25 (1.02-1.53)	0.86 (0.82-0.90)	1.04 (0.81-1.34)	0.93 (0.72-1.20)	0.89 (0.85-0.93)
2	496	2.28 (1.69-3.08)	1.73 (1.27-2.36)	0.76 (0.69-0.82)	1.71 (1.25-2.33)	1.41 (1.03-1.94)	0.83 (0.76-0.88)
≥3	252	2.61 (1.82-3.75)	1.69 (1.15-2.47)	0.65 (0.57-0.73)	2.29 (1.49-3.52)	1.57 (1.00-2.47)	0.69 (0.59-0.78)
Overall p-value		<0.001	<0.001		<0.001	0.029	
Age	6787	1.05 (1.00-1.09)	1.02 (0.98-1.07)		0.95 (0.89-1.00)	0.93 (0.87-0.98)	
Family Structure							
Living w/mother and father	4572	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
Other	2215	1.27 (1.09-1.49)	1.22 (1.04-1.43)		1.29 (1.05-1.58)	1.26 (1.03-1.55)	
Family Economy							
Above average	1214	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
Average	4966	1.16 (0.94-1.44)	1.23 (0.99-1.53)		0.93 (0.73-1.18)	0.95 (0.75-1.21)	
Below Average	607	1.61 (1.19-2.17)	1.41 (1.04-1.92)		1.36 (0.94-1.97)	1.10 (0.75-1.60)	
Psychological Distress	6787		1.94 (1.70-2.22)			2.10 (1.72-2.58)	

Abbreviations: CI, 95% Confidence Interval; OR_1, Odds Ratio for Regression Model 1; OR_2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are explained in footnotes to Table 1.

‡ Analyses were restricted to adolescents without missing values, (3494 females and 3293 males).

† All regression models are adjusted for age, family structure and family economy. Model 2 is additionally adjusted for psychological distress. Mediation by psychological distress is tested through analysis of ratio of odds ratio (Model 2/Model 1 = OR1 /OR2) with bootstrap 95% percentile confidence intervals presented, 10 000 replications.

~~The direct effect of exposure to PTIEs decreased after the hypothesized mediator, psychological distress, was entered into the regression equation (Table 2, Model 2). Bootstrap confidence intervals for the magnitude of this attenuation in OR when entering psychological distress in the regression equation ($1 - (OR_2 / OR_1)$ (Model2/1), indicated a significant reduction in ORs. Moreover, the magnitude of attenuation in OR increased with increasing exposure.~~

Similarly, ~~when investigating~~ the association~~s~~ between ~~trauma~~ exposure to PTIEs and headache by 'monthly', 'weekly', and 'daily' recurrence, respectively, were all~~a~~ significant and cumulative ~~association was found~~ (Model 1, Table 3). ~~Further, for~~For all frequencies of recurrent headache as outcomes, we ~~found~~ observed a significant ~~and cumulative~~ attenuation in OR~~r~~s, ~~when introducing~~with inclusion of psychological distress ~~as a potential mediator~~ in the logistic regression analyses (Model 2). ~~The associations~~ We found a stronger relationship between exposure to PTIEs and ~~were significantly stronger between PTIEs and~~ weekly, or more frequent, headache, compared to ~~, as~~ monthly headache. ~~compared to monthly complaints, although~~ This difference~~s~~ in strength of associations ~~leveled~~levelled out when ~~entering~~ adjusting for psychological distress~~, as the potential mediator, in the logistic regression analysis~~ (supplementary table A1~~3~~, online only).

Table 3. Recurrent Headache in Relation to Exposure to PTIEs, by Frequency of Recurrent Headache Complaints*†‡.

		Recurrent Headache, (n=1514)								
		Monthly Headache, (n=942)			Weekly Headache, (n=472)			Daily Headache, (n=100)		
Variables	No.	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2/OR_1 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2/OR_1 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_2/OR_1 (CI)
Sum of PTIEs										
0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.17 (0.97-1.41)	1.05 (0.87-1.27)	0.90 (0.87-0.93)	1.40 (1.08-1.81)	1.18 (0.91-1.53)	0.85 (0.80-0.89)	2.03 (1.23-3.36)	1.58 (0.95-2.64)	0.78 (0.70-0.86)
2	496	1.77 (1.37-2.28)	1.46 (1.12-1.90)	0.83 (0.78-0.87)	2.46 (1.77-3.41)	1.78 (1.26-2.50)	0.72 (0.65-0.79)	1.93 (0.89-4.20)	1.17 (0.52-2.63)	0.61 (0.48-0.73)
≥3	252	1.74 (1.22-2.48)	1.30 (0.90-1.87)	0.74 (0.67-0.81)	3.80 (2.61-5.54)	2.18 (1.45-3.27)	0.57 (0.49-0.66)	4.53 (2.26-9.07)	2.03 (0.95-4.34)	0.45 (0.32-0.60)
Overall p-value		<0.001	0.028		<0.001	<0.001		<0.001	0.164	
Sex§	6787	1.89 (1.64-2.19)	1.60 (1.38-1.87)		3.51 (2.82-4.37)	2.62 (2.09-3.30)		5.14 (3.06-8.64)	3.56 (2.09-6.07)	
Psychological Distress	6787		1.71 (1.50-1.95)			2.24 (1.90-2.63)			2.78 (2.03-3.80)	

Abbreviations: CI, 95% Confidence Interval; OR1, Odds Ratio for Regression Model 1; OR2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents without missing values, (n=6787).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress. Mediation by psychological distress is tested through analysis of ratio of odds ratio (Model2/Model1= OR2 /OR1) with bootstrap 95% percentile confidence intervals presented, 10 000 replications.

§ Male is reference category

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Table 3. Recurrent Headache by Frequency, in Relation to Exposure to PTIEs, Sex and Psychological Distress.*†‡

		Recurrent Headache (n=1514)					
		Monthly (n=942)		**Weekly** (n=472)		**Daily** (n=100)	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Variables	n	OR_1 (CI)	OR_2 (CI)	OR_1 (CI)	OR_2 (CI)	OR_1 (CI)	OR_2 (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	1250	1.17 (0.97-1.41)	1.05 (0.87-1.27)	1.40 (1.08-1.81)	1.18 (0.91-1.53)	2.03 (1.23-3.36)	1.58 (0.95-2.64)
2	496	1.77 (1.37-2.28)	1.46 (1.12-1.90)	2.46 (1.77-3.41)	1.78 (1.26-2.50)	1.93 (0.89-4.20)	1.17 (0.52-2.63)
≥3	252	1.74 (1.22-2.48)	1.30 (0.90-1.87)	3.80 (2.61-5.54)	2.18 (1.45-3.27)	4.53 (2.26-9.07)	2.03 (0.95-4.34)
Overall p-value		<0.001	0.028	<0.001	<0.001	<0.001	0.164
Sex§	6787	1.89 (1.64-2.19)	1.60 (1.38-1.87)	3.51 (2.82-4.37)	2.62 (2.09-3.30)	5.14 (3.06-8.64)	3.56 (2.09-6.07)
Psychological Distress	6787		1.71 (1.50-1.95)		2.24 (1.90-2.63)		2.78 (2.03-3.80)

Abbreviations: CI, 95% Confidence Interval; OR_1 and OR_2, Odds Ratio for Regression Model 1and Model 2, respectively; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses are restricted to adolescents without missing values, (n=6787).

‡ Both models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

§ Male is reference category

The association between exposure to PTIEs and subtypes of recurrent headache followed a similar consistently significant and cumulative pattern ~~.~~ for all assessed subtypes of recurrent headache; including t~~T~~ension-type headache (TTH), ~~simple~~ migraine without TTH, migraine with ~~tension-type headache~~TTH, and ~~'other'~~non-classifiable headache~~.s were all significantly and cumulatively associated with exposure to PTIEs~~ (Model 1, Table 4). Adding psychological distress ~~as a mediator~~ in regression Model 2, for all four subtypes of recurrent headache yielded a significant reduction in ORs ~~OR (1 – OR_2 / OR_1)~~ for all analyses. The association between PTIEs and recurrent headache was significantly stronger amongst adolescents reporting any migraine (with or without TTH), in comparison to adolescents reporting TTH only (supplementary table A2, online only). This observed difference between subtypes, seemed to be mainly driven by a stronger association between exposure to PTIEs and migraine with TTH, as opposed to TTH only. We found no significant difference in associations between victimization and the two groups of migraine; migraine with or without TTH.

~~*a significant reduction in OR (1 – OR_2 / OR_1) for all analyses.*~~ .
~~The association between traumatic events and recurrent headache was significantly stronger amongst those reporting any migraine in comparison to tension-type headache only (supplementary table A4, online only). This observed difference between groups was mainly driven by a stronger association between exposure to trauma and combined migraine with TTH, as opposed to TTH only. We found no significant differences in associations to victimization between the two groups of migraine only versus combined migraine and TTH headaches.~~

Table 4. Recurrent Headache in Relation to Exposure to PTIEs, by Type of Headache Complaints*††.

