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SHORT COMMUNICATION

Adult onset epilepsy incidence in Finland over 34 years: A nationwide registry study

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Abstract

Background and purpose: The incidence of epilepsy is decreasing among the working-aged in high-income countries, but previous studies have reported conflicting results in Finland.

Methods: A nationwide population-based cross-sectional analysis was made of annual epilepsy drug reimbursement rights frequency data from the Social Insurance Institution of Finland, the national authority, between 1986 and 2019. All persons at least 20 years of age living in Finland during the study period were included.

Results: Based on the analysis of 77,939 new reimbursement rights, crude incidence was 57.4/100,000 (95% confidence interval [CI] = 57.0–57.8) person-years, and age-standardized (to the European Standard Population 2013) incidence was 51.6/100,000 person-years. Both crude ($r = 0.62$, $p = 0.00009$) and standardized ($r = 0.65$, $p = 0.00003$) incidence increased over time. Incidence increased in both men (from 66.4 to 71.6/100,000, $r = 0.51$, $p = 0.002$) and women (from 51.5 to 55.3/100,000, $r = 0.68$, $p < 0.00001$). The mean male to female incidence rate ratio was 1.28 (95% CI = 1.26–1.30, range = 1.15–1.41), but decreased during the study period ($r = -0.47$, $p = 0.006$). Incidence decreased in those 20–59 years old but increased in all older age groups. This development was similar between sexes.

Conclusions: The incidence of adult onset epilepsy in Finland increased in people older than 60 years and decreased in the 20–59-year age group during the study period. These trends were similar between sexes. Therefore, etiological epilepsy trends in the elderly need to be studied further to plan public health measures to prevent epilepsy in this age group.

KEYWORDS
epidemiology, epilepsy, methods, neurological disorders, research

INTRODUCTION

Epilepsy incidence and prevalence rates in the adult population <65 years of age has been decreasing in high-income countries [1]. In Finland, a previous study based on drug reimbursement data reported that between 1986 and 2002, the incidence of epilepsy decreased in both children and adults 15-64 years of age, but increased in those older than 65 years [2]. However, another study utilizing inpatient admission data reported that between 1973 and 2013, epilepsy incidence increased in those older than 65 years, whereas there was no change in incidence in younger age groups [3]. Information on these trends is important in guiding public health

measures in epilepsy prevention and health care in treatment organizations. Therefore, in this study, we updated the data and trends on incidence of adult onset epilepsy.

METHODS

The open statistics of the Social Insurance Institution of Finland (KELA), Finland's national authority, were searched for changes in the annual numbers of new drug reimbursement rights for epilepsy in people ≥20 years old (code 111, which is only granted for epilepsy) between the years 1986 and 2019. All persons with newly diagnosed epilepsy are eligible for antiseizure drug reimbursement, which is also routinely applied for, necessitating a detailed statement by a neurologist and investigations at a specialist clinic. The statement is checked and approved by specialist physicians at the reimbursement institution KELA before the right is granted. The epilepsy diagnosis in Finland is made according to national guidelines, which have been updated according to the changes in International League Against Epilepsy (ILAE) epilepsy definitions. To calculate incidence rates, population data were obtained from Statistics Finland, the Finnish census entity. Changes in the population structure were accounted for by calculating both age- and gender-specific rates and age-standardized rates. European Standard Population 2013 and the direct method were used for age standardization. Relationships between continuous variables were analyzed using Pearson or Spearman correlation as appropriate. Poisson distribution was used to calculate 95% confidence intervals (CIs) for incidence and prevalence. Because the study is based on openly available anonymized data, no institutional review or permissions were needed or sought.

RESULTS

Altogether, 77,939 people were granted a new code 111 reimbursement right during the study period (45.7% to women). Overall crude epilepsy incidence was therefore 57.4/100,000 (95% CI = 57.0–57.8) person-years, increasing nonlinearly from 58.5/100,000 person-years in 1986 to 63.3/100,000 person-years in 2019 (r = 0.62, p = 0.00009; Figure 1). Overall age-standardized incidence was 51.6/100,000 person-years and also increased from 48.4/100,000 person-years in 1986 to 53.0/100,000 person-years in 2019 (r = 0.65, p = 0.00003; Figure 1). Incidence increased both in men (from 66.4 to 71.6/100,000; r = 0.51, p = 0.002) and women (from 51.5 to 55.3/100,000; r = 0.68, p < 0.00001; Figure 1). The mean male to female incidence rate ratio was 1.28 (95% CI = 1.26–1.30, range = 1.15–1.41), with a decreasing trend during the study period (r = −0.47, p = 0.006; Figure 1). Incidence decreased in those aged 20–59 years but increased in all older age groups (Table 1), a development similar between the sexes (Figure 1).

