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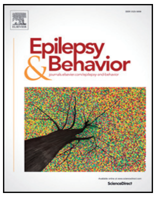

Welfare consequences for people diagnosed with nonepileptic seizures: A matched nationwide study in Denmark

Poul Jennum [a,*], Rikke Ibsen [b], Jakob Kjellberg [c]

[a] Danish Center for Sleep Medicine, Department of Clinical Neurophysiology, Faculty of Health Sciences, University of Copenhagen, Rigshospitalet, Copenhagen, Denmark
[b] i2minds, Aaboulevarden, Aarhus, Denmark
[c] VIVE – The Danish Center for Social Science Research, Denmark

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ABSTRACT

Objective: We aimed to evaluate the excess direct and indirect costs associated with nonepileptic seizures.
Methods: From the Danish National Patient Registry (2011–2016), we identified 1057 people of any age with a diagnosis of psychogenic nonepileptic seizures (PNESs) and matched them with 2113 control individuals. Additionally, 239 partners of patients with PNES aged ≥ 18 years were identified and compared with 471 control partners. Direct costs included frequencies and costs of hospitalizations and outpatient use weighted by diagnosis-related group, and specific outpatient costs based on data from the Danish Ministry of Health. The use and costs of drugs were based on data from the Danish Medicines Agency. The frequencies of visits and hospitalizations and costs of general practice were derived from National Health Security data. Indirect costs included labor supply-based income data, and all social transfer payments were obtained from Coherent Social Statistics.
Results: A higher percentage of people with PNES and their partners compared with respective control subjects received welfare benefits (sick pay, disability pension, home care). Those with PNES had a lower employment rate than did controls for equivalent periods up to three years before the diagnosis was made. The additional direct and indirect annual costs for those aged ≥ 18 years, including transfers to patients with PNES, compared with controls, were €33,697 for people with PNES and €15,121 for their partners.
Significance: Psychogenic nonepileptic seizures have substantial socioeconomic consequences for individual patients, their partners, and society.

Epilepsy is a common and chronic neurological disorder affecting approximately 1% of people of all ages [1,2]. Epilepsy involves several domains of patients' lives, causing significant personal, family, and societal burdens because of its frequent association with significant chronic comorbidity and mortality [3,4]. Consequently, epilepsy causes social stigma, psychosocial adversities, and reduced quality of life (QoL) for patients and their caregivers, from which stems its substantial socioeconomic impact [3–8]. However, other causes of episodes may give rise to differential diagnoses. These nonepileptic episodes may have different causes, including other pathological conditions, e.g., cardiogenic illnesses, other brain diseases (e.g., cataplexy in narcolepsy), or psychogenic nonepileptic seizure (PNES). The complex nature of PNES makes the disorder challenging to diagnose and prompts considerable concern in epilepsy clinics. Psychogenic nonepileptic seizure features paroxysmal behaviors resembling epileptic seizures, although, unlike epilepsy, there is no electrophysiological correlate. These episodes pose diagnostic challenges for physicians and observers, since patients often present emergent and dramatic changes that resemble true epileptic seizures. Other cases of PNES may not only be due to psychological factors, but may also have physiological causes such as vasovagal syncope or cataplexy [9].

Functional neurological symptom disorder and conversion disorder are common presentations in neurological and accident & emergency departments. Despite the nonepileptic nature of the disease, patients with PNES present significant somatic and psychiatric comorbidities and, probably, increased mortality [10–14], although this is suggested by only a few systematic, controlled studies. Because of the nature of the disease, patients with PNES face an increased risk of overtreatment with medication and surgical procedures [15,16]. Patients with PNES and their families report reduced QoL [17–20]. Management is complex, involving several lines of intervention. As patients with PNES are often hospitalized during their treatment, their healthcare costs are elevated. Diagnosis is difficult and involves prolonged video monitoring of seizure patterns in order to rule out epilepsy and other physical causes of the episodes, although this does not exclude coexisting seizure disorders [21]. Such a diagnosis gives rise to uncertainty and delay [21–23].

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* Corresponding author at: Danish Center for Sleep Medicine, Department of Clinical Neurophysiology, Faculty of Health Sciences, University of Copenhagen, Rigshospitalet, DK 2600 Glostrup, Denmark.
E-mail addresses: poul.joergen.jennum@regionh.dk (P. Jennum), rikke@i2minds.dk (R. Ibsen), jakj@vive.dk (J. Kjellberg).

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Although there is a strong association with several psychiatric comorbidities, low QoL, and prolonged psychiatric treatment [24–26], there is little information available about the social consequences of PNES. There are no systematic evaluations of the factual direct and indirect welfare costs, e.g., the specific societal treatment and social costs.

We therefore aimed to evaluate the total costs associated with PNES before and after its diagnosis, including the health (direct) and social (indirect) costs of the disease by means of a national population-based study.