		Recurrent Headache, (n=1514)					
		TTH, only (n=1048)			Migraine, only (n=293)		
Variables	No.	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.16	1.01	0.87	1.59	1.40	0.88
		(0.97-1.39)	(0.84-1.22)	(0.84-0.90)	(1.17-2.17)	(1.02-1.92)	(0.83-0.92)
2	496	1.71	1.35	0.79	2.26	1.76	0.78
		(1.34-2.20)	(1.04-1.75)	(0.74-0.84)	(1.48-3.44)	(1.14-2.72)	(0.69-0.86)
≥3	252	2.12	1.42	0.67	3.39	2.19	0.65
		(1.54-2.92)	(1.02-1.99)	(0.60-0.74)	(2.10-5.48)	(1.31-3.66)	(0.54-0.76)
Overall p-value		<0.001	0.034		<0.001	0.003	
Sex§	6787	2.10	1.71		3.08	2.49	
		(1.83-2.42)	(1.47-1.97)		(2.36-4.02)	(1.88-3.28)	
Psychological distress	6787		1.95			1.83	
			(1.72-2.21)			(1.49-2.25)	

		Migraine w/ TTH, (n=104)			Other Headache, (n=69)		
Variables	No.	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)	Model 1 OR_1 (CI)	Model 2 OR_2 (CI)	Model 2/1 OR_1/OR_2 (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]		1 [Reference]	1 [Reference]	
1	1250	1.64	1.38	0.84	1.62	1.40	0.86
		(0.98-2.76)	(0.82-2.33)	(0.77-0.91)	(0.88-2.97)	(0.76-2.58)	(0.77-0.96)
2	496	3.72	2.46	0.66	3.26	2.45	0.75
		(2.04-6.76)	(1.32-4.60)	(0.54-0.79)	(1.60-6.63)	(1.17-5.11)	(0.59-0.92)
≥3	252	6.08	3.36	0.55	1.69	1.08	0.64
		(3.16-11.70)	(1.66-6.77)	(0.42-0.70)	(0.50-5.68)	(0.31-3.78)	(0.39-0.89)
Overall p-value		<0.001	0.002		0.011	0.113	
Sex§	6787	4.73	3.38		2.94	2.31	
		(2.91-7.68)	(2.05-5.57)		(1.73-5.00)	(1.33-4.01)	
Psychological distress	6787		2.41			1.95	
			(1.77-3.27)			(1.31-2.88)	

Abbreviations: CI, 95% Confidence Interval; OR_1, Odds Ratio for Regression Model 1; OR_2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-type Headache.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents without missing values, (n=6787).

‡ Model 1 is adjusted for sex, age, family structure and family economy. Model 2 is adjusted for psychological distress, sex, age, family structure and family economy. Mediation by psychological distress is evaluated through analysis of ratio of odds ratio (Model 2/Model 1 = OR1 /OR2) with bootstrap 95% percentile confidence intervals presented, 10 000 replications.

§ Male is reference category

Table 4. Recurrent Headache by Type, in Relation to Exposure to PTIEs, Sex and Psychological Distress.*†‡

		Recurrent Headache (n=1445)					
		TTH (n=1048)		Migraine without TTH (n=293)		Migraine with TTH (n=104)	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Variables	n	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)	OR (CI)
Sum of PTIEs							
0	4789	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
1	1250	1.16 (0.97-1.39)	1.01 (0.84-1.22)	1.59 (1.17-2.17)	1.40 (1.02-1.92)	1.64 (0.98-2.76)	1.38 (0.82-2.33)
2	496	1.71 (1.34-2.20)	1.35 (1.04-1.75)	2.26 (1.17-2.17)	1.76 (1.14-2.72)	3.72 (2.04-6.76)	2.46 (1.32-4.60)
≥3	252	2.12 (1.54-2.92)	1.42 (1.02-1.99)	3.39 (2.10-5.48)	2.19 (1.31-3.66)	6.08 (3.16-11.70)	3.36 (1.66-6.77)
Overall p-value		<0.001	0.034	<0.001	0.003	<0.001	0.002
Sex§	6787	2.10 (1.83-2.42)	1.71 (1.47-1.97)	3.08 (2.36-4.02)	2.49 (1.88-3.28)	4.73 (2.91-7.68)	3.38 (2.05-5.57)
Psychological distress	6787		1.95 (1.72-2.21)		1.83 (1.49-2.25)		2.41 (1.77-3.27)

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio; PTIE, Potentially Traumatic Interpersonal Event; TTH, Tension-type Headache.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents without missing values, (n=6787). Data for analysis of non-classifiable recurrent headache (n=69) is not presented.

‡ Model 1 is adjusted for sex, age, family structure and family economy. Model 2 is adjusted for psychological distress, sex, age, family structure and family economy.

§ Male is reference category

Furthermore, in subgroup analysis, investigating the ~~role~~ impact of posttraumatic stress reactions on ~~as a potential additional mediator of~~ the relationship between ~~victimization~~ exposure to PTIEs and recurrent headache, posttraumatic stress reactions independently and significantly attenuated ORs. ~~Nonetheless, the~~The contribution of posttraumatic stress reactions became ~~additional contribution of posttraumatic stress, when~~insignificant when we additionally ~~also accounted for~~adjusted for general psychological distress~~, was insignificant (Table 5).~~.

Table 5. Recurrent Headache in Relation to Exposure to PTIEs, adjusted for Psychological Distress and Posttraumatic Stress Reactions*††.

		Recurrent Headache, (n=487)						
Variables	**No.**	Model 1 OR_1 (CI)	Model 2a OR_2 (CI)	Model 2a /Model 1 OR_2/OR_1 (CI)	Model 2b OR_2 (CI)	Model 2b /Model 1 OR_2/OR_1 (CI)	Model 2c OR_2 (CI)	Model 2c /Model 1 OR_2/OR_1 (CI)
Sum of PTIEs								
1	1055	1 [Reference]	1 [Reference]		1 [Reference]		1 [Reference]	
2	459	1.59(1.23-2.05)	1.46(1.13-1.89)	0.92 (0.87-0.96)	1.52(1.18-1.97)	0.96 (0.92-0.99)	1.44(1.11-1.87)	0.91 (0.85-0.96)
≥3	226	2.15(1.57-2.94)	1.69(1.21-2.35)	0.79 (0.71-0.86)	1.91(1.39-2.64)	0.89 (0.82-0.96)	1.63(1.17-2.27)	0.76 (0.67-0.84)
Overall p-value		<0.001	0.001		<0.001		0.002	
Sex§	1740	3.01 (2.40-3.77)	2.44 (1.93-3.10)		2.60 (2.06-3.30)		2.29(1.80-2.92)	
Psychological distress			1.68(1.40-2.01)				1.57(1.30-1.91)	
Posttraumatic Stress Reactions								
0	792				1 [Reference]		1 [Reference]	
1	417				1.13(0.84-1.51)		1.08(0.81-1.45)	
2	298				1.64(1.20-2.24)		1.45(1.05-1.99)	

3	233	1.78(1.26-2.50)	1.36(0.95-1.96)
Overall p-value		0.001	0.100

Abbreviations: CI, 95% Confidence Interval; OR1, Odds Ratio for Regression Model 1; OR2, Odds Ratio for Regression Model 2; PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents exposed to ≥1 PTIE, without missing values for any of the included variables, n=1740 (946 males and 794 females).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2a is additionally adjusted for psychological distress, Model 2b for posttraumatic stress reactions and Model 2c for both psychological distress and posttraumatic stress reactions. Mediation by psychological distress and/or posttraumatic stress reactions is evaluated through analysis of ratios of odds ratios (Model 2a-c/Model 1) with bootstrap 95% percentile-confidence intervals presented, 10 000 replications.

§ Male is reference category

DISCUSSION

To our knowledge this is the first population-based study to comprehensively assess associations between exposure to multiple ~~victimization~~ potentially traumatic interpersonal events (PTIEs) and recurrent headache, meeting the ICHD-II criteria. ~~The main findings were firstly, documentation~~ The study documents~~of~~ a strong and consistent relationship between exposure to ~~potentially traumatic interpersonal events (~~PTIEs~~)~~ and recurrent headache~~s~~ experienced by adolescents.~~,~~ The association was observed for both monthly, weekly and daily headache, although significantly stronger for weekly or more frequent complaints. ~~regardless of frequency of complaints. Secondly,~~ ~~A~~a similar, robust pattern was found between exposure to PTIEs and ICHD-II defined tension-type headache (TTH), migraine without TTH, migraine with TTH, and non-classifiable headache. ~~across all major subtypes of complaints. Thirdly,~~ Increasing exposure to PTIEs was associated with ~~a cumulative increase higher~~ ~~in strengths of associations was observed for~~prevalence of all assessed frequencies and ~~main~~ subtypes of recurrent headache~~with increasing victimization~~, indicating a dose-response relationship. ~~Last, the~~ Furthermore, ~~observed dependency between trauma exposure, general psychological distress and all recurrent headaches possibly reflect the role of psychological distress as a mediator on the pathway linking exposure to PTIEs and recurrent headache complaints. This~~ adjustment for psychological distress lead to a consistent and significant decrease in strength of associations between exposure to PTIEs and all frequencies and subtypes of recurrent headache. ~~mediating role of psychological distress on the relationship between trauma exposure and recurrent headache consistently amplified with sum of exposure to PTIEs for all frequencies and main subtypes of headache complaints.~~ Posttraumatic stress reactions ~~seemed~~ seem to play a similar ~~mediating~~ role ~~in subgroup analysis~~, although adjustment for general distress ~~leveled~~levelled out ~~it's~~its

specific effect. This may indicate that general psychological distress, as measured within this ~~study,~~study; encompass posttraumatic stress reactions, as found in a recent study of comorbidity in adolescents.[46]~~to some degree encompassed posttraumatic stress reactions.[42]~~

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The strengths of this study were the large sample size, the overall high participation rate, the use of a validated headache interview based upon the International Classification of Headache Disorder (II) criteria,[40] and the opportunity to assess the impact of several types of ~~victimization~~ PTIEs and confounding factors, within a population based cohort of adolescents.

