ORIGINAL

A cross-sectional population-based survey of migraine and headache in 21,177 Norwegians: the Akershus sleep apnea project

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Abstract The objective was to investigate the prevalence and interrelation of migraine and headache in the general population. Forty thousand men and women aged 20–80 years from the Norwegian general population received a mailed questionnaire with questions about migraine and headache. The questionnaire response rate was 54.5%. The lifetime prevalence of migraine was 26.5% (95% CI 25.9–27.1%), i.e., 18.1% (95% CI 17.3–18.9%) in men and 34.1% (95% CI 33.2–35.0%) in women. The prevalence of migraine decreased slightly in both men and women after an age of 45. The 1 year prevalence of headache was 77.2%, i.e., 69.6% (95% CI 68.7–70.6%) in men and 84.0% (95% CI 83.3–84.7%) in women. The frequency of headache decreased with age, but some of the elders aged 70 or above experienced more frequent headache. The prevalence of being headache free increased from 19.1% (95% CI 14.2–25.6%) to 74.7% (95% CI 70.0–78.8%) in 20 and 80 years old men without co-occurrence of migraine, and from 5.1% (95% CI 2.9–8.8%) to 61.4% (95% CI 54.9–67.6%) in 20 and 80 years old women without co-occurrence of migraine. Co-occurrence of migraine significantly increased the frequency of headache and decreased the prevalence of being headache free.

Keywords Headache · Migraine · Epidemiology · Prevalence · Age · General population

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Introduction

Headache is the most common type of pain experienced by man. Even though headache receives little attention probably due to the often mild symptoms, the fact is that most people rarely consult their physician for headache [1, 2]. However, the high prevalence and the considerable socio-economic impact render that suffering from headache should not be ignored [2–4]. The most common types of headache, such as migraine and tension-type headache, cause 270 days and 820 days of work absence per year per 1,000 people [2]. "Lifting the burden", a global campaign to reduce the burden of headache worldwide concluded that headache is among the ten most disabling conditions in the World Health Organizations ranking [4].

The aim of this study is to provide epidemiological data on migraine and headache among 20–80-year- old people from the Norwegian general population.

Subjects and methods

Sampling and representativeness

A random sample of 40,000 persons aged 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75 and 80 years was drawn by the National Population Register. The sample was stratified by age and gender, i.e., each age group included 2,000 persons of each gender, aged 30–60 years, while the remaining age groups included 1,000 persons of each gender. The participants were residing in Akershus, Hedmark or Oppland Counties, excluding the municipalities Asker and Bærum and municipalities north of Trysil, Åmot, Ringsaker, Vestre Slidre, Østre Slidre, Gausdal and Øyer. The sample size was reduced to 38,873 owing to decease ($n = 75$), dementia ($n = 23$), multihandicapped ($n = 4$), insufficient Norwegian skills ($n = 3$), and an error in the address list ($n = 1,024$).

The three counties have both rural and urban areas and Akershus County is situated in close proximity to Oslo. Data from Statistics Norway show that the sampling area was representative for the total Norwegian population regarding age, gender and marital status. Regarding employment; trade, hotel/restaurant and transport were overrepresented, while industry, oil and gas and financial services were underrepresented in the sampling area compared to the total Norwegian population [5].

Questionnaire

All persons received a mailed questionnaire with a standard letter containing information about the project. Apart from ensuring confidentiality and emphasising the importance of participation, it was stated that the object was to study sleepiness during daytime. The questions "Have you ever had migraine? Yes or no", and "How many days during the last year have you had headache? 0 days, 1–11 days, 12–30 days, 31–84 days, 85–179 days or $\geq$180 days" were used to screen for migraine and headache frequency. If the questionnaire evoked no response, a second mail was issued. The replies could be either on paper or electronically. The data were collected between February and August 2006. We defined infrequent headache to be less than 12 days per year, frequent headache to be between 12 and 179 days per year, while chronic headache was 180 days or more per year [1].