1. Methods

In Denmark, it is possible to calculate health sector costs and productivity losses related to diseases because information from public and private hospitals, general practice, privately practicing specialists, and about medication, social transfers, labor market income, and employment for all Danes is registered in central databases. All patient contacts with the hospital system, and the primary diagnosis, are recorded in the Danish National Patient Registry (NPR) at the time of contact [27]. The NPR is a time-based national database that includes data from all inpatient and outpatient contacts, meaning that the data that we can extract are representative of everyone in Denmark who has received a diagnosis of PNES in public and private hospitals. Since data are available for the entire observation period, we can trace patients retrospectively and prospectively, relative to the time of their diagnosis. Furthermore, all contacts in general and specialist practices and medication use are recorded in the National Health Security and Danish Medicine Agency databases, respectively. There is some underestimation of the number of people with PNES because those with a contact solely in the general practice sector are not recorded with a diagnosis in the NPR, unlike inpatient and outpatient contacts in hospitals. However, as patients with PNES are very likely to be managed by hospital clinics, the degree of underestimation is low.

The economic consequences of PNES for patients were estimated by determining the yearly cost of illness per patient diagnosed with the International Classification of Diseases version 10 (ICD-10) code for PNES (DR568G, nonepileptic seizures; DF445, dissociative convulsions; or DF449, dissociative condition); these codes are given after patient evaluation in each hospital, based on a standardized evaluation of seizure disorders. These figures are compared between patients and a randomly selected control group individually matched by gender, age, and municipality, but not suffering from epilepsy or PNES. There were twice as many controls as cases. Matches were obtained in all cases. The estimated health cost was then divided into annual direct and indirect healthcare costs.

From the NPR, we identified all people who received a first diagnosis of PNES between 2011 and 2016, as the current diagnoses were systematically used from 2011. Then, using data from the Civil Registration System and the Statistics Denmark database (which includes information about social factors, marital and cohabiting status, incomes, pensions, etc.) [28], we randomly selected citizens of the same age and sex as those with PNES. Social compensation was considered by selecting control subjects who resided in the same area of the country as the patients, and who had the same civil status. Patients and matched control subjects were followed from the year of diagnosis until 2016. If a patient or control was not present in the Personal social identifyer, 'centrale personregister (CPR) register on January 1st each year, then the corresponding control or person with PNES was not included in the dataset for that year. All partners of people with PNES were also identified. A partner is defined as another adult sharing a home with the subject (i.e., not a parent–child household). A similar group of partners for control subjects was identified based on age, gender, and sociodemographic status.

The estimation of detailed costs before and after subdivision into subgroups and of the consequences for partners, as estimated in previous studies [4], was not possible because of the limited number of observations.

Direct costs, including hospitalization, costs of outpatient visits, and use of medication, were calculated using diagnosis-related group (DRG) weights and specific outpatient tariffs. These cost estimates were all based on data from the Danish Ministry of Health [2]. Data on the use and costs of drugs were obtained from the National Danish Medicine Agency. The retail price of each drug (including dispensing costs) was multiplied by the number of transactions. The frequencies and costs of consultations with general practitioners and other specialists were obtained from National Health Security.

The indirect costs (foregone earnings), which are related to the reduced labor supply, were obtained from Danish Income Statistics [2]. Social transfer payments, which are primarily publicly funded in Denmark, were also included. These include subsistence allowances, pensions, social security, social assistance, publicly funded personal support for education, and others.

Cost-of-illness studies measure the economic burden resulting from disease and illness within a defined population. This comprises the direct and indirect costs. As patients leave the national data registers at the time of death, disappearance, or emigration, the indirect cost estimate is equal solely to the production loss related to disease-related work disability. It is important to distinguish health-related costs from monetary transfer payments such as disability and welfare payments. These payments transfer purchasing power to the recipients from general taxpayers, but do not represent net increases in the use of resources, for which reason they are not included in the total cost estimate.

Costs were measured on a yearly basis and adjusted to 2016 prices using the general price index. All costs were measured in DKK and converted to Euros using the stable exchange rate on June 30th, 2011 (€1 = 7.45DKK).

The study was approved by the Danish Data Protection Agency. Data were handled in a manner that did not reveal the identity of anyone with PNES or epilepsy, or of any control subjects, so neither individual nor ethical approval was required. Statistical analysis was done with SAS 9.1.3 (SAS Inc., Cary, NC). Statistical significance of the difference in the means of cost and income (social transfers and wage income) was estimated for matched case and control groups by a nonparametric bootstrapped *t*-test, which was appropriate because of the nonnormal distribution of the data [29]. For comorbidity, we used a conditional logistic regression model that estimated the difference between cases and controls for the 22 World Health Organization (WHO) chapters. Mortality was analyzed using a Cox proportional hazard regression model, which provided hazard ratio estimates.