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Importantly, the retrospective, cross-sectional study-design did not allow for causal inference, or differentiation between confounding and mediational effects. Findings should thus be interpreted within the given constraints of the study. ~~Although our findings indicate that exposure to trauma may be a causal factor in the chronification of headache disorders, our retrospective, cross-sectional study-design did not allow for causal inference, and findings should thus be interpreted within the given constraints of the study.~~

The lower participation- and response--rate among adolescents ~~who were out of~~not enrolled in school, and among those in senior high school compared with junior high school, represent a possible selection bias. ~~We also found that~~Additionally, young adolescents, boys, and adolescents not living with both parents were less likely to respond to the PTIE items. This missing-pattern may represent another source of -selection bias. The most prominent observed selection-bias within this study is the high non-response amongst adolescents not enrolled in school, which may have ~~regarding victimization~~. ~~These possible selection biases may have~~ led to an underestimation of the associations.[47] Our measures of PTIEs lack

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event-specific information on relationship to perpetrator, severity, frequency, duration and recency of exposure,[48] and commonly occurring PTIEs, such as emotional abuse, peer relational victimization and cyber-bullying were not addressed.[49 50] ~~[48]~~The above mentioned uncertainties, related to the measurement of PTIEs, may have affected the observed strengths of associations. Furthermore, analysis on an additional outcome-measure of headache-related functional impairment would, most probably, have strengthened associations.[24] ~~[51][31 58][56 57][30 35][51]A validated, comprehensive measure of trauma exposure would have strengthened the study, as would [30] a validated measure of headache related functional impairment.[24] [23]~~ Despite these, accounted for, potential selection-biases and measurement uncertainties, it is likely that the main findings can be generalized to other adolescent populations.

Prevalence rates of recurrent headache, including frequencies and subtypes of complaints, were in large unchanged in comparison with national headache ~~prevalence~~prevalence ~~rates~~ from 1995-1997,[51] and within the lower range of aggregated international estimates.[6] Further, the observed patterns of distribution of recurrent headache in this study, in relation to sex, age, [6] sociodemography[2 16 20] and psychological distress[2 4 10 19] complied with previous epidemiological documentation.~~As previously documented prevalence rates were doubled in girls as compared to boys, rose steadily with age throughout adolescence in females, whilst flattening out in males,[6] and were higher in adolescents reporting psychological distress,[2 4 10 19] living without both parents,[20] or within family economies below average.[2 16] Although overall comparison of traumatization~~ Likewise, the observed prevalence of exposure to PTIEs in our study was within the lower range, and distribution followed similar patterns, to that observed in comparable studies, although comparison

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across measures and populations is difficult. ~~the observed prevalence rates and patterns of distribution of exposure in our study complied with that reported elsewhere, although in the lower range.~~[28 33] Regarding levels of psychological distress screening estimates were in correspondence with ~~previous~~ prior national and international findings.[42 46]

Our main findings substantiate ~~of a strong, consistent and cumulative relationship between exposure to interpersonal trauma and recurrent headache in a general adolescent population, complies with~~ recent but scarce evidence provided by cross-sectional population-based studies of adolescents, of a significant association between exposure to PTIEs and headache.~~, of which two~~Two of these studies used the ICHD-II criteria.[14 21 23 25] Further, results are in coherence with one population-based,[52] two clinical,[27 53] and another two convenience-sample[26 54] retrospective, cross-sectional studies of adults, of which one used the ICHD-II criteria.[27] Apart from one adolescent study which examined girls only,[14] and the adult convenience sample study,[26] the sample-sizes in these studies were smaller, ~~in comparison to~~than in the present study. Generally, the adolescent studies assessed exposure to one type of ~~trauma exposure~~ PTIEs only, whilst the adult studies looked specifically at child abuse and family dysfunction.

~~In regard to the question of~~Concerning temporality of associations, a large cohort study using follow-up data over 12 years of adolescent and adult Canadians recently found childhood adversity and depression to be significant predictors of adult migraine.[38] Additionally, observational, prospective, convenience sample studies of adolescents exposed to bullying lend evidence to the more general relationship between victimization and psychosomatic complaints, although headache measurements in these studies were too

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imprecise to draw more specific conclusions of associations.[49 55 56] Taken together, ~~scarce~~ some evidence suggests that ~~victimization~~ PTIEs may be ~~an~~ important factors on the causal pathway leading to onset and chronification of ~~headache disorder~~headache disorder.

Amongst the observed relationships, between ~~trauma~~ exposure to PTIEs and main subtypes of headache, migraine was most strongly linked to ~~victimization~~exposure. ~~This discrepancy between tension-type headache and migraine~~ The observed stronger association between PTIEs and migraine, as opposed to TTH~~seemed~~, seemed to be explained ~~large~~in large~~ly~~ by the stronger association between ~~trauma~~ exposure to PTIEs and combined headache (migraine with ~~tension-type complaints~~TTH). ~~The~~This ~~se findings~~ may ~~reflect a pattern where~~indicate that exposure to ~~interpersonal trauma~~PTIEs predispose for more severe ~~headache complaints,~~ and ~~comorbidity in the form of multiple types of~~complex head pains,[57] reflecting a similar pattern as that observed in the relationship between ~~trauma~~ PTIE-exposure and comorbidity of psychiatric disorders.~~psychopathology.~~[29] Such an interpretation complies with previous findings that both migraines in ~~general,~~general and combined migraines ~~and tension-type headaches~~ specifically, tend to be clinically more severe and disabling, ~~in comparison~~compared to ~~other primary headache disorders~~TTH only.[18 19] On the other hand, the observed discrepancies in strength of associations ~~between PTIEs and subtypes of headaches~~ may be an artefact of underlying chronification of complaints, as ~~combined~~ migraine ~~and~~ with ~~tension-type headache~~TTH was more often experienced weekly or daily, as opposed to migraine or TTH only, which mostly recurred monthly.

~~In~~ Our findings suggest that ~~this study we found~~ psychological distress ~~to~~ may ~~be~~ play an important role as a confounder, or a mediator. ~~one plausible mediator via which traumatic experiences may increase the risk of chronification of headache complaints in adolescents.~~ A

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mediating role would~~This finding~~ comply~~ies~~ with current pathophysiological understanding, where violence as an environmental stressor, may acutely or over time overwhelm, exhaust and further dysregulate the stress response system.[58] Pathological effects, such as recurrent headache, though initially induced by external trauma, may largely be related to persistence of physiological distress, functioning as an internal stressor that triggers cerebral sensitization and hypersensitivity through alterations of shared neuroendoimmunological pathways of emotion and pain, which in turn may lead to hyperalgesia and chronification of headache disorders.[3 9 17 59] Future interdisciplinary studies need to explore these suggested ~~pathways~~ mechanisms to delineate etiological pathways, and further enable tailored interventions.

Sex differences in the strength of associations between PTIEs and recurrent headache may be related to the gender-biased qualitative differences of reported PTIEs, such as girls being more prone to sexual abuse and exposure within their social networks.[37] Such exposure is associated with worse health outcomes, which are possibly related to the developmental stage at the time of abuse, proximity to the perpetrator, and the persistence and severity of the abuse.[31 60] Other possible mechanisms may be related to developmental biological differences, or sociocultural gender role expectations affecting reaction patterns,[61] predisposing girls to internalizing as opposed to externalizing behaviour, which in turn increase their susceptibility of experiencing persistent chronic pain.[62]

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Conclusion and implications

Our main findings comply with essential features of current theoretical models of developmental psychopathology,[63] recurrent pain-[62] and chronic ~~pediatric~~paediatric

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headache ~~-~~[3 17 64] that underscore the need for a biopsychosocial approach to understand adverse health outcomes in childhood.~~[64]~~ Knowing that recurrent headaches are amongst the most common causes of disability in adults and adolescents alike,[1 18] substantiated empirical evidence of a strong, consistent and cumulative relationship between exposure to ~~trauma~~PTIEs, psychological distress and recurrent headache, regardless of subtype, demands for further investigation.~~-~~[23] We are currently at a stage where we recognize that childhood ~~trauma~~victimization~~, abuse~~ and adversities do little good for psychological and somatic health and development, and yet we lack valid, distinct and precise knowledge to guide public health interventions and clinical practice. Thus, primarily there is a need for more comprehensive, interdisciplinary research, preferably prospective, using valid measurements of risk factors and clinically applicable outcome-measures, aiming to identify underlying gene-environment ~~interactions~~ interplay, or biopsychosocial causal pathways, as targets of tailored prevention and intervention. Secondly, from a more general public health perspective, the observed dependency between ~~trauma~~ exposure to PTIEs and highly prevalent psychological and somatic conditions challenges the traditional dichotomization of health services, requiring establishment and maintenance of low-threshold, local health services directed toward adolescents that integrate and accommodate psychological and somatic needs.[64-67]

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CONTRIBUTORSHIP

Contributors: SØS carried out the data processing, ~~analysed~~analyzed the data, drafted and revised the paper. She is the guarantor. GD and JAZ contributed to the ~~intergration~~integration of the headache interview, measures of victimization and posttraumatic distress in the Young-HUNT3 Study. GD and ST wrote the original study protocol, applied for and received the grant for the study, and further participated in the epidemiological ~~modelling~~modeling, analysis and writing of the manuscript. TWL contributed to the statistical analysis. JAZ participated in the design of the study and helped to write the manuscript. All authors have read and approved the final version of the manuscript.

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COMPETING INTERESTS/DISCLOSURE

None declared. Synne Øien ~~.~~Stensland, Grete Dyb, Siri Thoresen, Tore Wentzel-Larsen and John-Anker Zwart report no competing interests. All authors have completed the BMJ declaration of competing interests and the Unified Competing Interest form (available on request from the corresponding author) and declare that S. Stensland has support from The Norwegian Council for Mental Health, The Norwegian ~~ExtraFoundation~~Extra Foundation for Health and Rehabilitation for the submitted work; (2) none have relationships with companies that might have an interest in the submitted work in the previous 5 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) the authors have no non-financial interests that may be relevant to the submitted work.

ACCESS AND INTEGRITY OF ALL AUTHORS

All authors had full access to all of the data (including statistical reports and tables) in the study and can take full responsibility for the integrity of the data and the accuracy of the data analysis.

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ETHICS APPROVAL

Inclusion was based upon written consent from participants aged 16 years and older and from parents for those under 16, in accordance with Norwegian law. This study was approved by the Norwegian Regional Committee for Medical and Health Research Ethics.