Statistical analyses

All questionnaires were scanned using TeleForm v9. The statistical analyses were performed using SPSS Base System for Windows 15.0. The 95% CI were calculated with the Vassar Collage statistics web-page [6]. χ^2 test with 5% level of significance was used. Non-linear regression analysis was applied to explore the trends in the prevalence of different headache frequency, age and gender groups. Headache frequency can be considered as a count or ordinal variable. Firstly, the Poisson regression model was explored, when modeling the differences in headache frequency. Although the assumptions for the Poisson regression model were reasonable, the fit was rather poor in this model. Secondly, the ordinal logistic regression model was considered. However, the assumption of parallel lines was not met, and this model was rejected. Thus, the multinomial logistic regression model was estimated to

Table 1 Questionnaire response rates by age and gender

Age	Men % (95% CI)	Women % (95% CI)
20	30.3 (27.4–33.3)	43.6 (40.4–46.9)
25	30.7 (27.8–33.8)	46.3 (43.1–49.6)
30	38.8 (36.5–41.0)	49.0 (46.8–51.3)
35	42.5 (40.2–44.7)	52.7 (50.4–54.9)
40	50.7 (48.4–52.9)	57.8 (55.6–60.0)
45	51.7 (49.5–54.0)	57.0 (54.8–59.2)
50	54.1 (51.8–56.3)	63.1 (61.0–65.3)
55	59.0 (56.8–61.2)	64.3 (62.2–66.4)
60	60.1 (57.9–62.3)	64.3 (62.2–66.4)
65	70.6 (67.7–73.4)	67.8 (64.8–70.7)
70	70.3 (67.3–73.1)	64.1 (61.0–67.1)
75	64.5 (61.4–67.4)	55.7 (52.5–58.8)
80	55.0 (51.8–58.2)	44.4 (41.3–47.6)
Overall response rate	51.9 (51.2–52.6)	57.0 (56.3–57.7)

CI confidence intervals

Table 2 Lifetime prevalence of migraine related to age and gender

Age	Men % (95% CI)	Women % (95% CI)
20	21.8 (17.2–27.3)	31.4 (26.9–36.4)
25	22.6 (17.8–28.3)	34.5 (30.0–39.4)
30	20.5 (17.6–23.8)	36.8 (33.6–40–1)
35	21.8 (19.0–25.0)	37.8 (34.7–40.9)
40	22.0 (19.3–24.8)	38.0 (35.1–41.0)
45	20.6 (18.1–23.4)	37.4 (34.5–40.4)
50	18.3 (15.9–20.9)	33.7 (31.0–36.5)
55	18.4 (16.2–20.9)	35.4 (32.7–38.3)
60	18.0 (15.8–20.4)	34.8 (32.2–37.6)
65	14.1 (11.6–17.1)	31.0 (27.4–34.8)
70	11.6 (9.3–14.4)	25.9 (22.5–29.7)
75	13.5 (10.9–16.5)	24.3 (20.7–28.3)
80	10.9 (8.4–14.0)	27.2 (22.9–31.9)
Overall prevalence	18.1 (17.3–18.9)	34.1 (33.2–35.0)

CI confidence intervals

Table 3 Headache frequency in relation to migraine, age and gender in people from the Norwegian general population