2. Results

One thousand fifty-seven people of all ages with a PNES diagnosis were considered and matched with 2113 control subjects. Their age distribution is shown in Table 1. Of the subjects, 30.7% were males. Mortality was significantly higher in people with PNES than in controls (hazard ratio: 3.21; 95% confidence interval [CI]: 1.92–5.34; $p < 0.001$). As children have limited income and no transfer income, we selected people aged at least 18 years for socioeconomic analysis: 593 patients with PNES and 1186 controls.

2.1. Health costs: outpatient clinic, hospital, primary care, and drugs

A higher percentage of patients with PNES than control subjects were treated in somatic compared with psychiatric clinics, were hospitalized, and had contact with the primary care system (Table 2). Compared with control subjects, a greater proportion of those with PNES were taking medication and receiving public support to pay for it (Table 2). Home care use was higher among people with PNES than controls (Table 2).

Table 1
Basic descriptive statistics.

	PNES		Control	
	N	%	N	%
Total	1057		2113	
Age (years)				
0–10	240	22.7	479	22.7
11–20	246	23.3	492	23.3
21–30	167	15.8	334	15.8
31–40	120	11.4	240	11.4
41–50	89	8.4	178	8.4
51–60	82	7.8	164	7.8
61–70	63	6.0	126	6.0
71–80	32	3.0	64	3.0
>80	18	1.7	36	1.7
Gender				
Male	325	30.7	650	30.8
Female	732	69.3	1463	69.2
Marital status				
Married	630	59.6	1259	59.6
Not married	427	40.4	854	40.4

2.2. Indirect costs: social costs, employment rate, and income

A greater percentage of people with PNES and their partners than their respective control subjects received social services benefits, i.e., sick pay or disability pension and housing benefits (Table 2). Because of these public services, early retirement was more common, and pension age was lower in patients than in controls. Conversely, compared with control subjects, a lower proportion of people with PNES received income from employment, and a higher proportion received social security, whereas unemployment benefit was lower. The latter pattern was due to the lower employment rate and greater uptake of disability pension in patients with PNES (Table 2). Consequently, those with PNES had lower employment rates and higher social transfer rates than control subjects (Table 2, Fig. 1). Patients with PNES who were employed had lower income levels than employed controls, but there were insufficient data to permit a more detailed analysis. People with PNES had lower employment rates than did controls over equivalent periods up to three years before (the limit for the current analysis), at the time of, and after the diagnosis of PNES (Fig. 1), estimated for people aged ≥18 years.

2.3. Welfare effects on partners

The direct costs and related health effects for partners of patients with PNES aged ≥18 years were not affected, whereas income was significantly lower for the partners of controls. Conversely, unemployment benefit, disability pension, and housing benefit were more frequent among partners of patients with PNES.

2.4. Total health costs per year

The sum of direct net healthcare costs per year (general practitioner services, hospital services, and medication) and indirect costs (loss of labor market income) were €27,985 for those with PNES and €2462 for their controls, i.e., an additional cost of €25,523. Social transfer payments were all significantly higher in patients with PNES than in control subjects. Patients with PNES received an annual mean excess social transfer income resulting in net costs including transfers of €33,697 (Table 2). The corresponding figures for partners of adult patients with PNES were net costs of €12,043, and net costs, including transfers, of €15,121.

Table 2
Total average healthcare costs and income for all patients and those aged ≥18 years. Psychogenic nonepileptic seizures (PNESs), diagnosed between 2011 and 2016 (€).

