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# Has the prevalence of migraine and tension-type headache changed over a 12-year period? A Danish population survey

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**Abstract.** *Objective*: The present study aims to compare the prevalence of primary headaches in Denmark in two periods as only few replicate studies have re-evaluated the prevalence of primary headaches. *Study Design and Setting*: The 2001 study is a replicate of a cross-sectional survey of primary headaches in 1989, and compares 297 subjects aged 25–36 years from the general population, with the 294 comparable subjects invited in 1989. Medical doctors diagnosed all headaches using IHS-classification. *Results*: The participation rate was 75% in 1989 and 70% in 2001. The prevalence of migraine did not change significantly (11–15%), while the prevalence of tension-type headache (79–87%), especially of frequent tension-type headache (29–37%) increased significantly. The prevalence of chronic tension-type headache (2–5%) tended to increase. The proportion of the migraineurs with migraine 14 days or more per year increased (12–38%). Female gender was a risk factor for both primary headaches. The majority of migraineurs (92–94%) also reported coexistent tension-type headache. *Conclusion*: The prevalence of tension-type headache but not of migraine increased. The increase in migraine and tension-type headache frequency suggests a higher individual and societal impact of primary headaches now, than 12 years ago.

**Key words:** Epidemiology, General population, Headache, Migraine, Prevalence, Tension-type headache

## Introduction

Primary headaches have been recognised by the World Health Organisation as a major public health problem because they are global, extremely prevalent, affect all ages, and have significant impact on individuals and their society [1].

The prevalence of migraine in the general population has been assessed in several studies using the diagnostic criteria defined by the International Headache Society [2]. Generally, consistent prevalence rates of migraine have been described [3, 4], but determining any change of prevalence over time requires comparable study designs in order to reliably compare prevalences. To our knowledge only very few replicate studies of migraine prevalence surveys have been published [5, 6].

In contrast to migraine, prevalence data of tension-type headache are sparse, and the variation of tension-type headache prevalence is wide [7, 8], probably reflecting methodological differences. Even though tension-type headache is the most prevalent primary headache and has significant functional impact on society [8], no other known study has repeated a previous prevalence survey to assess any secular trends of tension-type headache.

In 1989, we conducted an epidemiological cross-sectional population-based survey of primary headaches in Denmark [9]. The present survey is designed as a replicate of the 1989 study and is a cross-sectional study of primary headaches in a community-based population. The aim of the study is to assess any change in the prevalence of primary headaches over a 12-year period among the young adult population in Denmark.

## Materials

### *The 1989 cohort*

In 1989, a population-based cross-sectional survey of primary headaches was conducted at the Research Centre for Prevention and Health (the former Glostrup Population Studies) [9]. One thousand residents in the County of Copenhagen, aged 25–64 years, were randomly chosen from the Danish Civil Registration System. As all residents in Denmark are registered in the Civil Registration System with a unique 10-digit code, this sampling method ensures a random sample of the population. Subjects were invited to a headache interview by medical doctors including an extensive clinical examination. Participants were requested to fast before blood sample collection. Totally, 740 of 975

eligible (75.9%) participated. The age and gender distribution of the participants was representative of the cohort and the background population [9, 10]. Methods and results from this survey are described thoroughly elsewhere [9, 11, 12]. Of the 975 eligible subjects, 294 corresponded to the age span of the participants in the cross-sectional part of the 2001 study.