DATA SHARING STATEMENT

Data are available from the HUNT study http://www.huntbiosciences.com/Cohorts/Diabetes/The-HUNT-Bio-And-Databank. The general health questionnaire and headache interview used in the study are accessible from the HUNT bio-and databank (http://www.ntnu.edu/hunt/data/que). There is no additional data available.

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THE ORIGINAL STUDY PROTOCOL

The original study protocol is accessible from the corresponding author, and may be translated from Norwegian to English on ~~request .~~request.

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APPENDIX

SUPPLEMENTARY TABLES.

Between groups comparison of risk of recurrent headache

Table A1. Assessment of Differences in Association Between Varying Frequencies of Recurrent Headache Complaints in Relation to Exposure to PTIEs and Psychological Distress*†‡.

		Recurrent headache, n=1514							
		Monthly vs. Weekly			Weekly vs. Daily			Monthly vs. Daily	
Variables	**N**	Model 1 OR_1 (CI)	Model 2 OR_2(CI)	**N**	Model 1 OR_1 (CI)	Model 2 OR_2(CI)	**N**	Model 1 OR_1 (CI)	Model 2 OR_2(CI)
Sum of PTIEs									
0	908	[Reference]	[Reference]	334	[Reference]	[Reference]	684	[Reference]	[Reference]
1	269	1.15	1.07	117	1.47	1.42	202	1.62	1.39
		(0.86-1.54)	(0.80-1.44)		(0.86-2.52)	(0.83-2.45)		(0.97-2.72)	(0.82-2.35)
2	147	1.36	1.20	63	0.75	0.70	100	1.08	0.84
		(9.94-1.98)	(0.82-1.76)		(0.33-1.67)	(0.31-1.58)		(0.49-2.38)	(0.37-1.89)
⩾3	90	2.20	1.79	58	1.30	1.11	56	2.61	1.84

		(1.40-3.46)	(1.12-2.86)		(0.62-2.72)	(0.51-2.43)	(1.24-5.48)	(0.85-3.98)
Overall p-value		0.005	0.100		0.346	0.390	0.041	0.264
Psychological Distress	1414		1.45 (1.19-1.76)	572		1.24 (0.88-1.74)	1042	1.97 (1.40-2.78)
p-value			<0.001			0.221		<0.001

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio, PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents with recurrent headache without missing values, (n=1514 ($n_{monthly}$=942, n_{weekly}=472, n_{daily}=100)).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.

Table A2. Assessment of Differences in Association Between Varying Subtypes of Primary Recurrent Headache Complaints in Relation to Exposure to PTIEs and Psychological Distress*†‡.

		Recurrent Primary headache, n=1445									
		TTH vs. Migraine, only			Migraine, only vs. Migraine w/TTH			TTH vs. Migraine w/TTH			TTH vs. Any Migraine
Variables	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2(CI)	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2(CI)	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2(CI)	**No.**	Model 1 OR_1 (CI)	Model 2 OR_2(CI)
Sum of PTIEs												
0	872	[Reference]	[Reference]	229	[Reference]	[Reference]	747	[Reference]	[Reference]	924	[Reference]	[Reference]
1	256	1.32 (0.94-1.84)	1.31 (0.94-1.84)	84	1.08 (0.60-1.94)	1.04 (0.57-1.88)	216	1.47 (0.86-2.50)	1.36 (0.80-2.33)	278	1.34 (0.99-1.81)	1.31 (0.97-1.78)
2	128	1.35 (0.83-2.05)	1.30 (0.82-2.05)	46	1.68 (0.83-3.38)	1.50 (0.73-3.08)	114	2.17 (1.17-4.01)	1.92 (1.02-3.59)	144	1.49 1.01-2.20)	1.44 (0.97-2.14)
⩾ 3	85	1.64 (0.98-2.75)	1.63 (0.95-2.79)	38	1.71 (0.77-3.81)	1.38 (0.59-3.22)	75	2.74 (1.39-5.39)	2.21 (1.10-4.47)	99	1.89 (1.20-2.95)	1.77 (1.11-2.81)
Overall p-value		0.132	0.172		0.357	0.674		0.007	0.064		0.009	0.035

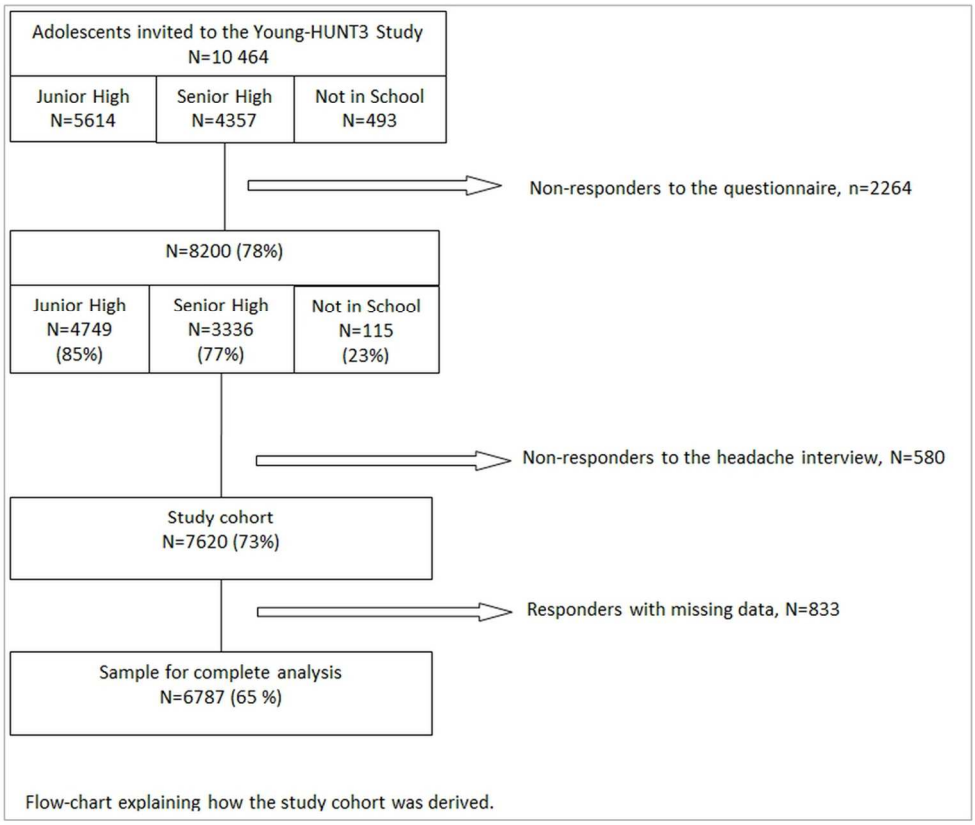
Psychological	1341	1.01	397	1.35	1152	1.46	1.11
Distress		(0.81-1.27)		(0.93-1.97)		(1.05-2.02)	(0.91-1.36)
p-value		0.991		0.115		0.023	0.313

Abbreviations: CI, 95% Confidence Interval; OR, Odds Ratio, PTIE, Potentially Traumatic Interpersonal Event.

* Study definitions and measures are defined in footnotes to Table 1.

† Analyses were restricted to adolescents with recurrent headache without missing values, (n=1514 (n_{TTH}=1048, $n_{migraine}$, only=293, $n_{migraine\ w/TTH}$=104)).

‡ All models are adjusted for sex, age, family structure and family economy. Model 2 is additionally adjusted for psychological distress.



Flow-chart explaining how the study cohort was derived.

108x90mm (300 x 300 DPI)

Young HUNT

ADOLESCENT SECTION OF THE HEALTH STUDY IN NORD-TRØNDELAG, HUNT

It's your turn to participate in the Nord-Trøndelag Health Study (**HUNT**)!

We hope you have read the information brochure about YOUNG HUNT that you took home with
you and have decided to participate!

Read the informed consent form that is inside the questionnaire and check that it is your name
that is on it. Mark it as to whether you will participate or not, sign it and hand it in to the teacher.

Your name should NOT be on your questionnaire!

Put an X in the boxes ∀ that you think apply to you. Answer the best you can! If there are
questions that you do not want to answer, skip them.

When you are finished, put the questionnaire in the envelope you have been given, seal it and
give the envelope to the teacher. Do this even if you haven't finished the questionnaire.

All your answers will be treated in the strictest of confidence!

No one at school is allowed to see your answers.

If you wish to speak to someone about the study, speak to the Young HUNT nurse when she
visits your school or ring HUNT Research Centre (see back of questionnaire).

Good Luck and Thank You!