	PNES	PNES control	P*	Age ≥ 18 years			Partner to PNES	PNES partner controls	P
				PNES	PNES control	P			
Number of persons (N)	873	1746		593	1186		239	471	
Somatic									
Outpatient services	1787	630	<0.001	2210	779	<0.001	764	626	0.891
Inpatient admissions	4595	731	<0.001	5573	808	<0.001	1003	901	1.000
Prescription drugs	579	256	<0.001	769	216	<0.001	452	288	0.641
Primary health sector	566	300	<0.001	696	346	<0.001	352	296	0.074
Somatic health costs total	7527	1916	<0.001	9247	2148	<0.001	2571	2111	0.961
Psychiatric outpatient services	535	97	<0.001	537	94	<0.001	74	8	0.086
Psychiatric inpatient admissions	1055	35	<0.001	1202	44	<0.001	96	1	0.081
Health costs total including psychiatric cost	9117	2049	<0.001	10,987	2286	<0.001	2740	2120	0.736
Home care									
Home care – care	798	94	<0.001	1158	137	<0.001	144	90	1.000
Home care – practical help	84	27	<0.001	122	39	<0.001	15	4	0.129
Home care total[a]	881	121	<0.001	1280	176	<0.001	158	94	1.000
Earned income (wage, self-employed)[b]	5530	16,328	<0.001	8065	23,783	<0.001	29,299	40,658	<0.001
Public transfer									
Unemployment benefit (cash assistance)	271	448	0.026	395	652	0.035	737	752	1.000
Social security	2882	942	<0.001	4177	1374	<0.001	1687	757	<0.001
Old age pension	1522	1401	0.998	2220	2039	1.000	1949	1720	0.998
Early retirement	35	148	0.039	51	215	0.046	440	438	1.000
Disability pension	4118	818	<0.001	6004	1190	<0.001	2292	680	<0.001
Sick pay (publicly funded)	753	436	<0.001	1097	634	<0.001	611	463	0.998
Housing benefits	640	338	<0.001	933	492	<0.001	336	76	<0.001
Child benefits	490	564	0.533	715	821	0.535	307	395	0.794
Total public transfer income	10,691	5096	<0.001	15,592	7417	<0.001	8359	5281	<0.001
Direct health costs	9117	2049		10,987	2286		2740	2120	
Home care costs	881	121		1280	176		158	94	
Indirect costs, foregone earnings	10,798			15,718			11,359		
Sum of direct and indirect costs	20,796	2170		27,985	2462		14,257	2214	
Net costs	18,627			25,523			12,043		
Social transfer payments	10,691	5096		15,592	7417		8359	5281	
Net costs including transfers	24,222			33,697			15,121		

* P-value from *t*-test.

[a] Home care cost data are only available from 2009.

[b] There is no income information for persons <18 years, so all incomes are set to 0 persons <18 years.

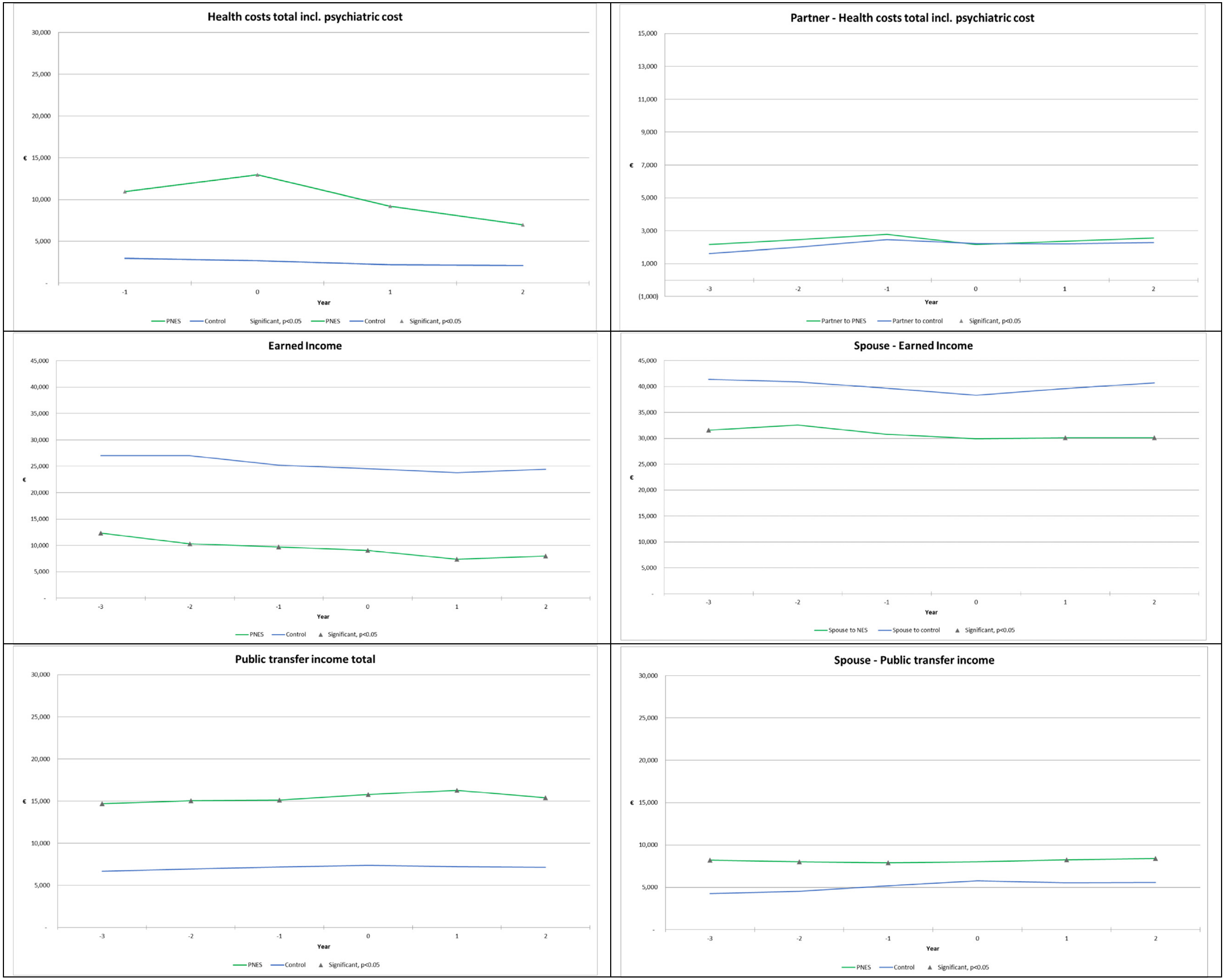

Fig. 1. Welfare costs of PNES.