### *The 2001 cohort*

In 2001, a cross-sectional survey designed to replicate the 1989 survey was initiated in addition to a follow-up study of the original study population. Three hundred new subjects aged 25–36 years were selected by the same selection criteria as in 1989. The 300 new subjects and all eligible subjects from the 1989 survey were invited to participate in a headache interview. The invitation stated that the purpose of the study was to obtain knowledge about headache in the general population. The headache interview consisted of a semi-structured face-to-face interview focusing on primary headaches and a general and neurological examination. As in 1989, information about socio-demographic and psychological factors was obtained by self-administered questionnaires. No requirements of fasting were made. If no response was obtained, completion by telephone of a reduced version of the headache interview was attempted. All headache interviews throughout the 2001 survey were conducted by a medical doctor (AL) between May 2001 and April 2002. Headache questions were replicates of the questions used in the survey from 1989, and phrased as 'Have you ever had a headache?' Each different form of headache was diagnosed and described extensively and headache diagnoses were based on the 1988 IHS-criteria [2]. The numeric code of each diagnose was recorded to the 1 digit level. According to the 2nd edition of the IHS criteria (2004) [13], episodic tension-type headache was subdivided into infrequent episodic tension-type headache (1–11 headache days per year) and frequent episodic tension-type headache (12–179 headache days per year). Chronic tension-type headache and chronic migraine was defined as 180 headache days or more per year.

The survey was approved by the Ethical Committee for Copenhagen County and by The Danish Data Protection Agency. Informed consent was obtained from each participant before the interviews.

### *Statistical analysis*

Comparison of groups was performed with $\chi^2$ test. Multivariate logistic regression models were performed with headache as the dependent variable. The independent variables were gender, age at examination (continuous variable), and study year (1989 vs. 2001). A possible change in the male:female prevalence ratio was examined by testing for interaction between study year and gender. Odds ratios and 95% confidence limits were calculated. All data analyses were made using the SAS statistical package V8e.

## Results

### *Participation*

In the 1989 survey, 221 (75.2%) of the 294 eligible subjects aged 25–36 years old (112 males, 109 females) participated in the clinical examination. Of the 300 persons invited to participate in the 2001 survey, 3 were not eligible due to errors in the address list. In total, 207 (69.7%) of the 297 eligible subjects participated (92 male, 115 females). Of these 127 (61%) participated in the face-to-face interview and 80 (39%) completed the telephone interview.

In separate logistic regression analyses of each survey, it was shown that the participants were representative of the survey populations with regard to age and gender (1989: age: OR:1.1, $p = 0.06$, gender: OR:1.0, $p = 0.99$; 2001: age: OR:1.0, $p = 0.45$. gender: OR:1.6, $p = 0.07$). Non-significant trends towards a higher participation rate of older subjects in 1989 and of females in 2001 were observed.

### *All headaches combined*

The prevalence of all headaches combined (primary and secondary) did not change significantly, as the lifetime prevalence was 97.3% in 1989 and 99.5% in 2001 ($p = 0.07$). No gender difference was found. The point prevalence of all headaches on the day of examination did not change significantly, 19.5% in 1989 vs. 16.4% in 2001 (Table 1). A significant higher prevalence was observed in women than in men. The male:female ratio was 1:2.9 in 1989 and 1:2.2 in 2001.

### *Migraine*

#### *Prevalence*

Neither the lifetime nor the one-year prevalence of migraine were significantly increased from 1989 to 2001, as only a tendency towards an increase was observed. The lifetime prevalence was 14.5% in 1989 and 18.4% in 2001, while the one-year prevalence of migraine was 11.3% in 1989 and 15.5% in 2001. For males the prevalence was unchanged (one-year prevalence 7.1% and 5.4%, respectively), while the prevalence tended to increase for females (one-year prevalence 15.6 and 23.5% respectively, $p = 0.14$). The male:female ratio of the one-year prevalence was 1:2 in 1989 and 1:4 in 2001 ($p = 0.22$). A logistic regression analysis including gender, age and interview-year showed gender to be highly significant with

