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ORIGINAL ARTICLE

The PACE study: lifetime and past-year prevalence of headache in Parma's adult general population

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Abstract Headache is a widespread disorder and therefore it has a strong impact on quality of life. In the present work we focused on lifetime and past-year prevalence of headache in general and by gender, in a population-based sample in Parma. A total of 904 subjects representative of Parma's adult general population were interviewed face-to-face by a physician from the Parma Headache Centre, using a validated questionnaire. The lifetime prevalence of headache was 69.1%, i.e. 75.8% in women and 60.6% in men; the crude past-year prevalence of headache was 42.8%, i.e. 52.0% in women and 31.1% in men. Both lifetime and past-year prevalence rates were significantly higher in females than in males (odds ratio, respectively, 2.0 and 2.4). In our study, past-year prevalence decreased after age 50 in both genders. Most people suffer from one headache subtype. In over 80% of cases, headache starts before age 40 and therefore people were not very likely to develop headache after 50 years. The past-year and lifetime prevalence rate of headache in general that we found in our study falls within the lower range of values for headache prevalence in European countries. Further researches need to be set in the Italian epidemiological background.

Keywords Headache · Past-year prevalence · Lifetime prevalence · Age of onset · General population · Epidemiology

Introduction

Headache is a widespread disorder globally [1]. However, its prevalence varies greatly in the different geographical regions. This variability could be due both to methodological differences between studies (particularly, in age ranges of study populations, methods of data collection and screening questions), and to ethical and cultural differences [1, 2]. In Europe, more than 50% of adults report having suffered from headache in the past year. Though possibly flawed by recall bias, even higher rates are reported for lifetime prevalence of the disease [2]. Most of the studies conducted so far on headache prevalence are from Western Europe and North America [3–6]. In Italy, however, epidemiological surveys are few and not recent, with a focus on selected age ranges [7–11]. The survey reported here is part of a broader research project, called PACE (PArma CEfalea) Study. This is a large observational population-based study aimed at investigating some epidemiological and clinical features of primary headaches in the city of Parma. Specifically, the objectives of the study were to calculate: (1) lifetime and past-year prevalence of headache in general and by gender; (2) past-year prevalence in the various decades of life; (3) the number of headache subtypes reported by subjects with past-year headache; and (4) mean age at onset and decade of onset of past-year headache, both in general and by gender.

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Materials and methods

The materials and methods we used for this survey are extensively explained in our previous study [12]; here we report a brief summary.

Sampling

Our study was carried out on Parma's adult general population in the period between September 2007 and February 2009, when the city had 152,140 inhabitants aged 18 years or over (71,280 men and 80,860 women) (Table 1). The official census of Parma residents as of 31 December 2006 was provided by the Parma Municipal Statistics Office [13].

The initial study sample was composed of 1270 subjects aged 18 years or over—681 women (53.6%) and 589 men (46.4%)—registered in the practice of a Parma-based General Practitioner (GP). Our study population can be considered representative of the Parma adult general population, because in Italy primary care is offered free of charge to every citizen from birth. For primary care providers to best fulfil their role, patients must be free to make their choice with no geographic, administrative or economic constraints. Every citizen may then decide at any time to change his/her primary care provider by simply addressing a request to the National Health System (NHS) local health authority. The GP's direct involvement was crucial to our study design, as selection was based on his willingness to actively collaborate in our survey. For his participation in the study, the GP did not receive any economic incentives.

Interview and case definition

The participants in our study were invited to answer questions in a face-to-face interview. Our team of physicians from the Parma Headache Centre administered a questionnaire (Supplementary Appendix I) specifically designed and previously validated for the diagnosis of primary headaches in the general population, according to the ICHD-II criteria [14, 15]. The interview was followed by a neurological examination, except for the subjects who could not reach our centre and were interviewed by phone.

Among others, the questionnaire included screening questions to detect subjects with lifetime headache (Have you ever had headache in your life?) and past-year headache (Have you had headache in the last 12 months?). A specific item surveyed patients who suffered from more than one type of headache ("Did you have more than one headache type", "If yes, how many types?"): in these cases we administered the diagnostic items of the questionnaire for each reported subtype.