3. Discussion

This study is the first to demonstrate the factual welfare cost in diagnosed patients with PNES selected from the national databases and compared with matched controls. The study demonstrates that patients with PNES have a significant socioeconomic impact on themselves and their partners. Compared with controls, patients with PNES had significantly higher rates of somatic and psychiatric healthcare use at all ages, and rates of contact with all sectors of the healthcare system, including general practice, outpatient clinics, and hospital inpatient services. Furthermore, total public transfer income is higher in patients with PNES than in controls.

At the time of diagnosis, the costs were elevated because of hospitalization and diagnostic procedures. The costs were also higher thereafter. We do not know when the patients had their first health contract due to the episode, so the period before could be due to the underlying disease or the misclassification of the disease. Furthermore, the direct health costs include all contacts and all comorbidities in those receiving a diagnosis of PNES. Psychogenic nonepileptic seizure has a significant effect on indirect costs, which are made up of unemployment benefits, disability pension, sick pay, and housing benefits, with the consequence that they come to account for almost half of the total costs.

We have previously reported that epilepsy often has early onset, and because it is commonly a chronic disorder, the influence of the diagnoses on early social prognosis and the impact on direct and, especially, indirect costs are considerable [8]. We have also shown the long-term negative impact of epilepsy in childhood- and adolescent-onset epilepsy [4,30–32]. The costs of PNES are significantly higher than those found for epilepsy using similar methods to those applied to national samples of patients; the net cost found in this study was €25,523 (€33,697 including transfers), compared with €11,223 in patients with epilepsy [30–32]. This is due to their many health-related contacts and their low level of employment. Consistent with the findings of our previous study of patients with epilepsy, we confirm that patients with PNES have higher welfare costs than those without the condition. This is probably even more marked in those with onset of the disease in childhood, adolescence, or young adulthood, although there were insufficient data to investigate this or to follow-up the population with PNES over the long term. However, our previous studies did demonstrate this [30–32], and we believe that this may also be applicable to the population with PNES, in which it probably has a negative impact on education, employment, and transfer income. Further analysis should identify the total societal burden of PNES, with reference to its negative social consequences and the impact of chronicity, comorbidity, and treatment [3,33,34]. In addition to the high level of healthcare usage, suggestive of underlying comorbidities, we demonstrated a significantly higher mortality rate among patients with PNES. As such, PNES is not a benign disease.

Cost of illness methods aimed to isolate the economic burden of disease and illness, including direct and indirect costs, within a defined population. In this study, the cost of illness was isolated by comparing the patient group with a control group with similar characteristics but without the specific disease. The cost of illness estimates represents all the costs specifically attributable to PNES and its comorbidities. Patients and controls were excluded from the dataset if they had died. The results of the study therefore reflect the yearly excess cost of a living person with PNES relative to a similar person without the disease. Including the mortality-related cost in the estimates would make interpretation of the estimated yearly costs difficult, since high mortality in the group with epilepsy would lower the yearly direct cost after diagnosis, not because treatment after diagnosis is effective, but because deceased people obviously have no requirement for healthcare. If we had data from the time of diagnosis to the time of death for all patients and controls, we could calculate the direct and productivity costs per person over their lifetime.

As in most other cost of illness analyses, it is difficult to isolate the cost of the disease in question from that of other comorbid conditions. The cost estimates found in this study cannot be definitively attributed to PNES but should be considered as the yearly excess direct health costs and the productivity cost for a living person diagnosed with PNES relative to a comparable living person without the illness.

Patients with PNES may also suffer from epilepsy [15,35,36]. We have not subdivided our analysis here because of the small number of such observations. Despite interventions including social and psychological support [37–40], patients with PNES experience it as a chronic neurological disorder, so the disease may have a major influence on their social competence and family relationships, in addition to its considerable negative economic impact. We chose to use a controlled design to estimate the additional cost above that accruing to the background population without an epilepsy or PNES diagnosis. If we had compared people with PNES with healthy members of the general population, the differences and socioeconomic impact would have been more pronounced.