**Table 1.** Point prevalence of headache (on the day of examination) according to primary headache diagnosis

| Headache diagnosis | 1989 | Cohort | | 2001 | Cohort | | *p*-Value (1989 vs.2001) |
|---|---|---|---|---|---|---|---|
| | (%) | N | 95% CI | (%) | N | 95% CI | |
| All participants | | N = 221 | | | N = 207 | | |
| Total | 19.5 | (43) | 14.2–24.7 | 16.4 | (34) | 11.4–21.5 | $p = 0.42$ |
| Males | 9.8 | (11) | 4.3–15.3 | 9.8 | (9) | 3.7–15.9 | $p = 0.99$ |
| Females | 29.4** | (32) | 20.8–37.9 | 21.7* | (25) | 14.2–29.3 | $P = 0.19$ |
| Migraine | | N = 25 | | | N = 32 | | |
| Total | 48.0 | (12) | 28.4–67.6 | 12.5 | (4) | 1.1–24.0 | $p = 0.003$ |
| Males | 12.5 | (1) | 0.0–52.7 | 0.0 | (0) | – | $p = 0.41$ |
| Females | 64.7* | (11) | 38.3–85.8 | 14.8 | (4) | 4.2–33.8 | $p = 0.0007$ |
| Tension-type headache | | N = 175 | | | N = 179 | | |
| Total | 23.4 | (41) | 17.4–30.4 | 19.0 | (34) | 13.5–25.5 | $p = 0.31$ |
| Males | 12.2 | (9) | 4.7–19.6 | 12.0 | (9) | 4.7–19.4 | $p = 0.98$ |
| Females | 31.7** | (32) | 22.6–40.8 | 24.0* | (25) | 16.2–33.4 | $p = 0.22$ |

96% of headaches on examination day were attributable to tension-type headache.
No subjects had migraine headache on the day of examination.
Gender difference within same cohort: * < 0.05, ** < 0.01.

**Table 2.** One-year prevalence of migraine and tension-type according to gender, age and interview-year

| | Variable | OR | (95% CI) | *p*-Value |
|---|---|---|---|---|
| Migraine | Gender | | | |
| | Male | 1 | | |
| | Female | 3.64 | 1.89–7.00 | 0.0001 |
| | Age* | 1.05 | 0.96–1.13 | 0.28 |
| | Interview-year | | | |
| | 1989 | 1 | | |
| | 2001 | 1.40 | 0.79–2.49 | 0.25. |
| Tension-type headache | Gender | | | |
| | Male | 1 | | |
| | Female | 3.83 | 2.18–6.75 | 0.0001 |
| | Age* | 0.95 | 0.88–1.02 | 0.13 |
| | Interview-year | | | |
| | 1989 | 1 | | |
| | 2001 | 1.56 | 0.92–2.65 | 0.10 |

*Age as a continuous variable.

an odds ratio of 3.6 for females compared with males (Table 2). There was no effect of age and interview-year.

*Frequency of headache days*

No subjects had chronic migraine (more than 180 days per year) in 1989 or in 2001. In 1989, 12.0% of subjects with migraine reported 14 migraine days or more per year, while in 2001, the figure was 37.5%. The increase in the proportion of the subjects with migraine reporting frequent migraine was significant ($\chi^2 = 4.71$, $p = 0.03$). Gender did not influence the frequency of migraine days in any of the cohorts. Table 3 illustrates the frequency of migraine days among subjects with migraine.

*Point prevalence*

In 1989, 48.0% of subjects with migraine had a headache of any type on the day of examination. The proportion was markedly reduced in 2001 to 12.5% (Table 1). Almost all headaches on the examination day both in 1989 and in 2001 were attributable to tension-type headache. In 1989, 28.0% of subjects with migraine (7 of 25) had had migraine within the preceding month, whereas in 2001, the corresponding figure was 47.6% (10 of 21), ($p = 0.17$). No significant gender difference was observed.

*Age at onset*

The distribution of age at onset did not change from 1989 to 2001 (Figure 1). Of the subjects with migraine 56% and 58%, respectively, estimated their age at onset to 20 years or less. A trend towards earlier onset among males than females was observed.

*Tension-type headache*

*Prevalence*

Both the lifetime and one-year prevalence of tension-type headache was found to have increased significantly. Between 1989 and 2001, the lifetime