Age (years)	N	No headache 0 days (%)	Infrequent headache 1–11 days (%)	Frequent headache			Chronic headache ≥180 days (%)
				12–30 days (%)	31–84 days (%)	85–179 days (%)	
No migraine							
Men							
20	202	19.3	55.0	21.3	4.0	0.5	0.0
25	197	15.7	56.9	17.8	8.6	1.0	0.0
30	512	14.8	53.1	19.9	8.0	2.7	1.4
35	563	15.5	56.1	14.9	8.2	3.0	2.3
40	674	16.3	55.0	16.2	8.0	4.0	0.4
45	700	20.4	55.6	12.1	7.7	3.1	1.0
50	754	27.9	50.0	12.9	5.4	2.4	1.5
55	830	35.3	45.3	11.9	4.1	1.6	1.8
60	858	41.7	42.8	9.0	3.6	1.7	1.2
65	517	50.1	39.7	6.6	2.1	0.2	1.4
70	521	56.8	33.0	4.4	4.0	1.0	0.8
75	473	63.8	25.6	4.7	4.2	1.1	0.6
80	395	74.7	15.2	3.3	4.1	1.3	1.5
Total	7,196	34.7	45.2	11.4	5.5	2.0	1.2
Women							
20	255	5.1	47.1	25.5	14.1	7.8	0.4
25	262	7.3	45.4	28.2	11.5	5.7	1.9
30	528	8.9	47.2	23.9	11.6	5.9	2.7
35	575	6.8	45.2	24.2	13.9	6.8	3.1
40	646	6.8	46.4	26.0	12.4	6.2	2.2
45	644	10.7	46.7	24.2	12.4	3.4	2.5
50	739	14.6	51.3	20.6	7.8	3.8	1.9
55	711	22.6	48.8	15.5	8.6	3.1	1.4
60	723	23.9	51.0	12.6	6.9	3.0	2.5
65	399	34.6	39.3	11.8	9.0	3.5	1.8
70	400	45.0	35.0	10.8	6.3	1.3	1.8
75	348	51.4	33.9	7.8	5.7	0.6	0.6
80	236	61.4	21.6	8.1	3.4	2.5	3.0
Total	6,466	20.3	45.0	18.8	9.7	4.1	2.1
Co-occurrence of migraine							
Men							
20	60	1.7	38.3	33.3	18.3	5.0	3.3
25	60	3.3	36.7	31.7	18.3	8.3	1.7
30	138	3.6	28.3	26.8	29.0	6.5	5.8
35	162	3.7	34.6	35.8	17.3	4.9	3.7
40	197	3.0	33.5	28.9	18.3	11.2	5.1
45	191	2.1	35.6	24.1	23.0	8.9	6.3
50	175	5.7	32.0	31.4	17.1	10.3	3.4
55	193	13.0	37.8	24.4	14.0	7.3	3.6
60	196	13.8	47.4	16.3	9.7	7.7	5.1
65	87	19.5	50.6	13.8	11.5	2.3	2.3
70	70	27.1	42.9	15.7	10.0	4.3	0.0
75	74	33.8	25.7	14.9	17.6	4.1	4.1
80	49	30.6	42.9	10.2	14.3	0.0	2.0
Total	1,652	9.8	36.9	24.8	17.1	7.2	4.1

Table 3 continued

Age (years)	N	No headache 0 days (%)	Infrequent headache 1–11 days (%)	Frequent headache			Chronic headache ≥180 days (%)
				12–30 days (%)	31–84 days (%)	85–179 days (%)	
Women							
20	117	0.9	24.8	21.4	30.8	14.5	7.7
25	142	0.0	24.6	30.3	24.6	15.5	4.9
30	323	1.9	22.9	31.6	26.0	10.5	7.1
35	359	0.6	22.3	25.1	30.1	15.3	6.7
40	411	1.0	19.5	27.3	29.7	13.1	9.5
45	392	2.0	22.2	31.9	25.5	10.7	7.7
50	383	3.4	27.9	25.8	22.5	13.1	7.3
55	405	5.4	33.1	28.1	21.0	7.9	4.4
60	408	8.3	39.0	21.6	16.9	7.4	6.9
65	181	15.5	37.0	23.2	13.3	7.2	3.9
70	146	26.7	32.2	18.5	17.8	2.7	2.1
75	112	31.3	34.8	11.6	12.5	4.5	5.4
80	92	39.1	21.7	13.0	16.3	5.4	4.3
Total	3,471	6.6	27.6	25.7	23.2	10.5	6.5

The sum of each row is 100%

quantify the differences in headache frequency in relation to age, gender, age and co-occurrence of migraine.

Ethical issues

The Regional Committees for Medical Research Ethics and the Norwegian Social Science Data Services approved the project.