Previous studies of the burden of epilepsy have focused on direct costs, e.g., those of hospital services and the use of treatment procedures, such as medication, physiotherapy, etc. [7,41,42]. However, as epilepsy causes a significant social burden [43], it is therefore essential also to assess indirect costs. A few studies have evaluated the cost of healthcare use and found it to be considerable [44–46]. Although the QoL of patients with PNES is significantly impaired [15,17,47,48], no previous studies have evaluated the indirect costs arising from its social consequences. Here, we have shown that patients who present PNES incur significantly higher direct and indirect costs; in fact, the social cost is significantly higher than the direct costs. This is like the welfare costs of epilepsy in that the disorder presents a significant social burden [4,30–32].

Factors resulting in increased costs associated with PNES would be most relevant if disease management (prevention or treatment) affected direct and indirect costs. If this was the case, prevention including early social and psychological intervention, effective treatment, and early intervention would be very important, since daily functioning is already impaired by the time PNES is diagnosed. Most treatment modalities focus mainly on eliminating ictal episodes and, to a lesser degree, on their effects on costs and social factors. If an intervention is identified that is effective at lowering morbidity, mortality, and healthcare use, thereby influencing the socioeconomic costs associated with epilepsy, then it will be even more important to have a means of detecting the early manifestation of brain disorders that lead to ictal episodes, and to intervene early. Therefore, measures that reduce the social consequences are likely to have a significant impact on the burden and consequences of PNES.

We based our current study on reports from all Danish clinics or hospitals registered in the NPR, which represents the complete national patient sample registered since 2011 (with the introduction of specific ICD codes). This was possible because all Danes are registered using social security codes, and from whom linked health, medication, social, and employment data are collected. These costs cover those of all contacts with the primary and secondary sectors (general practice and hospitals), including diagnostic and treatment procedures at the time of diagnosis. The estimate of the direct costs is therefore a conservative one. All indirect costs, including transfer payment costs, and income levels were included in the analysis. As the aim of the study was to identify the total burden of a PNES diagnosis, we included all the cases in the national sample with a first diagnosis of PNES but did not consider the criteria for any other verification of the diagnoses. It would also be valuable to conduct subgroup analyses, for example, of patients with multiple contacts, and of those with specific comorbidities to estimate costs with respect to the severity of the disease. The control group was not defined as a group of healthy subjects; they were selected based on age, gender, and geography (the latter to allow adjustment for social factors).

In conclusion, the current study found PNES to be associated with significantly higher health-related and social transfer costs, and home care use, and lower levels of employment among patients. Psychogenic nonepileptic seizure was also associated with significant effects on patients' partners. These results suggest that earlier intervention to reduce both health and social costs would have a substantial benefit.

Key points

- Psychogenic nonepileptic seizures are associated with significantly higher health-related and social transfer costs, and home care use, and lower levels of employment and income than formerly found for patients with epilepsy.
- Psychogenic nonepileptic seizure is also associated with significant effects on patients' partners.
- These results suggest that earlier intervention to reduce health and social costs would have substantial benefit.
- Future research should evaluate the effect of early disease identification, disease management, and the effects on socioeconomic factors, work capabilities, and healthcare and social needs on reducing the costs to patients, families, and society.

Ethical disclosure

We confirm that we have read the journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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Declaration of Competing Interest

None of the authors has any conflicts of interest to disclose.