A diagnosis of secondary headache was made in those cases in which the neurological examination was pathological and headache occurred for the first time in close temporal relation to another disorder that is known to cause headache.

In our study we calculated the mean age at onset of past-year headache; when considering the cases with more than one headache diagnosis we referred to the headache subtype with the earliest age at onset.

Statistical analysis

Crude prevalence was defined as the number of headache cases every 100 inhabitants. It was standardized by age and

Table 1 Gender and age distribution of Parma's general population, of the initial sample and of responders

Age (years)	Parma's general population[a]						Initial sample[b]						Responders[c]					
	F		M		Total		F		M		Total		F		M		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
18–29	10,253	12.7	10,582	14.9	20,835	13.7	82	12.1	69	11.7	151	11.9	51	10.0	33	8.3	84	9.3
30–39	15,105	18.7	15,208	21.3	30,313	19.9	86	12.6	93	15.8	179	14.1	55	10.8	51	12.9	106	11.7
40–49	13,834	17.1	13,845	19.4	27,679	18.2	98	14.4	104	17.7	202	15.9	78	15.4	61	15.4	139	15.4
50–59	11,738	14.5	10,628	14.9	22,366	14.7	106	15.6	98	16.6	204	16.1	96	18.9	74	18.7	170	18.8
60–69	11,505	14.2	9925	13.9	21,430	14.1	103	15.1	103	17.5	206	16.2	86	16.9	88	22.2	174	19.2
70–79	10,059	12.4	7239	10.2	17,298	11.4	107	15.7	81	13.8	188	14.8	93	18.3	64	16.2	157	17.4
>79	8366	10.4	3853	5.4	12,219	8.0	99	14.5	41	6.9	140	11	49	9.6	25	6.3	74	8.2
Total	80,860	53.1	71,280	46.9	152,140	100	681	53.6	589	46.4	1270	100	508	56.2	396	43.8	904	100

[a] Parma's general population as of 31 December 2006 [13]

[b] Patients registered in the lists of one GP

[c] Subjects that completed the questionnaire

gender in the Parma general population aged 18 or over, based on the official census of Parma residents as of December 2006 [13]. We used the Chi square test for frequency distribution and Student's t test for means comparison. The 95% confidence intervals (CI) for prevalence were calculated using the method suggested by Schoenberg [17]. The collected data were analysed using the SPSS software version 20.0 for Windows.

Ethics

The study was approved by the University of Parma Ethics Board on 13 February 2007. All subjects gave their informed consent.

Results

The 904 responders (71.2% of the initial study sample) included 508 women (56.2%; mean age 55.9 years, SD 17.2 years, max. 92 years) and 396 men (43.8%; mean age 55.0 years, SD 18.2 years, max. 91 years). In 89 cases (48 men and 41 women), the interview was conducted by phone (Fig. 1). Table 2 shows the demographic and socioeconomic features of the study sample.

No statistically significant differences were found in gender and age distribution between Parma's general population, the initial study sample and responders. The only exception was the 18- to 29-year age group, which showed a difference between responders and the general population ($p = 0.046$) (Table 1).

The crude lifetime prevalence of headache was 69.1% (95% CI 66.1–72.1, $n = 625$), i.e. 75.8% (95% CI 72.1–79.5, $n = 385$) in women and 60.6% (95% CI 55.8–65.4, $n = 240$) in men; the prevalence rate was significantly higher in females than in males [odds ratio (OR) 2.0, 95% CI 1.5–2.7].

The crude past-year prevalence of headache was 42.8% (95% CI 39.6–46.0, $n = 387$), i.e. 52.0% (95% CI 47.6–56.3, $n = 264$) in women and 31.1% (95% CI 26.5–35.6, $n = 123$) in men; the prevalence rate was significantly higher in females than in males (OR 2.4, 95% CI 1.8–3.2). Table 3 shows the crude past-year prevalence of headache in general by age and gender.

The adjusted past-year prevalence of headache was 47.0% (95% CI 43.7–50.3), i.e. 56.2% (95% CI 51.9–60.5) in women and 34.2% (95% CI 29.5–38.9) in men.