Results

Questionnaire response rate

The overall response rate was 54.5%, and it was significantly higher among women than men ($P < 0.001$). Table 1 shows the response rate by age and gender. The response rate increased steadily from age 20 to age 65 years, and then it slowly declined in the elder age groups. Among responders, the first, second, and electronic questionnaire were replied by 64.7, 27.0 and 8.3%, respectively. There were no significant differences between headache and migraine response to first, second and electronic version analyzed separately by age and gender. The electronic version was replied significantly by more men than women (men 11.6% vs. women 5.3%; $P < 0.001$), and the response rate increased slightly from age 20 to age 25, then it declined gradually to 1.0 and 0.0% among 80 old men and women ($P < 0.001$ in both gender). Information about headache was missing in 5.9% of men and

4.8% of women, while information about migraine was missing in 6.6% of men and 5.2% of women. Complete information on both headache and migraine was received by 88.0% of men and 89.4% of women.

Migraine

Table 2 shows the prevalence of migraine by age and gender. Women had significantly more frequent migraine than men [34.1% (95% CI 33.2–35.0%) vs. 18.1% (95% CI 25.9–27.1%), $P < 0.001$]. The prevalence in men was unchanged from age 20 to age 40 years, and then it decreased slightly with age, while the prevalence in women increased from age 20 to age 40 years, and then decreased slightly with increasing age.

Headache

The 1 year prevalence of headache was 77.2%, i.e., 69.6% (95% CI 68.7–70.6%) in men and 84.0% (95% CI 83.3–84.7%) in women. Table 3 shows headache frequency in relation to migraine, age and gender. The frequency of headache decreased with age, but some of the elders aged 70 years or above experienced more frequent headache. The risk and frequency of headache was significantly higher in those with than without co-occurrence of migraine ($P < 0.001$ for both the gender). Table 4 presents the results of a multinomial logistic regression model showing odds ratios in relation to headache frequency, age and gender, with headache free and age