DISCUSSION

This nationwide registry study showed that, over the past 34 years in Finland, the incidence of adult onset epilepsy increased in people

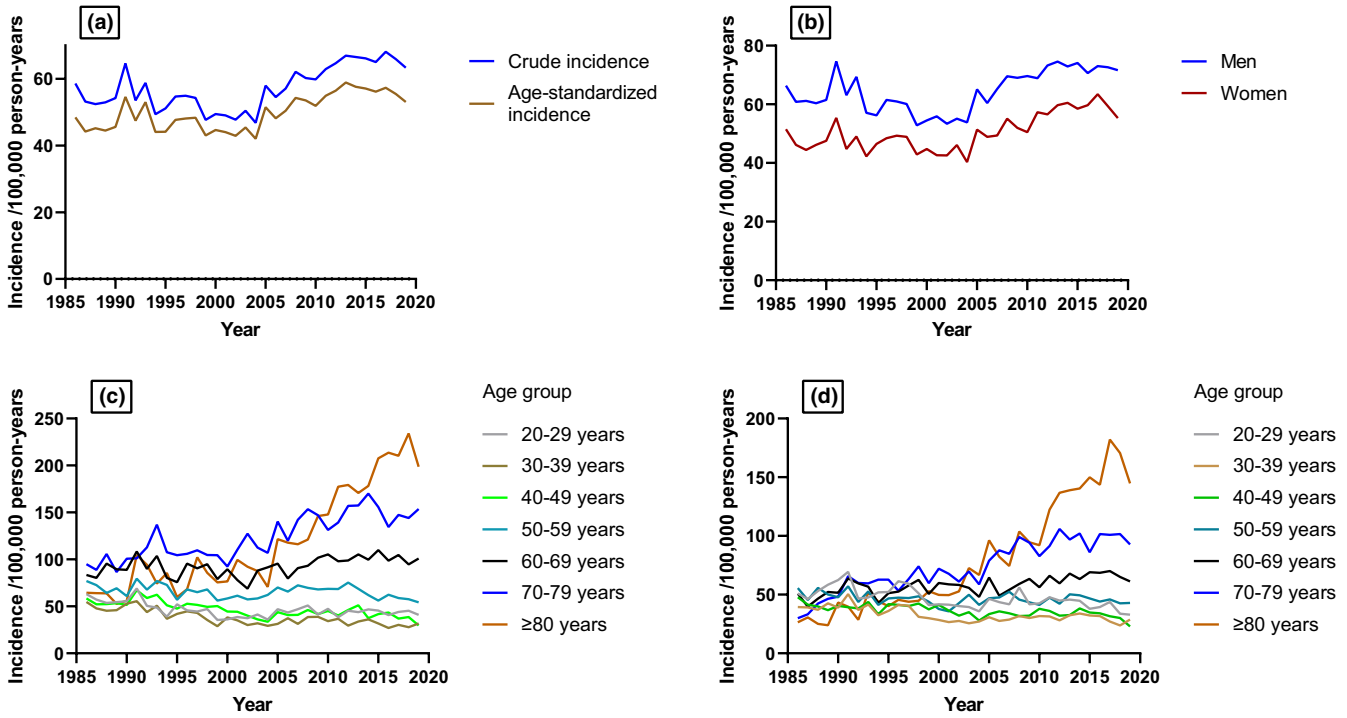

FIGURE 1 Annual adult onset epilepsy incidence in Finland (a) as crude and age-standardized rates and (b) by sex and age group in (c) men and (d) women