Crude past-year prevalence (Fig. 2) decreased after age 50 and even more after age 70, from 66.2% under 49 down to 49.4% over 50 and to 17.8% over 70. There were no significant differences between men and women in age distribution of crude prevalence.

Among the 387 subjects with past-year headache, 16.8% ($n = 65$), i.e. 18.2% of women ($n = 48$) and 13.8% of men ($n = 17$), had more than one headache subtype (61 reported two and four reported three).

In Table 4 we consider the crude past-year prevalence of the different headache subtypes we diagnosed among the participants of the PACE study; these data are extensively explained in our previous studies [12, 16] on the same population.

Among the secondary headache cases, we diagnosed one case of acute post-traumatic headache (ICHD-II code 5.1), three cases of medication-overuse headache (ICHD-II code 8.2), two cases of headache attributed to other disorder of cranium (code 11.8); one case corresponded to ICHD-II code 14.1 (headache not elsewhere classified).

Mean age at onset of past-year headache was 26.0 years (±14.8 years, range 5–85), i.e. 25.1 years (±14.6 years, range 5–85) for women and 28.0 years (±14.9 years, range 6–76) for men.

When evaluating age at onset by decade, we found that headache started before age 40 in 82.8% of cases ($n = 318$). This finding was consistent in both populations (male and female).

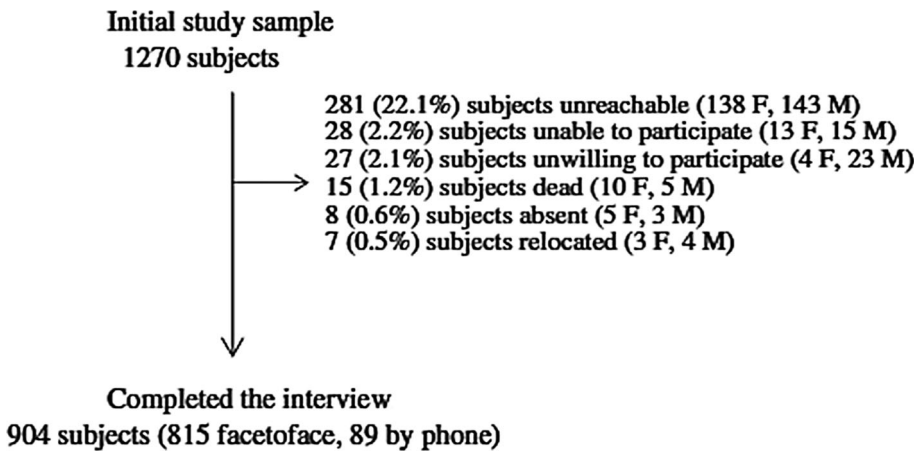

Fig. 1 Study population flow chart. Initial sample, non-responders (with respective reasons) and responders

Table 2 The demographic and socioeconomic data of the study sample

	M		F		Total	
	N	%	*N*	%	*N*	%
Sex	396	43.8	508	56.2	904	100
Race						
Caucasian	394	99.4	506	99.6	900	99.6
Asian	1	0.3	–	–	1	0.1
Hispanic	–	–	1	0.2	1	0.1
Black	1	0.3	–	–	1	0.1
Other	–	–	1	0.2	1	0.1
Side dominance						
Right-handed	351	88.6	469	92.3	820	90.7
Left-handed	17	4.3	10	2.0	27	3.0
Ambidextrous	28	7.1	29	5.7	57	6.3
Body mass index						
<18.5	3	0.7	25	4.9	28	3.1
18.5–24.9	155	39.0	275	54.3	430	47.5
25–29.9	183	46.1	133	26.3	316	35.0
≥30	57	14.2	73	14.5	130	14.4
Education level						
≤8 years	223	56.3	290	57.1	513	56.7
9–13 years	126	31.8	147	28.9	273	30.2
≥14 years	47	11.9	71	14.0	118	13.1
Occupation						
Unemployed	1	0.3	75	14.8	76	8.4
Pensioner	151	38.2	173	34.1	324	35.8
Employee	87	22.0	149	29.3	236	26.2
Labourer	54	13.6	25	4.9	79	8.7
Student	18	4.5	28	5.5	46	5.1
Teacher	4	1.0	23	4.5	27	3.0
Farmer	2	0.5	1	0.2	3	0.3
Self-employed	79	19.9	34	6.7	113	12.5
Marital status						
Single	85	21.5	101	19.9	186	20.6
Married	280	70.7	292	57.4	572	63.2
Cohabiting	6	1.5	1	0.2	7	0.8
Divorced	3	0.8	7	1.4	10	1.1
Separated	7	1.8	11	2.2	18	2.0
Widowed	15	3.7	96	18.9	111	12.3
Cigarette smoking						
Current smoker	95	24.0	107	21.1	202	22.3
Former[a] smoker	119	30.0	69	13.6	188	20.8
Never smoked	182	46.0	332	65.3	514	56.9