Table 4 Headache analyzed with a multinomial logistic regression model

Age and migraine	Men			Women		
	Odds ratios	95% CI	P values	Odds ratios	95% CI	P values
1–11 days						
20	0.879	0.583–1.324	0.537	1.384	0.741–2.587	0.308
25	1.069	0.693–1.649	0.764	1.036	0.589–1.820	0.903
30	1.031	0.749–1.420	0.850	0.768	0.505–1.167	0.216
35	1.062	0.782–1.444	0.700	1.051	0.675–1.635	0.827
40	1	–	–	1	–	–
45	0.826	0.626–1.090	0.176	0.634	0.430–0.934	0.021
50	0.527	0.405–0.684	<0.001	0.508	0.354–0.729	<0.001
55	0.373	0.290–0.480	<0.001	0.325	0.230–0.459	<0.001
60	0.312	0.244–0.400	<0.001	0.313	0.223–0.441	<0.001
65	0.239	0.183–0.313	<0.001	0.169	0.117–0.242	<0.001
70	0.173	0.132–0.227	<0.001	0.107	0.075–0.154	<0.001
75	0.113	0.085–0.151	<0.001	0.092	0.064–0.133	<0.001
80	0.070	0.051–0.096	<0.001	0.048	0.032–0.073	<0.001
Migraine	2.877	2.385–3.470	<0.001	1.981	1.679–2.337	<0.001
No migraine	1	–	–	1	–	–
12–30 days						
20	1.065	0.664–1.708	0.793	1.198	0.629–2.281	0.583
25	1.117	0.675–1.847	0.667	1.090	0.612–1.942	0.769
30	1.241	0.858–1.793	0.252	0.732	0.476–1.127	0.157
35	1.068	0.746–1.530	0.719	0.965	0.612–1.521	0.879
40	1	–	–	1	–	–
45	0.624	0.444–0.877	0.007	0.619	0.415–0.923	0.019
50	0.494	0.358–0.680	<0.001	0.357	0.244–0.521	<0.001
55	0.317	0.231–0.434	<0.001	0.198	0.137–0.286	<0.001
60	0.190	0.137–0.263	<0.001	0.138	0.095–0.199	<0.001
65	0.116	0.078–0.173	<0.001	0.089	0.059–0.134	<0.001
70	0.079	0.051–0.121	<0.001	0.054	0.036–0.082	<0.001
75	0.070	0.045–0.109	<0.001	0.032	0.020–0.051	<0.001
80	0.042	0.024–0.071	<0.001	0.028	0.017–0.045	<0.001
Migraine	7.666	6.230–9.433	<0.001	4.523	3.797–5.387	<0.001
No migraine	1	–	–	1	–	–
31–84 days						
20	0.587	0.314–1.096	0.094	1.389	0.717–2.691	0.330
25	1.060	0.589–1.909	0.846	0.854	0.464–1.569	0.610
30	1.348	0.884–2.058	0.166	0.643	0.409–1.012	0.056
35	1.027	0.674–1.564	0.901	1.103	0.690–1.762	0.682
40	1	–	–	1	–	–
45	0.861	0.586–1.266	0.447	0.546	0.359–0.832	0.005
50	0.428	0.289–0.635	<0.001	0.284	0.190–0.426	<0.001
55	0.243	0.163–0.362	<0.001	0.174	0.118–0.257	<0.001
60	0.158	0.105–0.239	<0.001	0.122	0.082–0.182	<0.001
65	0.097	0.057–0.166	<0.001	0.082	0.053–0.128	<0.001
70	0.121	0.074–0.197	<0.001	0.054	0.035–0.085	<0.001
75	0.129	0.081–0.206	<0.001	0.037	0.023–0.061	<0.001
80	0.099	0.059–0.166	<0.001	0.027	0.016–0.048	<0.001
Migraine	11.168	8.896–14.021	<0.001	7.978	6.633–9.596	<0.001
No migraine	1	–	–	1	–	–

Table 4 continued

Age and migraine	Men			Women		
	Odds ratios	95% CI	P values	Odds ratios	95% CI	P values
85–179 days						
20	0.226	0.076–0.672	0.007	1.542	0.755–3.151	0.235
25	0.486	0.199–1.185	0.112	1.046	0.540–2.028	0.893
30	0.706	0.396–1.260	0.239	0.620	0.372–1.031	0.066
35	0.637	0.363–1.118	0.116	1.186	0.711–1.979	0.514
40	1	–	–	1	–	–
45	0.630	0.384–1.033	0.067	0.417	0.256–0.679	<0.001
50	0.400	0.244–0.655	<0.001	0.331	0.210–0.522	<0.001
55	0.197	0.117–0.333	<0.001	0.138	0.086–0.220	<0.001
60	0.174	0.104–0.289	<0.001	0.114	0.072–0.183	<0.001
65	0.026	0.008–0.084	<0.001	0.079	0.046–0.137	<0.001
70	0.064	0.029–0.140	<0.001	0.021	0.010–0.044	<0.001
75	0.058	0.026–0.126	<0.001	0.017	0.007–0.038	<0.001
80	0.040	0.015–0.103	<0.001	0.028	0.014–0.057	<0.001
Migraine	12.664	9.413–17.037	<0.001	8.552	6.856–10.667	<0.001
No migraine	1	–	–	1	–	–
≥180 days						
20	0.426	0.092–1.984	0.277	0.751	0.303–1.862	0.536
25	0.262	0.033–2.084	0.205	0.605	0.264–1.388	0.236
30	1.733	0.778–3.861	0.178	0.625	0.349–1.117	0.113
35	1.826	0.852–3.912	0.122	0.941	0.523–1.695	0.839
40	1	–	–	1	–	–
45	1.156	0.545–2.452	0.705	0.531	0.309–0.913	0.022
50	0.711	0.332–1.523	0.381	0.316	0.186–0.539	<0.001
55	0.606	0.294–1.250	0.175	0.126	0.071–0.221	<0.001
60	0.437	0.210–0.912	0.027	0.177	0.106–0.296	<0.001
65	0.289	0.119–0.699	0.006	0.073	0.037–0.143	<0.001
70	0.120	0.038–0.378	<0.001	0.041	0.019–0.086	<0.001
75	0.163	0.060–0.442	<0.001	0.034	0.015–0.076	<0.001
80	0.209	0.080–0.541	0.001	0.049	0.024–0.103	<0.001
Migraine	12.169	8.498–17.425	<0.001	10.358	7.967–13.467	<0.001
No migraine	1	–	–	1	–	–