TABLE 1 Annual epilepsy incidence by age group

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
20-29 years	64.4	59.8	53.4	56.3	58.9	69.2	48.6	48.2	45.4	52.3	53.5	51.7
30-39 years	49.2	43.5	41.3	44.3	46.0	53.1	40.5	46.3	34.6	39.1	43.0	41.8
40-49 years	51.6	45.1	46.3	45.2	46.2	53.5	48.7	53.3	42.3	44.8	47.1	46.0
50-59 years	66.0	63.5	60.0	59.4	54.2	68.1	55.7	64.7	56.8	51.8	57.7	56.0
60-69 years	69.5	57.6	67.6	68.4	67.9	83.6	73.2	77.9	60.0	62.5	72.4	72.9
70-79 years	64.4	61.9	64.6	60.5	66.8	78.3	78.7	87.3	79.0	78.0	72.8	80.7
>80 years	36.8	39.7	35.6	31.8	46.7	57.6	46.6	57.9	55.6	45.6	51.8	59.9

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
20-29 years	49.1	38.3	38.8	40.0	38.8	40.4	35.8	46.8	43.4	44.4	53.5	41.5
30-39 years	33.4	29.4	33.4	30.9	28.9	28.8	28.2	31.1	32.7	30.1	35.3	34.5
40-49 years	46.1	44.0	42.9	40.4	36.1	35.6	30.8	38.7	38.3	37.6	39.0	37.0
50-59 years	58.3	50.0	48.1	48.6	50.1	54.2	51.7	58.5	56.6	62.5	57.7	55.7
60-69 years	77.6	63.9	73.8	67.9	63.3	71.1	68.8	79.4	63.8	71.8	75.6	82.0
70-79 years	85.8	77.0	80.1	84.7	88.0	87.4	78.8	104.6	101.4	109.2	122.5	117.1
>80 years	55.8	59.0	57.0	63.3	63.7	76.8	67.9	103.6	92.8	86.9	109.1	110.7

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	r	p
20-29 years	45.1	43.0	45.1	44.8	45.8	41.8	40.1	43.8	39.7	37.0	-0.65	0.000031
30-39 years	33.1	34.2	28.8	33.1	35.0	32.0	29.3	28.7	25.8	30.4	-0.73	<0.00001
40-49 years	41.6	38.2	39.2	42.1	37.8	38.3	38.8	34.4	34.5	26.3	-0.79	<0.00001
50-59 years	54.8	57.8	58.6	59.4	55.7	51.4	53.2	52.4	50.1	48.6	-0.47	0.0052
60-69 years	80.0	81.5	78.6	86.1	80.9	88.9	83.1	86.8	79.5	80.5	0.66	0.000026
70-79 years	103.9	112.4	128.5	123.7	132.4	117.4	116.5	122.0	120.9	120.7	0.92	<0.00001
>80 years	109.8	140.2	150.7	149.5	153.2	169.7	168.0	192.0	193.3	164.2	0.97	<0.00001

Abbreviations: *p*, probability value for Pearson or Spearman correlation; *r*, correlation coefficient.

older than 60 years but decreased in the 20–59-year age group, with trends similar between sexes. These results are in full agreement with global temporal epilepsy epidemiology trends and generally compatible with previous reports from Finland [1,2,4].

One previous Finnish study reported increasing incidences of epilepsy in the elderly, but no change in the working-aged or children between 1973 and 2013 [3]. The study used inpatient admission data, which were suggested as more reliable than the previously used methodologies. However, contrary to what this study's authors stated, adults with seizures (including those newly diagnosed with epilepsy) are often only monitored in Finnish emergency rooms and discharged without inpatient admission. Adult onset epilepsy diagnoses are also often made during outpatient appointments. Therefore, it is unclear how accurate adult epilepsy incidence results based on inpatient data are. Furthermore, the validity of epilepsy diagnoses in the Care Registry for Health Care, the database the inpatient data were obtained from, has not been studied. Epilepsy drug reimbursement data, as used in an earlier study [2] and the current one, therefore appear more robust compared to administrative inpatient admission data when evaluating epilepsy incidence in Finland. Previous researchers have concluded that epilepsy prevention efforts have failed [3], but our results suggest that this may not be the case with the working-aged.