[a] Adults who have smoked at least 100 cigarettes in their lifetime, but say they currently do not smoke

There was a significant correlation between age at the time of the interview and age at headache onset ($p = 0.000$).

Mean headache duration since onset was 22.4 years (±14.8 years, range 0–68); it was 20.7 for men (±13.2 years, range 0–54) and 23.2 for women (±15.5 years, range 0–68).

Discussion

Headache is a widespread disease of global concern, with past-year prevalence rates exceeding 50% in Western countries [1]. Therefore, it has a strong impact on quality of life: according to Stovner et al. [1], in terms of Years Lived with Disability (YLD) it ranks 10th among diseases in general. Based on 2011 WHO data [18], migraine alone accounts for 2.9% of all YLDs, ranking seventh highest among specific causes of disability globally.

In our study, the crude past-year prevalence of headache in a representative sample of the Parma adult population was 42.8% (52.0% in women and 31.1% in men). This figure falls within the lower range of the values reported in the literature for Europe and is less than reported for North America.

In particular, in European countries [19–24], past-year prevalence rates of headache range from 37.4% in Norway [22] to 65.2% in Croatia [21].

Past-year prevalence rates in North America are higher than in Europe, ranging from 59.7% in the US [6] to 87.3% in Canada [25].

Outside Europe and North America, past-year prevalence rates of headache are even more variable. In Africa, two studies showed a prevalence rate of 23.1% in southern Tanzania [26] and of 67.5% in Ethiopia [27]. In Asia [28–31], reported rates range from 23.8% in China [31] to 74.5% in Georgia [29]. Finally, in South America, prevalence varies between 28.7% in Peru [32] and 80.8% in Brazil [33].

In a 2007 review, Stovner et al. [1] calculated that the mean overall value of past-year headache prevalence was 46%, a figure that is very close to ours.

In Italy, prevalence studies of headache in general are few and were conducted on populations that are not comparable to ours by age. D'Alessandro [8] reported a similar past-year prevalence (46.0%), but his sample included also children (aged over 7). Prencipe [7] and Camarda [11] reported a past-year prevalence of 51.0% and 21.8%, respectively, in samples of subjects aged over 65. Finally, Schwaiger [9] estimated a 51.7% rate in subjects ranging in age from 55 to 94.

In our study, past-year headache prevalence was higher in females than in males (52.0 vs 31.1%) with an F/M gender ratio of 1.7. This figure is comparable to the one in the literature, which varies between 1.1 [25] and 1.5 [24].

Table 3 Crude past-year prevalence of headache by age and gender

Age (years)	M			F			TOTAL		
	n	%	95% CI	*n*	%	95% CI	*n*	%	95% CI
18–29	15	45.5	28.5–62.4	38	74.5	62.5–86.5	53	63.1	52.8–73.4
30–39	18	35.3	22.2–48.4	40	72.7	61.0–84.5	58	54.7	45.2–64.2
40–49	29	47.5	35.0–60.1	63	80.8	72.0–89.5	92	66.2	58.3–74.1
50–59	23	31.1	20.5–41.6	61	63.5	53.9–73.2	84	49.4	41.9–56.9
60–69	26	29.5	20.0–39.1	36	41.9	31.4–52.3	62	35.6	28.5–42.7
70–79	11	17.2	7.9–26.4	17	18.3	10.4–26.1	28	17.8	11.8–23.8
>79	1	4.0	0.0–11.7	9	18.4	7.5–29.2	10	13.5	5.7–21.3
Total	123	31.1	26.5–35.6	264	52.0	47.6–56.3	387	42.8	39.6–46.0