40 years old as reference categories. Intercept was included in the model, but is not show in the table. The Pearson χ^2 values were insignificant for both the models indicating that the estimated multinomial regression models fit data reasonably well. Table 5 shows age trends in different subgroups assessed using the non-linear regression model for each gender separately. This fit was rather good, with moderate or high values of R^2 and normally distributed residuals. In some subgroups the linear regression gave best fit, however, graphical analysis of the data showed that most subgroups displayed a curvilinear relationship (second or third order) between headache frequency and age (Fig. 1).

Headache free

The prevalence of being headache free increased from 19.1% (95% CI 14.2–25.6%) to 74.7% (95% CI 70.0–78.8%) in 20 and 80-year-old men without co-occurrence of migraine, and from 5.1% (95% CI 2.9–8.8%) to 61.4% (95% CI 54.9–67.6%) in 20 and 80-year-old women without co-occurrence of migraine. The prevalence of being headache free increased from 1.7% (95% CI 0.1–10.1%) to 30.6% (95% CI 18.7–45.6%) in 20 and 80-year-old men with co-occurrence of migraine, and from 8.5% (95% CI 0.4–53.6%) to 39.1% (95% CI 29.3–49.9%) in 20 and 80-year-old women with co-occurrence of migraine.

Table 5 The age trends in different subgroups were assessed using the non-linear regression model for each gender separately

Dependent variable	Coefficients of regression model				P values	R^2
	b_0	b_1	b_2	b_3		
No migraine						
Men						
0 days	30.43	−1.12	0.02	–	<0.001	0.988
1–11 days	39.34	1.07	−0.02	–	<0.001	0.985
12–30 days	27.03	−0.30	–	–	<0.001	0.957
31–84 days	−19.05	1.94	−0.04	0.0003	<0.001	0.869
85–179 days	−15.38	1.20	−0.02	0.0001	<0.001	0.855
≥180 days	−5.54	0.40	−0.01	0.00004	0.197	0.390
Women						
0 days	23.04	−1.21	0.02	–	<0.001	0.991
1–11 days	22.88	1.32	−0.016	–	<0.001	0.835
12–30 days	29.49	−0.03	−0.003	–	<0.001	0.924
31–84 days	17.41	−0.16	–	–	<0.001	0.822
85–179 days	9.20	−0.10	–	–	<0.001	0.821
≥180 days	−9.89	0.83	−0.02	0.0001	0.056	0.550
Co-occurrence of migraine						
Men						
0 days	11.55	−0.62	0.01	–	<0.001	0.949
1–11 days	89.72	−4.18	0.09	−0.001	0.306	0.317
12–30 days	43.30	−0.39	–	–	<0.001	0.804
31–84 days	−19.61	3.15	−0.07	0.0005	0.036	0.596
85–179 days	−2.99	0.54	−0.006	–	0.005	0.660
≥180 days	−0.004	0.20	−0.002	–	0.199	0.276
Women						
0 days	21.80	−1.33	0.02	–	<0.001	0.980
1–11 days	94.78	−5.62	0.13	−0.001	<0.001	0.832
12–30 days	11.94	0.87	−0.01	–	<0.001	0.809
31–84 days	36.41	−0.29	–	–	<0.001	0.778
85–179 days	19.68	−0.20	–	–	<0.001	0.796
≥180 days	9.00	−0.06	–	–	0.037	0.338