Another previous study from Finland reported that between 1986 and 2002, the incidence of epilepsy increased only in elderly women, but remained stable in elderly men [2]. Interestingly, the current data show that around 2005, incidence began to increase in elderly men, and the increase in elderly women steepened. One possible factor in this development is alcohol. Its use has become more frequent in both sexes in the 65–79-year age group over the past 2 decades, predisposing users both to brain injuries and also directly to seizures. Hospitalizations of persons older than 70 years due to traumatic brain injuries increased in both sexes in Finland between 2004 and 2014 [5]. Meanwhile, the age-adjusted incidence of stroke has also been decreasing in the elderly [6,7]. This and the reported decline in the prevalence of Alzheimer disease between 1990 and 2016 [8] are both expected to have decreased the incidence of epilepsy. More detailed studies of epilepsy etiology in the elderly are therefore needed, especially considering that in people older than 80 years, the incidence of epilepsy increased fourfold in men and almost sevenfold in women between 1986 and 2019. Interestingly, in Denmark, epilepsy incidence almost doubled between 1995 and 2002 in people >80 years of age [9]. The reasons for this were unclear, but the development was suggested to be partly explained by more careful diagnostics and increased survival after disorders such as stroke. Recent data have shown that after 2002, incidence has stabilized also in this age group [10]. It is therefore possible that Finland is repeating the pattern with a lag of approximately 15 years. In the recent study on epilepsy incidence in Ireland, cerebrovascular disease was connected with increasing incidence of epilepsy in the elderly [11]. Unfortunately, we do not have etiology data for our analysis and therefore no prevalence trend data are available on this for Finland. In any case, it is likely that epilepsy has become more

actively recognized and reported in the elderly, facilitated by the new operational definition of epilepsy by the ILAE in 2014 [11].

Epilepsy incidence is generally higher in men compared to women [1], as observed in the current data. However, we also found that the male to female incidence ratio slightly decreased during the study period. The reasons for this are unclear, but differing risk factor trajectories are one possible explanation. For example, smoking has declined much more among Finnish men compared to women [6]. Smoking predisposes individuals to, among other things, stroke and cancer, which are both important epilepsy etiologies in adults and the elderly. First-ever stroke incidence appears to have decreased more in elderly men compared to elderly women [7]. Moreover, traumatic brain injuries seem to have increased more in older women and also appear to generate more severe consequences than in elderly men [5].

This retrospective registry study was performed using freely available, anonymized data from the national provider KELA. Therefore, individual patient data were unavailable. As the study was based on administrative registry data that have not been collected for clinical or scientific use, some cases may have been missed because of erroneous diagnoses or administrative coding or because the reimbursement right had not been sought. Moreover, there have been no studies on the validity of epilepsy drug reimbursement decisions in Finland. However, the reimbursement right process suggests that this should be rather high. The study period was also extensive, covering 34 years during which, to our knowledge, there were no changes in how epilepsy reimbursement decisions are made. However, the definition of epilepsy has evolved, which may have influenced the results, although it seems that the 2014 introduction of the current definition of epilepsy did not trigger the previously predicted increases in incidence rates [12]. Data from Ireland show that this change made diagnosing epilepsy much more likely, especially in the elderly [11]. However, in Finland, the trend of increasing epilepsy incidence in the elderly had already started a decade earlier and seems to have leveled off during the past few years, and the same appears to have happened in Denmark even earlier [10]. These discrepancies call for further studies and international comparisons. The data in the current study are nationwide, with virtually complete coverage of diagnosed cases. The results are likely to be generalizable to other high-income countries.

In conclusion, the incidence of epilepsy in Finland slightly declined in adults 20–59 years old, but markedly increased in those older than 60 years between 1986 and 2019, with similar trends between sexes. As the incidence of epilepsy in the elderly increases and populations age, the need for neurological services grows.

CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

Jussi O. T. Sipilä: Conceptualization (lead), data curation (lead), formal analysis (lead), investigation (equal), methodology (equal), project administration (lead), resources (lead), visualization (lead), writing–original draft (lead). **Reetta Kälviäinen:** Conceptualization (supporting), formal analysis (supporting), investigation (equal), methodology (equal), supervision (lead), writing–review & editing (lead).

ETHICAL APPROVAL

Ethical approval and informed consent were not required because the study was based on anonymous public data.

DATA AVAILABILITY STATEMENT

The data used in this study are openly available at http://raportit.kela.fi/ibi_apps/WFServlet?IBIF_ex=NIT084AL&YKIELI=E.

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