**Table 3.** Headache frequency in days per year in subjects with migraine or tension-type headache diagnosis within the last year

| | 1–7 days N (%) | 8–14 days N (%) | 15–30 days N (%) | 30–179 days N (%) | >180 days N (%) | Total N |
|---|---|---|---|---|---|---|
| Migraine | | | | | | |
| 1989 cohort | 16 (64.0) | 6 (24.0) | 1 (4.0) | 2 (8.0) | 0 (0) | 25 |
| 2001 cohort | 13 (40.6) | 7 (21.9) | 7 (21.9) | 5 (15.6) | 0 (0) | 32 |
| Tension-type headache | | | | | | |
| 1989 cohort | 66 (37.7) | 41 (23.4) | 36 (20.6) | 28 (16.0) | 4 (2.3) | 175 |
| 2001 cohort | 57 (31.8) | 35 (19.6) | 32 (17.9) | 45 (25.1) | 10 (5.6) | 179 |

Migraine: $\chi^2 = 5.4$, d.f. = 3, $p = 0.15$. Infrequent vs. frequent (>14 days): $\chi^2 = 4.71$, $p = 0.03$.
Tension-type headache: $\chi^2 = 7.9$, d.f. = 4, $p = 0.10$. Infrequent Vs. frequent (>14 days): $\chi^2 = 3.41$, $p = 0.06$.

prevalence increased from 81.9 to 89.4% $p = 0.02$), and the one-year prevalence increased from 79.2 to 86.5% ($p = 0.04$). However, the change was only seen for males, where the one-year prevalence increased significantly from 66.1 to 81.5% ($p = 0.01$). For females the one-year prevalence was 92.7% and 90.4%, respectively. The male:female ratio was 1:1.4 in 1989 and 1:1.1 in 2001, but the change was not significant in the logistic regression analysis. Gender was significant for the odds for tension-type, while there was no influence of age and interview-year (Table 2).

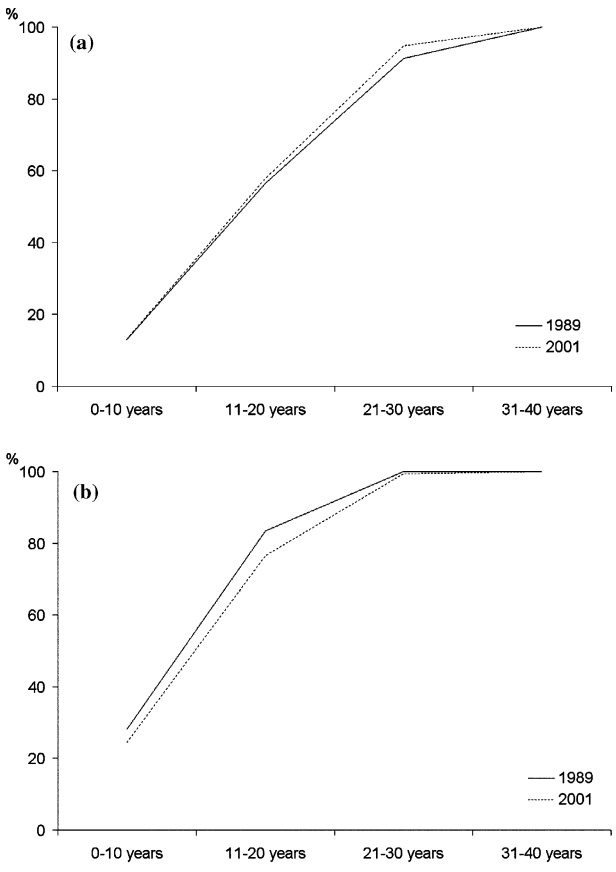


**Figure 1.** Accumulated proportion of subjects with primary headache by age at onset.

*Frequency of headache days*

The prevalence of frequent episodic tension-type headache defined according to the 2nd edition of the IHS Classification [13] increased significantly from 29.0% in 1989 to 37.2% in 2001 ($p = 0.03$). A higher proportion of females than males with tension-type headache reported frequent episodic tension-type headache (males 21.1%, females 43.8%, $p < 0.0001$). The prevalence of chronic tension-type headache also tended to increase, from 1.8% (n = 4) in 1989 to 4.8% (n = 10) in 2001 ($p = 0.08$). Due to the small number, no statistical test on gender was performed. The frequency of tension-type headache in days per year for subjects with tension-type headache is illustrated in Table 3.