Discussion

### Methodological considerations

The study included 21,177 persons at age 20–80 years, providing sufficient data for age and gender-specific prevalence of headache and migraine. Participation was restricted to those responding to the migraine and headache questions. The response rate was fair and there were few missing values. We were not able to investigate whether responder and non-responders had a similar migraine and headache pattern, since we were not allowed to contact non-responders. However, similar replies to the first and second issued questionnaire as well as electronic responses suggest that responders and non-responders are not different. A previous Danish epidemiological survey found no significant difference in the frequency of migraine among responders and non-responders [7]. The single question about lifetime occurrence of migraine has been evaluated against a clinical interview by two physicians in another Norwegian survey conducted in eastern Akershus County. The observed agreement rate was 0.81 and Kappa was 0.62, a good strength of agreement (previous unpublished data). This is in line with validation of two Danish epidemiological surveys where the observed agreement rate was 0.92 and 0.94, and Kappa was 0.77 and 0.81, respectively [7, 8]. A single questionnaire question about tension-type headache has previously been evaluated against a clinical interview by a physician in a Danish population-based survey [8]. The observed agreement rate was 0.91 and the chance corrected agreement rate Kappa was 0.74, i.e., a good strength of agreement. The frequency of tension-type headache among 475 persons, aged 25–64-year-old, from the Danish general population, i.e., none, infrequent, frequent and chronic tension-type headache was also evaluated against a clinical interview by a physician on the same day in those with self-reported tension-type headache. The observed agreement rate was 0.87 and the chance corrected agreement rate Kappa was 0.77, again a good strength of agreement [9]. Our question regarding headache is likely to be more or at least equally precise as a single question about tension-type headache, since everybody knows what headache is, while some may not know what tension-type headache is. Thus, our simple questionnaire on migraine and headache is considered to be valid, even though our epidemiological survey included persons aged 20–80 years. It would be quite surprising, if 20 years old and 70–80 years old were significantly different from 25 to 65 years old regarding our simple questions about migraine and headache. In contrast, questionnaires based on a series of questions are not valid [8]. Due to the high number of participants in our survey, it was not feasible to apply the gold standard, i.e., a clinical interview by a physician/neurologist with expertise in headache diagnostics. The prevalence was based on headache within the last year. This was chosen in order to reduce recall bias. As headache is usually not a disabling or life threatening disorder, recall bias is likely to occur if one asks about headache years ago. Actually, the use of the 1-year prevalence is likely to secure more precise data on headache. Thus, the methodological precautions should secure that the data are both representative and generalizable.

Migraine

One of our main findings was the 26.5% lifetime prevalence of migraine with a male–female sex ratio of approximately 1:2. Our lifetime prevalence is quite similar to that found in other epidemiological surveys of