References

[1] Christensen J, Vestergaard M, Pedersen MG, Pedersen CB, Olsen J, Sidenius P. Incidence and prevalence of epilepsy in Denmark. Epilepsy Res 2007;76:60–5.
[2] Jennum P, Gyllenborg J, Kjellberg J. The social and economic consequences of epilepsy: a controlled national study. Epilepsia 2011;52:949–56.
[3] Jennum P, Pickering L, Christensen J, Ibsen R, Kjellberg J. Morbidity and mortality of childhood- and adolescent-onset epilepsy: a controlled national study. Epilepsy Behav 2017;66:80–5.
[4] Jennum P, Sabers A, Christensen J, Ibsen R, Kjellberg J. Welfare consequences for people with epilepsy and their partners: a matched nationwide study in Denmark. Seizure 2017;49:17–24.
[5] Riechmann J, Strzelczyk A, Reese JP, Boor R, Stephani U, Langner C, et al. Costs of epilepsy and cost-driving factors in children, adolescents, and their caregivers in Germany. Epilepsia 2015;56:1388–97.
[6] Strzelczyk A, Reese JP, Dodel R, Hamer HM. Cost of epilepsy: a systematic review. Pharmacoeconomics 2008;26:463–76.
[7] Pugliatti M, Beghi E, Forsgren L, Ekman M, Sobocki P. Estimating the cost of epilepsy in Europe: a review with economic modeling. Epilepsia 2007;48:2224–33.
[8] Nimmo-Smith V, Brugha TS, Kerr MP, McManus S, Rai D. Discrimination, domestic violence, abuse, and other adverse life events in people with epilepsy: population-based study to assess the burden of these events and their contribution to psychopathology. Epilepsia 2016;57:1870–8.
[9] Kornum BR, Knudsen S, Ollila HM, Pizza F, Jennum PJ, Dauvilliers Y, et al. Narcolepsy. Nat Rev Dis Primers 2017;3:16100.
[10] Plioplys S, Doss J, Siddarth P, Bursch B, Falcone T, Forgey M, et al. Risk factors for comorbid psychopathology in youth with psychogenic nonepileptic seizures. Seizure 2016;38:32–7.
[11] Beghi M, Negrini PB, Perin C, Peroni F, Magaudda A, Cerri C, et al. Psychogenic non-epileptic seizures: so-called psychiatric comorbidity and underlying defense mechanisms. Neuropsychiatr Dis Treat 2015;11:2519–27.
[12] Kanner AM, Schachter SC, Barry JJ, Hesdorffer DC, Mula M, Trimble M, et al. Depression and epilepsy, pain and psychogenic non-epileptic seizures: clinical and therapeutic perspectives. Epilepsy Behav 2012;24:169–81.
[13] Hovorka J, Nezadal T, Herman E, Nemcova I, Bajacek M. Psychogenic non-epileptic seizures, prospective clinical experience: diagnosis, clinical features, risk factors, psychiatric comorbidity, treatment outcome. Epileptic Disord 2007;9(Suppl. 1):S52–8.
[14] Duncan R, Oto M, Wainman-Lefley J. Mortality in a cohort of patients with psychogenic non-epileptic seizures. J Neurol Neurosurg Psychiatry 2012;83:761–2.
[15] Gonzalez Otarula KA, Tan YL, Dubeau F, Correa JA, Chang E, Hall JA, et al. Psychogenic nonepileptic seizures in patients with surgically treated temporal lobe epilepsy: presurgical and de novo postsurgical occurrence. Epilepsy Behav 2017;75:252–5.
[16] Kerr WT, Janio EA, Braesch CT, Le JM, Hori JM, Patel AB, et al. Identifying psychogenic seizures through comorbidities and medication history. Epilepsia 2017;58:1852–60.
[17] Rawlings GH, Brown I, Reuber M. Predictors of health-related quality of life in patients with epilepsy and psychogenic nonepileptic seizures. Epilepsy Behav 2017;68:153–8.
[18] Karakis I, Montouris GD, Piperidou C, Luciano MS, Meador KJ, Cole AJ. Patient and caregiver quality of life in psychogenic non-epileptic seizures compared to epileptic seizures. Seizure 2014;23:47–54.
[19] LaFrance Jr WC, Alosco ML, Davis JD, Tremont G, Ryan CE, Keitner GI, et al. Impact of family functioning on quality of life in patients with psychogenic nonepileptic seizures versus epilepsy. Epilepsia 2011;52:292–300.
[20] LaFrance Jr WC, Syc S. Depression and symptoms affect quality of life in psychogenic nonepileptic seizures. Neurology 2009;73:366–71.
[21] Popkirov S, Jungilligens J, Gronheit W, Wellmer J. Diagnosing psychogenic nonepileptic seizures: video-EEG monitoring, suggestive seizure induction and diagnostic certainty. Epilepsy Behav 2017;73:54–8.
[22] Moseley BD, Dewar S, Haneef Z, Eliashiv D, Stern JM. Reasons for prolonged length of stay in the epilepsy monitoring unit. Epilepsy Res 2016;127:175–8.
[23] Kerr WT, Janio EA, Le JM, Hori JM, Patel AB, Gallardo NL, et al. Diagnostic delay in psychogenic seizures and the association with anti-seizure medication trials. Seizure 2016;40:123–6.
[24] Duncan R, Graham CD, Oto M, Russell A, McKernan L, Copstick S. Primary and secondary care attendance, anticonvulsant and antidepressant use and psychiatric contact 5-10 years after diagnosis in 188 patients with psychogenic non-epileptic seizures. J Neurol Neurosurg Psychiatry 2014;85:954–8.