Fig. 2 Crude past-year prevalence of headache by age and gender

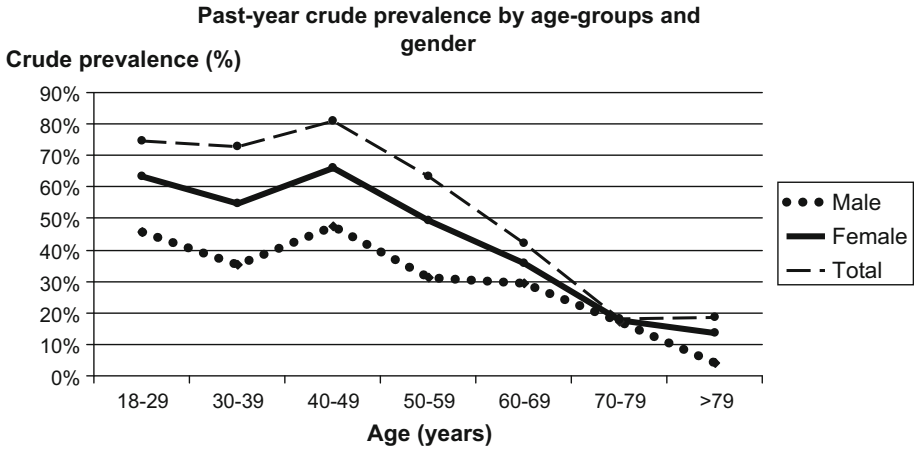

Table 4 Crude past-year prevalence of headache subtypes by gender

Headache subtype	M			F			TOTAL		
	n	%	95% CI	*n*	%	95% CI	*n*	%	95% CI
Tension-type headache	73	18.4	14.6–22.3	102	20.1	16.6–23.6	175	19.4	16.8–21.9
Migraine	45	11.4	8.2–14.5	151	29.7	25.7–33.7	196	21.7	19.0–24.4
Cluster headache	–	–	–	1	0.2	0–0.6	1	0.1	0–0.3
Primary stabbing headache	3	0.8	0–1.6	11	2.2	0.9–3.4	14	1.5	0.7–2.4
Secondary headache	4	1.0	0–2.0	5	1.0	0.1–1.8	9	1.0	0.3–1.6

As to the pattern of past-year prevalence based on age and gender, both in women and in men we found a bimodal distribution with a first peak between 18 and 29 years of age (74.5% in females and 45.5% in males) and a second, higher peak between 40 and 49 years (80.8% in females and 47.5% in males). In our study, prevalence decreased after age 50 in both genders. A recent prospective study from Germany [19] confirms such figures, indicating that between 1995 and 2005 and in 2009 the pattern of headache prevalence in that country continued to show higher rates between 20 and 59 years and decreased after 60. This pattern had already been observed in Europe by Stovner [2], with a peak in prevalence between 18 and 29 years in Germany [5, 20] and between 18 and 35 years in the UK [34].

A comparison with the literature shows differences that can be partly explained by the different methodologies used in the various studies. As stressed by Manzoni and Stovner [35], different methodologies may determine an up to 30% variability in results.

Based on our experience, screening questions represent the single major methodological difference between studies. In our survey, we used a neutral question (Have you had headache in the last 12 months?), so as to include all headache types, regardless of the nature, frequency and intensity of pain. Other studies used more specific questions, such as "Have you suffered from headache in the last 12 months?" [8, 20, 24], or "Have you suffered from headache not caused by a cold or cold temperatures, hangover, or head injury at least once in the last

12 months?" [36]. Such questions tend to screen only subjects who identify headache as a disorder and stress the suffering caused by headache. In our opinion, and in agreement with Hagen [24], the appropriate screening question to include all headache cases should be neutral.

Some literature studies were designed to estimate the prevalence of specific headache subtypes, such as migraine or tension-type headache [10, 20, 25, 28].