Fig. 1 Headache frequency versus age in men (*first row*) and women (*second row*)
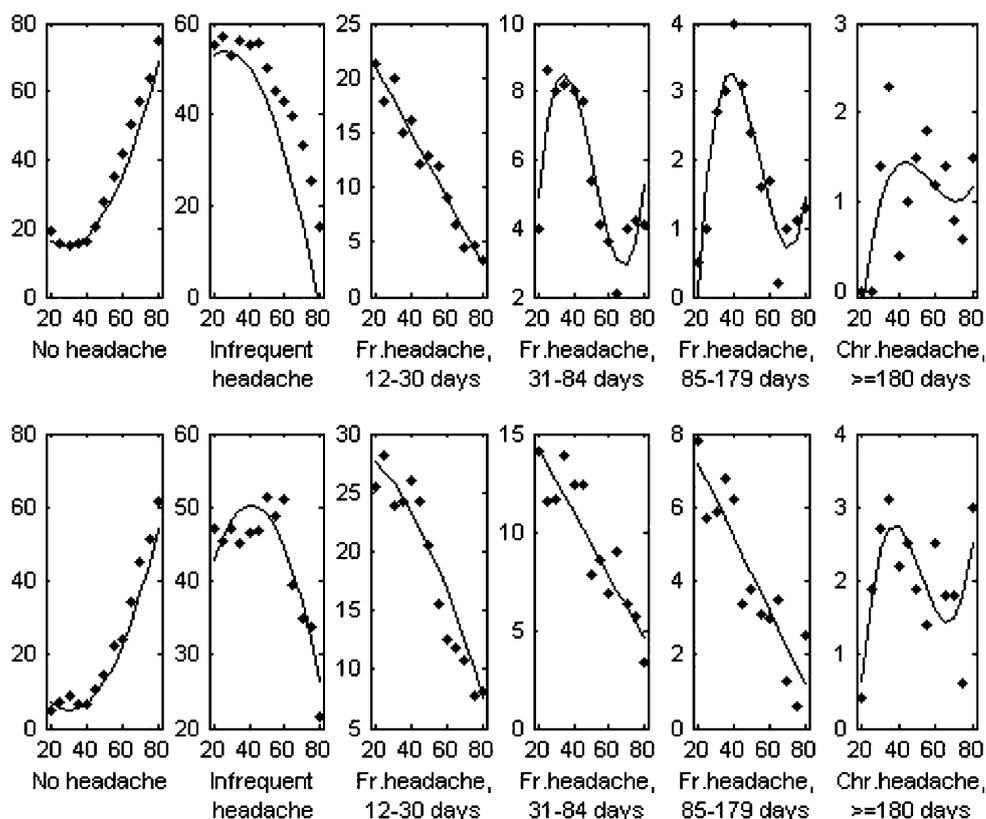
Caucasians conducted in Germany, the Netherlands and Sweden, while it is higher than that found in Canada, Croatia, Denmark and Italy [7, 10–15]. The different methodologies of these epidemiological surveys are likely to explain a part of the variation in prevalence. The prevalence of migraine is much lower in Africans, Asians and South Americans [4]. Although we do not have data on the frequency of migraine attacks, the high prevalence indicate that many people experience migraine at least a few times in their life, supporting the high socioeconomic impact of migraine [2–4]. The statistically significantly decreased prevalence of migraine in elder men can be a true phenomenon or it might be caused by recall bias. Women also had a tendency of decreased prevalence by age, but this was not statistically significant. Since, the epidemiological survey was population-based, the prevalence finding cannot be explained by physician consultation rate differences.

Headache

Another main finding was the 77.2% 1-year prevalence of headache with a male–female sex ratio of approximately 1:1.2. This corresponds well with the prevalence found in neighboring countries Denmark, Finland and Sweden [16–18]. However, another Norwegian epidemiological survey found a much lower prevalence of headache [19]. The latter survey was based on the question have you suffered from headache during the last 12 months? [20]. This phrasing is likely to cause underestimation of the "real" prevalence of headache, as people with a mild headache might not reply yes to question about suffering from headache. An interesting finding was the slightly increased risk of frequent and chronic tension-type in some of the elders. Figure 1 gives a graphical presentation of this aspect. This increase is likely to be secondary to other causes like stroke, tumors, etc., which become more common with age. An increase in headache frequency is a warning sign and should be dealt seriously with proper investigations. The data clearly demonstrated that co-occurrence of migraine increased the risk of headache. This has also been found in other epidemiological surveys [9, 21, 22]. Whether frequent headaches can cause attacks that mimics migraine or whether abortive attacks of migraine can be experienced as headache is uncertain. This is currently being debated among headache researchers, but it is not the scope of our paper. However, even thought the etiology is unsolved, the features of migraine and non-migraine headache are distinct and non-overlapping, as defined by the explicit diagnostic criteria of the International Classification of Headache Disorders [1]. The prevalence of being headache free increased significantly with age, and this is more so in men than in women, and in those without co-occurrence of migraine than those with the co-occurrence of migraine. So, even thought a person

has frequent episodes of headache and migraine there is hope at the end of the tunnel.

Conflict of interest None.

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