*Point prevalence*

Among subjects with tension-type headache, 23% in 1989 and 19% in 2001 had tension-type headache on the examination day. The point prevalence was significantly higher for women than men, both in 1989 and in 2001 (Table 1).

Among subjects with tension-type headache in 1989, 62% had had a tension-type headache within the preceding month. In 2001, the corresponding figure was 79%, but the change was not significant ($p = 0.17$). Significantly more females than males reported tension-type headache within the preceding month (1989: $p = 0.0008$; 2001: $p = 0.04$).

*Age at onset*

The age at onset of tension-type headache did not change from 1989 to 2001 (Figure 1). The majority of subjects reporting tension-type headache estimated the age at onset to 20 years or less (83% in 1989 and 77% in 2001). No gender difference was observed.

*Coexisting migraine and tension-type headache*

The majority (92% in 1989 and 94% in 2001) of subjects with migraine also reported tension-type headache and 56% reported frequent tension-type

**Table 4.** One-year prevalence of tension-type headache in subjects with or without migraine.

| | 1989 cohort | | | 2001 cohort | | |
|---|---|---|---|---|---|---|
| | Migraine | No migraine | Total | Migraine | No migraine | Total |
| Frequent episodic tension-type headache | | | | | | |
| Yes | 44% (11) | 27% (53) | 29% (64) | 56% (38) | 39% (69) | 42% (87) |
| No | 56% (14) | 73% (143) | 71% (157) | 44% (14) | 61% (106) | 58% (120) |
| All tension-type headache | | | | | | |
| Yes | 92% (23) | 78% (152) | 79% (175) | 94% (30) | 85% (149) | 86% (179) |
| No | 8% (2) | 22% (44) | 21% (46) | 6% (2) | 15% (26) | 14% (28) |

Frequent tension-type headache: 1989: $\chi^2 = 3.10$, $p = 0.08$; 2001: $\chi^2 = 3.14$, $p = 0.08$.
Any tension-type headache: 1989: $\chi^2 = 2.81$, $p = 0.09$; 2001: $\chi^2 = 1.71$, $p = 0.19$.

headache in 2001. No significant differences in prevalence of tension-type headache were seen for subjects with or without migraine (Table 4).

## Discussion

Reliable information about changes of the prevalence of primary headaches over a period of time is important, both from a clinical and a public health perspective [1]. In the present study the prevalence of migraine did not significantly increase over a 12-year period, but a significant increase was observed for frequent migraine (i.e. 14 migraine days per year or more), tension-type headache prevalence among males, and frequent episodic tension-type headache. An increase in the frequency of days with headache was observed for both migraine and tension-type headache.

The present finding of stable prevalence of migraine is in concord with the replicate studies conducted in USA and France [5, 6], as these two studies found stable prevalence rates in adults over a period of 10 years. In the present study, we assessed the prevalence of migraine in the age groups usually exhibiting the highest prevalence rates, thus resulting in high prevalence rates. Lipton et al. found an overall 1-year prevalence rate of 18% and 7% in females and males, respectively, but in the age-group 30–39 years old, the prevalence was as high as 27% and 10%, respectively [5]. When comparing with age-specific prevalence rates, our results are in agreement with most previous findings [3–6, 14–23].

We found a marked increase from 12% of the subjects with migraine in 1989 to 38% in 2001 suffering from frequent migraine, but chronic migraine was not identified. This increase in frequency was not seen in the replicate studies in France and USA, as they found stable or decreasing proportions with frequent attacks of migraine [5, 6, 20, 24]. Methodological variations probably account for some of this variation, as studies like the present, phrasing the primary screening question as 'Have you ever experienced a headache?' frequently find a higher proportion of subjects with migraine with infrequent attacks than studies phrasing the primary screening question as 'Do you suffer from headache?'. Our result of increased frequency of migraine points to a greater impact of migraine in a stable proportion of the population. If an increase in the frequency of migraine can be verified, further intensive research in risk factors and prophylactic strategies is needed.