2

Date of questionnaire completion ____/_____20____

1. For those who are in Junior High School: **What type of plans do you have regarding your studies**
in High School?

High School academic studies ∀ High School vocational studies ∀ Don't know ∀

2. What type of plans do you have regarding continued studies?
(Put one or more Xs)

* College or university * Other vocational training ……. ∀
for 4 years or more …… ∀ * No plans ……..… ∀
* College or university * Don't know…… ∀
less than 4 years …… ∀

WHERE YOU LIVE

3. What type of housing do you live in? (Only one X)

* Single-family house …… ∀ * Farm w/ animal husbandry…… ∀
* Row house/2-4 family housing …… ∀ * Farm w/out animal husbandry …… ∀
* Flat in block/flat …… ∀ * Other housing …… ∀

4. Who do you currently live with? (Put one or more Xs)

* Mother …… ∀ * Foster parents …… ∀
* Father …….. ∀ * Adoptive parents …… ∀
* 1-2 siblings …… …. ∀ * Grandparents/other…… ∀
* 3 or more siblings…… ∀ * Spouse/partner…… ∀

* Mother's new husband or partner ∀ * Friends…….. ∀

***** Father's new wife or partner…… ∀ ***** Alone/in a rented room…….. ∀

5. If your mother and father do not live together, who do you live with?

Mostly my mother ∀ Mostly my father ∀ Equal time at both parents ∀

6. Are there pets living in your home?

No ……. ∀ Yes, other animals with fur ……. ∀

Yes, cat …… ∀ Yes, bird …… ∀

Yes, dog …….. ∀ Yes, other …… ∀

3

YOUR HEALTH

7. How is your health at the moment? (One X)

* Poor …… ∀ *Good…….. ∀

* Not so good …… ∀ * Very good…… ∀

8. Are you disabled in any of these ways? (Put an X for each line)

No A little Somewhat Severely

* Motor impairment (movement) ∀ ∀ ∀ ∀

* Vision impairment ∀ ∀ ∀ ∀

* Hearing impairment ∀ ∀ ∀ ∀

* Impairment due to physical illness ∀ ∀ ∀ ∀

* Impairment due to mental health problems ∀ ∀ ∀ ∀

9. Have you had any of these ailments in the past 12 months: (Put an X for each line)

Not at all A little Much

* Palpitation ∀ ∀ ∀

* Constipation ∀ ∀ ∀

* Diarrhoea ∀ ∀ ∀

* Alternating constipation and diarrhoea ∀ ∀ ∀

* Bloating ∀ ∀ ∀

* Nausea ∀ ∀ ∀

ALLERGIES

10. Do you have allergies? Yes ∀ No ∀ Don't know ∀

If Yes, **what do you think you are allergic to?** (One or more Xs)

* Grass/trees ∀ * Dogs ∀ * Food ∀

* House dust ∀ * Cats ∀ * Other ∀

* Horses ∀ * Don't know ∀

11. Has a doctor given you any allergy tests (blood tests, skin tests)**?**

Yes ∀ No ∀ Don't know ∀

If Yes, **what did you have an allergic reaction to?** (One or more Xs)

4

* Nothing ∀ * Dog ∀ * Food ∀

* Grass/trees ∀ * Cat ∀ * Other ∀

* House dust ∀ * Horse ∀ * Don't know ∀

RESPIRATORY TRACT

12. Have you ever had wheezing or whistling in the chest?

Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 15

13. Have you had wheezing or whistling in the chest in the past 12 months?

Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 15

14. How many attacks of wheezing have you had in the past 12 months?

None ∀ 1 to 3 ∀ 4 to 12 ∀ More than 12 ∀

****

15. Do you have or have you had asthma? Yes ∀ No ∀

If YES, **has a doctor said that you have/have had asthma?** Yes ∀ No ∀

16. In the past 12 months has your chest sounded wheezy during or after exercise?

Yes ∀ No ∀

17. In the last 12 months have you had a dry cough at night apart from a cough associated a cold or chest infection?

Yes ∀ No ∀

NASAL PROBLEMS

18. In the past 12 months, have you had a problem with sneezing or a runny or blocked nose when you did not have a cold or the flu?

Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 21

19. Has this nose problem been accompanied by itchy-watery eyes?

Yes ∀ No ∀

20. How much did this nose problem interfere with your daily activities? (One X)

Not at all ∀ A little ∀ A moderate amount ∀ A lot ∀

5

21. Have you ever had hay fever or nasal allergies? Yes ∀ No ∀

RASHES

22. Have you had an itchy rash during the last 12 months? Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION 25

23. Have you had this itchy rash in the following places: the folds of your elbow (inside), back of your knees, on the front of your ankles, under your buttocks or around your neck, ears or eyes? Yes ∀ No ∀

24. How often on the average has this itchy rash kept you awake at night? (One X)

Not at all ∀ Less often than 1 night a week ∀ 1 night or more a week ∀

25. Have you ever had eczema? Yes ∀ No ∀

If Yes, has a doctor said that you have/ have had "atopic eczema"? Yes ∀ No ∀

ACNE

26. Have you had problems with acne? Yes ∀ No ∀

IF YOU ANSWERED "NO", SKIP TO QUESTION **31**

27. Where was the acne? (Put one or more Xs)

Forehead…..... ∀ Cheeks…….. ∀ Shoulders…….. ∀ Other places……... ∀

Nose…….. ∀ Chest……... ∀ Back…… ∀

28. How much has the acne bothered you? Very much ∀ Much ∀ A little ∀ Not at all ∀

Only one X

29. Have you used non-prescription creams, skin astringents or other similar products to get rid of the acne? (bought at the drug store or other shop, not prescribed by a doctor)

Yes ∀ No ∀

If Yes, has it helped? One X No ∀ Some ∀ Yes ∀

30. Have you been to a doctor because of acne? Yes ∀ No ∀

If Yes, did the doctor recommend any of the following treatments? (Put an X for each line)

- Topical treatment (ex: creams or liquid solutions) ……. Yes ∀ No ∀
- Antibiotic tablets (tetracycline) …….. Yes ∀ No ∀
- Roaccutan tablets …… Yes ∀ No ∀

If Yes, did this treatment help? (One X) No ∀ Some ∀ Yes ∀

6

31. How often have you had any of the below listed pain during the last 3 months? (Without having injured yourself or having a known illness that is the reason for the pain)

Look at the figure and put an X for each line

IF YOU ANSWERED "NEVER OR SELDOM" FOR EVERYTHING, SKIP TO QUESTION 34

If you have had pain during the last 3 months,

32. Does anything on the below list apply to you? (Put an X for each line):

	Yes	No
* Pain makes it difficult to fall asleep……..	∀	∀
* Pain disturbs my sleep at night. ……	∀	∀
* Pain makes it difficult to sit in class. ……	∀	∀
* Pain makes it difficult for me to walk more than one kilometre. …… ……..	∀	∀
* Because of pain I have problems in gym class. ……..	∀	∀

33. All things considered, has pain made it difficult to do daily activities? (Put an X for each line)

	No	Yes, sometimes	Yes, often
* At school ……	∀	∀	∀
* In leisure time ……	∀	∀	∀

If you answered Yes, **what type of pain makes daily activities difficult?** *(One or more Xs)*

Headache/migraine ∀ Stomach pain ∀ Muscular/skeletal pain ∀ Other pain ∀

Never or seldom

About once a month

About once a week

More than once a week

Almost every

day
A. Headache/migraine
B. Neck/ shoulder pain
C. Pain in the upper back
D. Pain in the lower back/buttocks
E. Pain in chest
F. Stomach pain
G. Pain in left arm
H. Pain in right arm
I. Pain in left leg
J. Pain in right leg
Other pain

PAIN

7

OTHER ILLNESSES

34. Has a doctor diagnosed you with: (Put an X for each line) Yes No

***** Epilepsy …… ∀ ∀

* Diabetes …… ∀ ∀

* Migraine …… ∀ ∀

* Juvenile arthritis …… ∀ ∀

* Other illnesses that have lasted longer than 3 months …… ∀ ∀

MEDICINE USE

35. How often in the last 3 months have you taken non-prescription medicine for any of the below listed complaints? (medicine not prescribed by a doctor, for example bought at a store or pharmacy) (Put an X for each line)

	Never or less	1 day a week	2 days a week	3 days a week	4 days a week or more
* Headache/migraine	∀	∀	∀	∀	∀
* Muscle/joint pain	∀	∀	∀	∀	∀
* Back pain	∀	∀	∀	∀	∀
* Stomach pain	∀	∀	∀	∀	∀
* Other	∀	∀	∀	∀	∀

36. Do you take any medicine that was prescribed for you by a doctor? Yes ∀ No ∀

37. Do you take/use any of these medicines or dietary supplements? (Put an X for each line)

	Never	Sometimes	Almost daily
* Iron tablets	∀	∀	∀
* Laxative tablets	∀	∀	∀
* Vitamins	∀	∀	∀
* Cod-liver oil	∀	∀	∀
* Homeopathic medicine, herbal medicine	∀	∀	∀
* Other	∀	∀	∀

TOBACCO

38. Does anyone you live with smoke at home? (One or more Xs)

***** No, nobody ∀ ***** Yes, my mother ∀ * Yes, a sibling ∀

* Yes, my father ∀ * Yes, other people ∀

39. Have you tried smoking? (at least one cigarette) Yes ∀ No ∀

8

IF YOU ANSWERED "NO", SKIP TO QUESTION 43

40. Do you smoke? (Put an X in the appropriate box and write in the number of cigarettes. A package of loose tobacco equals approx. 50 cigarettes)

∀ Yes, I smoke about _____ cigarettes daily.

∀ Yes, I smoke occasionally, but not daily.

∀ No, not anymore, but previously I smoked occasionally.

∀ No, not anymore, but previously I smoked about _____cigarettes daily.

∀ No, I don't smoke.