[25] Sadan O, Neufeld MY, Parmet Y, Rozenberg A, Kipervasser S. Psychogenic seizures: long-term outcome in patients with and without epilepsy. Acta Neurol Scand 2016;133:145–51.
[26] Yi YY, Kim HD, Lee JS, Cheon KA, Kang HC. Psychological problems and clinical outcomes of children with psychogenic non-epileptic seizures. Yonsei Med J 2014;55:1556–61.
[27] Lynge E, Sandegaard JL, Rebolj M. The Danish National Patient Register. Scand J Public Health 2011;39:30–3.
[28] Pedersen CB. The Danish Civil Registration System. Scand J Public Health 2011;39:22–5.
[29] Efron B, Tibshirani RJ. An introduction to the bootstrap: (monographs on statistics and applied probability). In editor book an introduction to the bootstrap: (monographs on statistics and applied probability). London, England: Chapman & Hall; 1994.
[30] Khatami R, Luca G, Baumann CR, Bassetti CL, Bruni O, Canellas F, Dauvilliers Y, Del Rio-Villegas R, Feketeova E, Ferri R, Geisler P, Högl B, Jennum P, Kornum BR, Lecendreux M, Martins-da-Silva A, Mathis J, Mayer G, Paiva T, Partinen M, Peraita-Adrados R, Plazzi G, Santamaria J, Sonka K, Riha R, Tafti M, Wierzbicka A, Young P, Lammers GJ, Overeem S. European Narcolepsy Network. The European Narcolepsy Network (EU-NN) database. J Sleep Res 2016;25(3):356–64.
[31] Jennum P, Christensen J, Ibsen R, Kjellberg J. Long-term socioeconomic consequences and health care costs of childhood and adolescent-onset epilepsy. Epilepsia 2016;57:1078–85.
[32] Jennum P, Pickering L, Christensen J, Ibsen R, Kjellberg J. Welfare cost of childhood- and adolescent-onset epilepsy: a controlled national study. Epilepsy Behav 2016;61:72–7.
[33] Jennum P, Sabers A, Christensen J, Ibsen R, Kjellberg J. Socioeconomic outcome of epilepsy surgery: a controlled national study. Seizure 2016;42:52–6.
[34] Jennum P, Sabers A, Christensen J, Ibsen R, Kjellberg J. Socioeconomic evaluation of vagus stimulation: a controlled national study. Seizure 2016;42:15–9.
[35] Milan-Tomas A, Persyko M, Del Campo M, Shapiro CM, Farcnik K. An overview of psychogenic non-epileptic seizures: etiology, diagnosis and management. Can J Neurol Sci 2018;45:130–6.
[36] Wasserman D, Herskovitz M. Epileptic vs psychogenic nonepileptic seizures: a video-based survey. Epilepsy Behav 2017;73:42–5.
[37] Kozlowska K, Chudleigh C, Cruz C, Lim M, McClure G, Savage B, et al. Psychogenic non-epileptic seizures in children and adolescents: part II - explanations to families, treatment, and group outcomes. Clin Child Psychol Psychiatry 2018;23:160–76.
[38] Kozlowska K, Chudleigh C, Cruz C, Lim M, McClure G, Savage B, et al. Psychogenic non-epileptic seizures in children and adolescents: part I - diagnostic formulations. Clin Child Psychol Psychiatry 2018;23:140–59.
[39] Chen DK, Sharma E, Lafrance Jr WC. Psychogenic non-epileptic seizures. Curr Neurol Neurosci Rep 2017;17:71.
[40] Carlson P, Nicholson Perry K. Psychological interventions for psychogenic non-epileptic seizures: a meta-analysis. Seizure 2017;45:142–50.
[41] Manjunath R, Paradis PE, Parise H, Lafeuille M, Bowers B, Duh M, et al. Burden of uncontrolled epilepsy in patients requiring an emergency room visit or hospitalization. Neurology 2012;79:1908–16.
[42] Ben-Menachem E, Hellstrom K, Verstappen D. Analysis of direct hospital costs before and 18 months after treatment with vagus nerve stimulation therapy in 43 patients. Neurology 2002;59:S44–7.
[43] Lindsten H, Stenlund H, Edlund C, Forsgren L. Socioeconomic prognosis after a newly diagnosed unprovoked epileptic seizure in adults: a population-based case-control study. Epilepsia 2002;43:1239–50.

[44] Salinsky M, Storzbach D, Goy E, Kellogg M, Boudreau E. Health care utilization following diagnosis of psychogenic nonepileptic seizures. Epilepsy Behav 2016;60:107–11.
[45] Nunez-Wallace KR, Murphey DK, Proto D, Collins RL, Franks R, Chachere 2nd DM, et al. Health resource utilization among US veterans with psychogenic nonepileptic seizures: a comparison before and after video-EEG monitoring. Epilepsy Res 2015; 114:114–21.
[46] Ahmedani BK, Osborne J, Nerenz DR, Haque S, Pietrantoni L, Mahone D, et al. Diagnosis, costs, and utilization for psychogenic non-epileptic seizures in a US health care setting. Psychosomatics 2013;54:28–34.
[47] Brown RJ, Reuber M. Psychological and psychiatric aspects of psychogenic non-epileptic seizures (PNES): a systematic review. Clin Psychol Rev 2016;45:157–82.
[48] Novakova B, Howlett S, Baker R, Reuber M. Emotion processing and psychogenic non-epileptic seizures: a cross-sectional comparison of patients and healthy controls. Seizure 2015;29:4–10.