In our study we sought the prevalence of headache in general and saw that primary forms are definitely more frequent: of the 387 subjects who answered "Yes" to the question "Have you had headache in the last 12 months?", only nine had a secondary form, corresponding to a crude prevalence of 1.0% (95% CI 0.3–1.6). This finding is consistent with the observations of Rasmussen et al. [3].

Having distinguished between primary and secondary forms and considering that the prevalence of headache in general is minimally affected by the inclusion of secondary forms, we were able to make a comparison also with those studies that reported prevalence only for primary forms [5, 11, 23].

Other methodological differences are determined by the methods used to collect data, i.e. through a face-to-face interview [7, 9, 11, 19, 23, 28, 29], a self-administered questionnaire [5, 22, 24], or an interview by phone [6, 20, 25]. In general, as the diagnosis of primary headaches can be made only clinically, the face-to-face interview appears the most accurate methodology to investigate the prevalence of this disorder.

Differences in prevalence studies also arise from the age composition of the patient sample. Some studies included subjects aged over 65 [7, 11] or children aged over 7 [8], or more restricted age groups, such as subjects between 18 and 65 years [5, 6, 28] or between 55 and 94 years [9].

As to the time window of prevalence, most of the studies on headache prevalence in the literature considered the last 12 months; in one study [34] prevalence was related to the last 3 months. However, according to Stovner [2], such studies, too, can be compared with past-year ones, because they include subjects that had headache in the recent past.

By contrast, studies on lifetime headache prevalence may be affected by the recall bias [2], because subjects are requested to recall all the headaches they had in their whole life.

In our study we calculated a lifetime prevalence of 69.1%. In the literature, the lifetime prevalence of headache ranges from 21.2% in the US [37] to 71.4% in Germany [38]. Very high rates of 96% [3] and 99.5% [4] were found in Denmark. Only the UK had comparable high rates (92.6%) [34].

Most people suffer from one headache subtype. When multiple subtypes are present, in the overwhelming majority of cases they never exceed two. Literature data on this issue basically refer to comorbidity between primary headaches and not to the presence of different headache subtypes in the same subject. Our findings are in agreement with those of Schwartz et al. [6].

In over 80% of cases, headache starts before age 40 and therefore people are not very likely to develop headache at an advanced age (>50 years). Several authors have reported data on mean age at onset for the most common types of primary headache, but there are no data on mean age at onset for headache in general.

We found a correlation between age at the time of the interview and age at headache onset. Therefore, the mean age calculated in our study may be older than the actual one due to the telescoping bias, a bias in which respondents report events closer to the time of the interview than is true [39].

Our study had some limitations that need to be addressed. (1) The questionnaire has been validated in a clinical population of headache patients evaluated at our Headache Centre [14], but in the present study we applied it to a sample representative of Parma's general population. (2) The subjects interviewed by phone were not subjected to a medical visit; as their number was very small and the interview was accurate, however, we do not believe that this affected our study results. Furthermore, we did not compare the results of in-person interviews with the results of phone interviews because the number of the latter was low. (3) Our study was not designed for the diagnosis of secondary headache types; therefore, we are well aware that some secondary headache diagnosis might have been missed. (4) The study population was not recruited from the general population. We chose this design because the GP's direct involvement was crucial to our study and the selection largely depended on the GP's willingness to actively collaborate in the survey. However, as suggested by Stovner et al. [40], a non-probability sampling method can be equally valid if the study sample is compared with the whole population, as we did in our case [12].

With respect to other studies in the literature, ours had the advantage of being conducted through face-to-face interviews by headache experts, who used a neutral question to screen a sample that was representative of Parma's adult population.

In conclusion, the past-year prevalence rate of headache in general that we found in our study is very similar to the mean overall value calculated by Stovner [1] and falls within the lower range of values for headache prevalence in European countries—a range that is fairly broad in itself, partly due to the wide variability of methodology. Finally, the influence of geographic, cultural, and racial factors cannot be excluded. Future epidemiological surveys in Italy and Europe will help determine the exact influence of these factors on headache prevalence.

Compliance with ethical standards

Conflict of interest We certify that there is no actual or potential conflict of interest in relation to this article.

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