IF YOU ANSWERED "NO, I DON'T SMOKE", SKIP TO QUESTION 44

41. If you smoke or have smoked daily:

* How old were you when you began smoking daily? _____ years old
* If you quit smoking daily, how old were you when you quit? _____ years old

42. If you smoke or have smoked occasionally:

* How old were you when you began smoking occasionally? _____ years old
* How many days have you smoked in the last month? _____ number of days

(Write 0 if you have not smoked in the past month)

* About how many cigarettes have you smoked in the last month? _____ number of cigarettes

(Write 0 if you have not smoked in the past month)

* If you quit smoking occasionally, how old were you when you quit? _____ years old

43. How many of your friends smoke? None ∀ A few ∀ Almost all ∀ (One X)

****

44. Do you use or have you used snuff, chewing tobacco or similar products? (One X)

No, never ∀ Yes, but have quit ∀ Yes, sometimes ∀ Yes, everyday ∀

IF YOU ANSWERED "NO, NEVER", SKIP TO QUESTION 50

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45. If you use or have used snuff/chewing tobacco:

* How old were you when you began using snuff/chewing tobacco? _____ years old
* If you stopped using snuff/chewing tobacco, how old were you when you stopped? _____years old
* How many boxes/bags of snuff/chewing tobacco do you use/have you used a week? _____ number of boxes/bags

(Write 0 if you use less than one box a month

46. If you smoke cigarettes and use snuff, which did you start first? (One X)

∀ Snuff ∀ About the same time (within 3 months)

∀ Cigarettes ∀ Don't remember

47. Did you start using snuff to try to quit smoking or to smoke less? (One X)

∀ No ∀ Yes, to quit smoking ∀ Yes, to smoke less

48. How many of your friends use snuff/chewing tobacco? (One X**)**

None ∀ A few ∀ Almost all ∀

****

49. Have you ever tried hash, marijuana or other drugs? (One X) Yes ∀ No ∀

If Yes, **How old were you the first time?** _____ years old

50. Do you have friends or acquaintances who use drugs? Yes ∀ No ∀

SPORTS AND EXERCISE

51. Not during the average school day: **How many days a week do you play sports or exercise to the point where you breathe heavily and/or sweat?** (*Only one X*)

* Everyday ∀ * Less often than once a week ∀

* 4-6 days a week ∀ * Less often than once a month ∀

* 2-3 days a week ∀ * Never ∀

* 1 day a week ∀

10

52. Not during the average school day: **How many hours a week do you play sports or exercise to the point where you breathe heavily and/or sweat?** (*Only one X*)

None ∀ * About 2-3 hours ∀

About ½ hour ∀ * About 4-6 hours ∀

About 1-1½ hours ∀ * 7 or more hours ∀

53. Think about the past 7 days: How many hours did you spend sitting in an average day?

(This could be the time spent sitting at the computer, doing homework, at friends, reading and TV watching
(include times both sitting and laying down for the last two). Count the times at school and in your leisure
time.) _____Number of hours

54. Do you work out/train at a health club? Yes ∀ No ∀

55. How often have you done/participated in any of the following activities/sports the past 12 months? (Put an X for each line)

	Never	Less than 1 x a week	Once a week	Several x a week
* Endurance sports (ex: running, cross-country skiing, cycling, swimming)	∀	∀	∀	∀
* Team sports (ex: football, volleyball, handball, ice hockey, squash)	∀	∀	∀	∀
* Aesthetic sports (ex: dance, gymnastics, aerobics)	∀	∀	∀	∀
* Strength sports (ex: weightlifting, wrestling, bodybuilding)	∀	∀	∀	∀
* Martial arts/combat sports (ex: judo, karate, taekwondo, boxing)	∀	∀	∀	∀
* Technical sports (ex: riding, track sports, alpine skiing, ski jumping, snowboard, skate boarding)	∀	∀	∀	∀
* Adrenaline sports (ex: white water rafting, mountain climbing, paragliding)	∀	∀	∀	∀
* Jogging or racewalking/hiking	∀	∀	∀	∀
* Other	∀	∀	∀	∀

56. If you haven't been involved in any of these activities/sports in the past 12 months, but did so previously, how old were you when you stopped? ____ years old

57. Do you participate in sports competitions? (One X)

Yes ∀ No, but I used to compete ∀ No ∀

ALCOHOL

58. Have you ever tried drinking alcohol? (Meaning alcoholic beer, wine, hard liquor or moonshine)

Yes ∀ No ∀ Don't know ∀

If Yes, **do you sometimes drink alcohol now?** Yes ∀ No ∀

IF YOU ANSWERED NO, SKIP TO QUESTION 66

11

59. How old were you when you began drinking (more than a sip)**?** _____ years old

60. Have you ever drunk so much alcohol that you felt intoxicated (drunk)?
(One X)

* No, never ……. ∀ * Yes, 4-10 times …….. ∀

* Yes, once …… ∀ * Yes, 11-25 times …….. …….. ∀

* Yes, 2-3 times …… ∀ * Yes, more than 25 times ..... ∀

61. About how much beer, wine or hard liquor do you usually drink during two weeks?
Don't
count alcohol free beer. Write 0 if you do not drink alcohol.
Beer..... number of 1/2 bottles Hard liquor, liqueurs..... number of glasses (approx. 1/2 dl)
Wine..... number of glasses (approx. 1 dl) Moonshine ..... number of glasses (approx. 1/2 dl)
Alcopop ……. number of bottles

62. How often do you currently drink alcohol? (One X)

* Every week or more often …… ∀

* Every other week …….. ∀

* More seldom than every other week, but more often than once a month …… ∀

* Once a month or more seldom than once a month ……..……..... ∀

* Never …….. ∀

63. On which days during the week do you most often drink alcohol? (One or more Xs)

I do not drink ∀ Fridays/Saturdays ∀ Other days of the week ∀

64. Have you ever seen either of your parents intoxicated? (One X)

* Never …….. ∀ * A few times during the year …… ∀

* A few times …… ∀ * A few times a month …… ∀

* A few times a week …… ∀

12

MEALS AND EATING HABITS

65. How often do you usually eat these meals? *(Put an X for each line)*

	Every day	4-6 days a week	1-3 days a week	Seldom or never
* Breakfast	∀	∀	∀	∀
* Lunch	∀	∀	∀	∀
* Dinner (warm)	∀	∀	∀	∀
* Supper/evening snack	∀	∀	∀	∀

66. Are you trying to lose weight? (*One X)*

No, I'm comfortable with my weight ∀ No, but I need to lose weight ∀ Yes ∀

67. What do you usually eat at school? (*One X)*

Packed lunch ∀ Buy food at the cafeteria ∀ Do not eat lunch at school ∀

68. Below are listed things that concern your eating habits. (Put an X for each line)

	Never	Seldom	Often	Always
* When I first begin eating, it is difficult to stop.	∀	∀	∀	∀
* I vomit after I have eaten.	∀	∀	∀	∀
* I spend too much time thinking about food.	∀	∀	∀	∀

* I feel that food controls my life. ∀ ∀ ∀ ∀
* When I eat, I cut my food up in small pieces. ∀ ∀ ∀ ∀
* It takes me longer than others to finish a meal. ∀ ∀ ∀ ∀
* Other people think I'm too thin. ∀ ∀ ∀ ∀
* I feel that others pressure me to eat. ∀ ∀ ∀ ∀

69. How often do you usually drink the following? (Put an X for each line)

	Seldom/ never	1-6 glasses a week	1 glass a day	2-3 glasses a day	4 glass or more a day
* Cola/soda/still soft drinks w/ sugar……	∀	∀	∀	∀	∀
* Cola/soda/still soft drinks w/out sugar…	∀	∀	∀	∀	∀
* Whole milk/kefir/yoghurt……	∀	∀	∀	∀	∀
* Low fat milk or yoghurt/cultured milk…….	∀	∀	∀	∀	∀
* Skim milk (sour/sweet) ..……	∀	∀	∀	∀	∀
* Fruit juice ……	∀	∀	∀	∀	∀
* Water …… ……	∀	∀	∀	∀	∀

13

70. How often do you usually eat the following foods? (Put an X for each line)

	Several times a day everyday	Once a day	Every week but not every day	Less often than every week	Never
* Whole grain bread/crispbread ……	∀	∀	∀	∀	∀
* Oily fish (salmon, trout, mackerel)……	∀	∀	∀	∀	∀
* Fruit……..	∀	∀	∀	∀	∀
* Vegetables ……	∀	∀	∀	∀	∀
* White cheese ……	∀	∀	∀	∀	∀
* Potato chips and such ……	∀	∀	∀	∀	∀
* Candy, chocolate, other sweets……..	∀	∀	∀	∀	∀

71. What type of fat do you usually use on bread? (One X)

Butter/hard margarine ∀ Soft/low fat margarine ∀ Liquid margarine/Oil ∀ Don't use any ∀

72. Do you consider yourself: (One X)

* Very fat …… ∀ * Thin…… ∀
* Chubby …… ∀ * Very thin…….. ∀
* About the same as others…… ∀

HOW THINGS ARE GOING FOR YOU

73. Thinking about your life at the moment, would you say that you by and large are satisfied with life, or are you mostly dissatisfied? (One X)

* Very satisfied …….. ∀ * Somewhat dissatisfied …… ∀
* Satisfied…….. …….. ∀ * Dissatisfied …….. ∀
* Somewhat satisfied …….. ∀ * Very dissatisfied …….. ∀
* Neither satisfied nor dissatisfied ∀

74. Do you feel, for the most part, strong and fit or tired and worn out? (One X)

* Very strong and fit …… ∀ * Somewhat tired and worn out.. ∀
* Strong and fit …….. ∀ * Tired and worn out…… ∀
* Somewhat strong and fit …….. ∀ * Very tired and worn out …. ∀
* Somewhere in between …… ∀

75. Would you say you are usually cheerful or downhearted (sad)? (One X)

* Very downhearted (sad) …… ∀ * Somewhat cheerful …….. ∀
* Downhearted (sad) …… ∀ * Cheerful …….. ∀
* Somewhat downhearted (sad) ……. ∀ * Very cheerful …… ∀
* Some of both ……... ∀

14

76. Below is a list of some problems. Have you been bothered by any of these in the last 14 days? (Put an X for each line)

	Not bothered	A little bothered	Quite bothered	Very bothered
* Been constantly afraid and anxious ……	∀	∀	∀	∀
* Felt tense or uneasy ……	∀	∀	∀	∀
* Felt hopelessness when you think of the future ……...	∀	∀	∀	∀
* Felt dejected or sad ……	∀	∀	∀	∀
* Worried too much about various things ……	∀	∀	∀	∀

77. How do you see yourself? Put an X in a box for each sentence below indicating whether you agree or disagree in how it relates to you. (Put an X for each line)

	Strongly Agree	Agree	Disagree	Strongly disagree
* I take a positive attitude toward myself……	∀	∀	∀	∀
* I certainly feel useless at times……..	∀	∀	∀	∀
* I feel I do not have much to be proud of……..	∀	∀	∀	∀
* I feel that I am a person of worth, at least on an equal plane with others…..……	∀	∀	∀	∀