The prevalence of tension-type headache in both the 1989 and the 2001 survey is remarkably higher than in most other population studies [7, 8, 21, 25, 26], where the prevalence estimates generally vary between 16% and 39%. No other known studies have repeated the assessment of the prevalence of tension-type headache, and our survey is thus believed to be the first to report an increase in the prevalence of tension-type headache. The diagnoses of frequent and infrequent episodic tension-type headache were introduced in the 2nd edition of the IHS Classification [13]. This sub-classification is valuable in permitting analysis of the trend of tension-type headache and in facilitating comparison of prevalence estimates across studies. The wide variation in prevalence of tension-type headache might be due to different capture of subjects with infrequent tension-type headache. As for migraine, we intended to capture all subjects with tension-type headache regardless of frequency. A relevant comparison might be to compare our prevalence of frequent episodic tension-type headache with the tension-type headache prevalence estimates in previous studies. This comparison reveals a high degree of concordance between our results and most previous findings [7, 8, 21, 25, 26]. Interestingly, the prevalence of frequent episodic tension-type headache increased significantly from 1989 to 2001. This increase suggests a higher impact of tension-type headache now than 12 years ago, but verification is necessary.

Additionally, we found a tendency towards an increase in the prevalence of chronic tension-type headache, but the number of affected subjects was limited and no firm conclusion can be drawn. In

previous studies, the prevalence of chronic tension-type headache has been 2–3% [8], which is comparable to our prevalence in 1989, but considerably lower than our recent finding in 2001. The possibility that the prevalence of chronic tension-type headache may be influenced by participation bias, and thus is overestimated in the present study, is not likely due to the relatively high participation rate, but cannot be excluded.

Though the point prevalence of headache on the day of examination was not quite as high in 2001 as in 1989, a considerable proportion of the subjects had headache at the examination. In 1989, the point prevalence of headache was considered to be extraordinarily high due to the fact that the participants were requested to fast before blood sample collection [9]. In 2001, fasting was not requested, but only an insignificant reduction in the overall point prevalence was seen and may reflect the overall increased frequency of tension-type headache. The significant reduction of the point prevalence of headache among subjects with migraine is interesting and supports the frequent complaint from migraine patients that fasting and irregular meals provoke headaches. Further studies of such cause–effects relations are needed in a clinical setting. Almost all the reported headaches were tension-type headache, regardless of migraine status. Our finding that the majority of subjects with migraine also reported tension-type headache supports the notion of a very high and probably frequently underreported prevalence of coexisting headache [27, 28]. The fact that tension-type headache prevalence did not differ significantly with migraine status also supports the distinction between these two primary headache disorders.

Both for migraine and for tension-type headache, the majority reported onset in the 1st and 2nd decades, most pronounced for tension-type headache. Data about age at onset are sparse, but the observed distribution of age at onset of migraine is in concordance with previous reports [14]. To our knowledge, no studies have reported on age at onset of tension-type headache.

A major strength of this study is the use of the nation-wide Danish Civil Registration System enabling the sampling of a representative cohort in 2001 comparable to the 1989 cohort. Other important strengths of this study are that all headache diagnoses in both surveys were conducted by medical doctors and the exact replication of design and methodology. These features ensure high stability and validity and facilitate comparison of prevalence estimates over time. A limitation of this study is the limited age-span of the cross-sectional 2001 cohort, which does not allow us to estimate prevalence rates across a wider age-range. On the other hand, this study encompasses the age group with the highest headache prevalence in the general population. However, a relatively small number of cases especially of migraine and chronic tension-type headache may limit the power to detect significant changes.

A differential participation rate depending on the occurrence of headaches can result in an overestimation of prevalence rates. As the total response rates in 1989 and in 2001 were comparable and acceptably high, it is expected that any non-response bias would apply equally to both our cross-sectional cohorts and thus not interfere with the comparison over time.

In conclusion, this study emphasises the need, both in a clinical and a public health perspective, for reliable information of prevalence trends. Our findings of significant increases of the prevalences of tension-type headache, frequent episodic tension-type headache and frequent migraine suggest a trend towards a higher individual and societal impact of primary headaches now, than 12 years ago. Large-scale population-based studies designed as replicates of well-conducted headache studies are essential for monitoring the impact of the headache disorders over time.

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