78. How often do you experience the reactions that are described below? (Put an X for each line)

	Never	Seldom	Some-times	Often	Always
* I feel anxious and don't know what to do in an embarrassing situation ……	∀	∀	∀	∀	∀
* I feel anxious when I am with others and have to do something while they watch me do it *(ex: be in a play, play music, sports)* ……..	∀	∀	∀	∀	∀
* I feel anxious when I have to speak or read aloud in front of a group of people ……	∀	∀	∀	∀	∀
* Before I go someplace where I'm going to be with people (*ex: a party, school, football game*) I sweat, my heart beats fast and/or I get a headache or stomach ache ……	∀	∀	∀	∀	∀
* Before I go to a party or someplace with other people I think about what could go wrong *(ex: that I make mistakes, seem dumb and/or…what if they see how frightened I am!)* ……	∀	∀	∀	∀	∀

* I feel anxious and don't know what to do
when I'm in a new situation …… ∀ ∀ ∀ ∀ ∀

15

79. How have you thought and felt about yourself and about your family in the past month?

(Put an X for each line)

	Totally agree	Agree	Average	Disagree	Totally disagree
* I easily make others feel comfortable around me ……..	∀	∀	∀	∀	∀
* In my family we share views of what is important in life....	∀	∀	∀	∀	∀
* I easily find new friends ……	∀	∀	∀	∀	∀
* I feel comfortable with my family ……..	∀	∀	∀	∀	∀
* I am good at talking to new people ……..……	∀	∀	∀	∀	∀
* My family view the future as positive, even when very sad things happen……..	∀	∀	∀	∀	∀
* I always find something fun to talk about……..	∀	∀	∀	∀	∀
* In my family we support each other… ……	∀	∀	∀	∀	∀

81. Have you during the past month:

(Put an X for each line)

	Almost every night	Often	Some-times	Never
* Had difficulty falling asleep in the evening	∀	∀	∀	∀
* Woke too early and couldn't fall asleep again	∀	∀	∀	∀

82. Have any of the following things happened to you? *(Put an X for each line)*

	No	Yes, last year	Yes, in my life
* That someone in your family has been seriously ill…….	∀	∀	∀
* Death of a loved one…….. ……..	∀	∀	∀
* A catastrophe (fire, avalanche, tidal wave, hurricane, etc.)……	∀	∀	∀
* A serious accident (ex: a very serious car accident) ……	∀	∀	∀
* Been violently hurt (beaten or injured) ……	∀	∀	∀
* Seen others violently hurt ……	∀	∀	∀
* Been put in sexually uncomfortable/abusive situations by someone about your age ……	∀	∀	∀
* Been put in sexually uncomfortable/abusive situations by an adult……	∀	∀	∀
* Been threatened or physically harassed by other students at school for a long time……	∀	∀	∀
* Received painful or frightening treatment at the hospital while being treated for an illness or injury……	∀	∀	∀
* Experienced something else that was very frightening, dangerous or violent……..	∀	∀	∀

IF YOU ANSWERED NO TO ALL THE ABOVE, SKIP TO QUESTION 86

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If you have experienced any of the above in question 82:

83. Do you still think very much about what happened? Yes ∀ No ∀

If Yes, **do you have frightening thoughts, see images or hear sounds from the actual**

experience even when you don't want to? Yes ∀ No ∀

84. When something reminds you about what happened do you become distant, afraid or sad?

Yes ∀ No ∀

85. Do you try to avoid talking about it, thinking about it or feel any feelings about what happened?

Yes ∀ No ∀

86. If it was an injury or accident, do you have physical (bodily) late complications/problems from this? Yes ∀ No ∀

LEISURE TIME

87. How many teams or clubs are you part of? (for example: sports team, boy/girl scouts, band, etc.)

None ∀ One ∀ Two or more ∀

88. How often have you done any of these activities in the past week?

(Put an X for each line)

	None	Once	2-3 times	4 times or more
* Visited someone you know	∀	∀	∀	∀
* Was visited at home	∀	∀	∀	∀
* Read a book, magazine, comic book	∀	∀	∀	∀
* Listened to music	∀	∀	∀	∀
* Played an instrument	∀	∀	∀	∀
* Was out with friends for more than two hours in a row	∀	∀	∀	∀
* Was at a meeting or training with a club/team	∀	∀	∀	∀
* Did a hobby	∀	∀	∀	∀
* Did homework for more than one hour	∀	∀	∀	∀
* Watched TV/DVD	∀	∀	∀	∀
* Played a computer/TV game	∀	∀	∀	∀
* Played, chatted or surfed the internet	∀	∀	∀	∀
* Was at the library	∀	∀	∀	∀
* Went to the movies	∀	∀	∀	∀
* Was at a cafe or a meeting place for people your age	∀	∀	∀	∀
* Was in a play, theatre	∀	∀	∀	∀
* Did photography/film	∀	∀	∀	∀
* Went to a concert	∀	∀	∀	∀
* Went to watch a sport event, game	∀	∀	∀	∀
* Sang in a chore	∀	∀	∀	∀

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89. **If you normally do some of the below listed activities, how long do you usually do so each time?** (Put an X for each line)

	Less ½	-1	More than

than ½ hour hour 1 hour

* Watch TV/DVD …….. ∀ ∀ ∀

* Play computer/TV games……..∀ ∀ ∀

* Play, chat or surf the internet ……..……. ∀ ∀ ∀

* Listen to music……..…. ∀ ∀ ∀

90. Do you have a mobile phone? Yes ∀ No ∀

If Yes:

* How long do you usually talk on your mobile phone a day? _____Number of minutes
* How many text/picture messages do you usually get a day? _____ Number of messages
* How many text/picture messages do you send a day? _____Number of messages

FAMILY AND FRIENDS

91. About how many close friends do you have? (Include those you can speak confidentially with and who help you when you need help. Do not include people you live with, but other relatives should be included.) (One X)

None ∀ One ∀ Two or more ∀

92. Do you have a steady boyfriend/girlfriend? Yes ∀ No, not now, but before ∀ No ∀

93. Are your parents separated or divorced, or have they lived separately for more than one year? *(X the appropriate box and write in your age where necessary)*

∀ No

∀ Yes, they lived separately or were separated when I was _____ years old, but they later moved back together again.

∀ Yes, they were divorced or separated when I was ____ years old.

94. How well off do you think your family is compared to most others? (One X)

About the same as most others ∀ Better financial situation ∀ Worse financial situation ∀

95. Has there been or is there much arguing in your family? (One X)

No ∀ Yes, the past 12 months ∀ Yes, previously ∀

96. How good is the relationship you have with your immediate family? (Put an X for each line of the family members you have. If you have more than one sibling, think about the sibling you have the best relationship to.)

Very good Good Not so good Bad *

Mother …… ∀ ∀ ∀ ∀

* Father …… ∀ ∀ ∀ ∀

* Sibling …… ∀ ∀ ∀ ∀

* Stepmother or stepfather…… ∀ ∀ ∀ ∀

97. Do you often feel lonely? (One X)

* Very often …… ∀ * Seldom …….. ∀

* Often …….. ∀ * Very seldom or never…….. ∀

* Sometimes …… ∀

SCHOOL

98. Do any of the following things happen to you at school, or have any of them happened?
(Put an X for each line)
Never Some- Often Very often
times

* Have difficulties concentrating during class ∀ ∀ ∀ ∀
* Think that gym or art is fun ∀ ∀ ∀ ∀
* Think other classes are fun ∀ ∀ ∀ ∀
* Argue with the teacher ∀ ∀ ∀ ∀
* Look forward to going to school ∀ ∀ ∀ ∀
* Skip school ∀ ∀ ∀ ∀
* Understand what is being taught ∀ ∀ ∀ ∀
* Have fun during recess/break time ∀ ∀ ∀ ∀
* Are satisfied with your test results ∀ ∀ ∀ ∀
* Have fistfights ∀ ∀ ∀ ∀
* Are reprimanded by the teacher ∀ ∀ ∀ ∀
* Cannot manage to be calm/sit still during class ∀ ∀ ∀ ∀
* Become bored or dissatisfied ∀ ∀ ∀ ∀
* Receive help for reading or writing problems ∀ ∀ ∀ ∀
* Are called a negative name by students for a long time ∀ ∀ ∀ ∀
*****Are snubbed/excluded by the students for a long time ∀ ∀ ∀ ∀

HEALTH SERVICES

99. During the last 12 months have you been to: (Put an X for each line)
Yes No

* General practitioner (family doctor, doctor outside the hospital)..... ∀ ∀
* Doctor at the hospital ..... ∀ ∀
* Child health care clinic run by nurses..... ∀ ∀
* School health services ..... ∀ ∀
* Psychologist ..... ∀ ∀
* Physiotherapist ..... ∀ ∀
* Chiropractor ..... ∀ ∀
* Other practitioner (naturopath, reflexologist,
laying on of hands, healer, psychic, etc.)..... ∀ ∀

100. Have you been admitted to the hospital during the past 12 months?
Yes ∀ No ∀

101. How often have you been absent from school due to illness during the last 12 months?
Less than 1 week ∀ 1-2 weeks ∀ More than 2 weeks ∀

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PHYSICAL DEVELOPMENT

Below are some questions about physical changes that occur through adolescence.

102. During the teenage years there are periods where one grows quickly (growing spurt). Have you noticed that your body has grown quickly (become taller)? (One X)

* No, I have not begun to grow …… ∀

* Yes, I have barely begun a growing spurt …… ∀

* Yes, I've clearly begun a growing spurt …… ∀

* Yes, it seems that I'm finished with growing spurts …… ∀

103. Concerning hair on your body (under your arms and your crotch/groin)? Would you say
that the hair on your body has: (One X)

* Not begun to grow yet …….. ∀

* Barely begun to grow …… ∀

* Quite clearly begun to grow …… ∀

* It seems that my body hair has grown in …… ∀

104. When you look at yourself, do you think that you are physically maturing/have physically matured earlier or later than others your own age? (One X)

* Much earlier …… ∀ * A little bit later …… ∀

* Earlier ……. …… ∀ * Later ……..…….. ∀

* A little bit earlier…….. ∀ * Much later ……..…….. ∀

* The same as others …… ∀

QUESTIONS FOR BOYS

105. Has your voice begun to change? (One X)

* No, hasn't begun yet …… ∀

* Yes, has just barely begun …… ∀

* Yes, has clearly begun …….. ∀

* It seems my voice has finished changing …….. ∀

106. Has facial hair begun to grow (moustache or beard)? (One X)

* No, hasn't begun yet …… ∀

* Yes, has just barely begun …… ∀

* Yes, has clearly begun …… ∀

* Yes, I have quite a lot of facial hair …… ∀

QUESTIONS FOR GIRLS

107. Have you begun to develop breasts? (One X)

* No, haven't begun yet …… ∀ * Yes, have quite clearly begun …….. ∀

* Yes, have barely begun …… ∀ * It seems my breasts are fully developed …..… ∀

108. Have you begun menstruating (gotten your period)? Yes ∀ No ∀

IF YOU ANSWERED "NO", GO TO PAGE 22

109. How old were you when you first began menstruating?

I was _____years old and _____months.

110. How many times have you menstruated in the last 12 months? _____ times

111. How long is it usually between your menstruation periods? (From the first day of a period to the
first day of the next period)

Less than 3 weeks ∀ 3-4 weeks ∀ More than 4 weeks ∀

112. Have you ever missed (not gotten) your period for several months after a regular period?
(without being pregnant)? (One X)

*Yes, 2-5 mos. …….. ∀ * Yes, more than 1 year …….. ∀

*Yes, 6-12 mos. …… ∀ * No, never ……..…….. ∀

113. Have you ever taken birth control pills or the mini-pill?

Yes, I take them now ∀ Yes, I took them before ∀ No ∀

If Yes:

How old were you when you first began taking birth control pills/mini-pills? _____ years old

How long in total have you taken birth control pills/mini-pills? _____ years old

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FOR STUDENTS IN HIGH SCHOOL

These questions are only to be answered by High School students.

114. During the last year, have you often felt that you pressured yourself or continuously pushed yourself?

Yes ∀ No ∀ Don't know ∀

115. Do you feel that you are constantly short of time, even in your everyday tasks?

* Always, or almost always …… ∀

* Sometimes …… ∀

* Never…… ∀

116. Have you ever had thoughts about taking your own life? Yes No

117. Have you ever used anabolic steroids or other performance enhancing drugs? Yes No

118. Have you ever had sexual intercourse? Yes ∀ No ∀

If Yes, **How old were you the first time? _____** years old

119. For GIRLS: Have you ever become pregnant when you did not want to be?

Yes ∀ No ∀

120. For BOYS: Have you ever gotten a girl pregnant without intending to?

Yes ∀ No ∀ Don't know ∀

For BOTH boys and girls:

If Yes,

How old were you when this happened? ____ years old

Was the result an abortion? Yes ∀ No ∀ Don't know ∀

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COMMENTS

If you have time, you could write here about what you think is important, but was not asked about in this questionnaire. What are your thoughts about being young these days? What do feel can be improved upon concerning health and wellbeing for youth of today?

Thank you for your contribution ☺

Sincerely,

Turid Lingaas Holmen, førsteamanuensis/barnelege

Ung-HUNT leder

HUNT forskningssenter, Neptunveien 1, 7650 Verdal

Telefon: 74075180__

HUNT 3
Declaration of Consent form + 2nd to last page of the brochure

Consent

Participation in HUNT 3 and other public health studies is voluntary. The information from the health study cannot be used for research without the consent of the participants. You will be asked to sign a declaration of consent when you participate. Information and samples that you give will be stored for an indefinite time period. In the future it may be used in studies that as of yet have not been planned provided the studies are in accordance with laws and regulations.
In the future, you will be informed about new research projects that use HUNT data. This information can be found at www.hunt.ntnu.no, and in addition, once a year written information will be sent out to the public. There will also be media coverage about some of the research projects.
You can, at any time after the health study, withdraw your consent and ask that the data about you is deleted or that your blood and urine samples be destroyed. If you wish to withdraw your consent, contact HUNT Research Centre, Neptunveien 1, 7650 Verdal, Telephone 74 07 51 80, Fax 74 07 51 81 or their e-mail: hunt@medisin.ntnu.no. We will respect your wishes to not use your information in specific research projects if you request this.

New Consent

If in the future we need your information for new types of research questions not described in this brochure, it may be necessary to ask for a new declaration of consent. If this is the case, we will send you a letter. You may also be asked for a new consent in the eventuality of a collaboration with a private company in genetic research. The research of this type of collaboration must also adhere to public laws and regulations. Under no circumstances will blood or other biological material be sold.

Personal Information Protection and Security

All information that you give to HUNT 3 will be handled with respect to personal information protection and your private life and in accordance with the laws and regulations. As soon as information, blood samples and/or urine samples are collected, they are stored without being labelled using the identity of the donor. Researchers who later use the information do not have access to names, birthdates or personal identification numbers. All employees associated with the health study have an obligation of confidentiality.
The Data Inspectorate supervises to ensure that the laws and regulations concerning the storage and use of health care information are followed. HUNT 3 is licensed by the The Data Inspectorate.

Ethical Approval

All research projects must be approved by an ethical committee. The committee is an independent agency that evaluates the ethical aspect of research projects. HUNT 3 has been approved by The Regional Committee for Medical Research Ethics, Mid-Norway. All future research projects that use data from HUNT must gain approval from the committee.

HUNT Databank

HUNT databank contains information collected during HUNT 1, 2 and 3 by means of questionnaires, examinations and analyses of blood and urine samples. If you participated in HUNT 1 and 2, your information will be compared to information in HUNT 3. Genetic material is stored at the HUNT biobank. The goal of the biobank is that in the future it will be possible to take out samples, perform various analyses and compare it to the results of other

data from the HUNT databank. In this way there will be continuously more data to be put into the databank.
When researchers receive data from the HUNT databank there are no names, birthdates or other identifiable characteristics with the data, so they do not know who gave the information.
Comparing Information from other Registers
For certain research projects it may be necessary to compare data from HUNT with other public records, for example The Norwegian Prescription Database, The Birth Register, The Cancer Register and The Cause of Death Register. HUNT data may also be compared to other registers/databases at Statistics Norway (SSB), for example concerning the environment, population, education, income, public contribution, employment and other situations that may have an effect on health.
In addition, it may also be relevant to obtain diagnosis information, for example hip fracture, heart attack, stroke or lung illnesses from primary health care, the hopitals in Nord-Trøndelag or St. Olavs hospital. Some projects may compare information of parents, children, siblings and grandparents if they have participated in HUNT.
All these comparisons require consent and/or approval from the applicable agencies, for example The Regional Committee for Medical Research Ethics, The Data Inspectorate, The Public Health Department or Social Security. All information will be handled with respect to personal information protection and your private life and in accordance with the laws and regulations. No researchers will know who gave the information.

Compensation
There is very little risk that participation will lead to injury. If this should occur, compensation can be applied for through The Norwegian System of Compensation to Patients (NPE). NPE facilitates compensation applications for patients who have been injured in the public health care service system.
Young HUNT
All adolescents in the age group 13 to 19 years old in Nord-Trøndelag are invited to participate in Young HUNT. The project will take place at their schools, with the filling out of the questionnaire and clinical examinations occurring during school hours. Adolescents and their parents will receive information about Young HUNT through the school.

Declaration of consent for use of health information in research
The Nord-Trøndelag Health Study 2006-2008 (HUNT3)
In the brochure I received I have read about the health study's content and intent, and I have been given the opportunity to ask questions.

I consent to participating in the study.

Place, date time

_____ _____
Name Date of Birth

The STROBE checklist* for the manuscript: Potentially Traumatic Interpersonal Events, Psychological Distress and Recurrent Headaches in Adolescents A population based study The HUNT Study

The authors have aimed to adhere to the STROBE statements, in order to ensure transparency and the highest possible quality of data handling and presentation (1).

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	5-6
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	7-9
Objectives	3	State specific objectives, including any pre-specified hypotheses	9
Methods			11
Study design	4	Present key elements of study design early in the paper	10
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	10, 13-14 and supplemental flow-chart
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11-13
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	11-13
Bias	9	Describe any efforts to address potential sources of bias	10 (we were unable to to reach non-respondents, but have aimed for a transparent report of potential biases, including flowchart attached)

Study size	10	Explain how the study size was arrived at	10, 13-14 and supplemental flow-chart
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	13-14
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	13-14
		(*b*) Describe any methods used to examine subgroups and interactions	14
		(*c*) Explain how missing data were addressed	14
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	13-14
		(*e*) Describe any sensitivity analyses	Not done
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13-14
		(b) Give reasons for non-participation at each stage	10, 13-14
		(c) Consider use of a flow diagram	Attached
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	16-18
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	Not applicable
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	Not applicable
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	Not applicable
		Cross-sectional study—Report numbers of outcome events or summary measures	16-28
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	16-28
		(*b*) Report category boundaries when continuous variables were categorized	16-28
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	26-28
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Supplemental file
Discussion			
Key results	18	Summarise key results with reference to study objectives	29
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	29-30

Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	29-33
Generalisability	21	Discuss the generalisability (external validity) of the study results	29-33
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	36

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting.
The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/).
Information on the STROBE Initiative is available at www.strobe-statement.org .

1. von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007 Oct 335(7624):806-8.