



## Disability patterns over the first year after a diagnosis of epilepsy

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### ABSTRACT

**Objective:** To determine the patterns and predictors of disability over the first 12 months after a diagnosis of epilepsy.

**Patients and methods:** The Sydney Epilepsy Incidence Study to Measure Illness Consequences (SEISMIC) was a prospective, multicenter, community-based study of people with newly diagnosed epilepsy in Sydney, Australia. Disability was assessed using the World Health Organization's, Disability Assessment Schedule (WHODAS) 2.0 12-item version, at baseline (i.e. within 28 days of diagnosis) and 12 months post-diagnosis. Demographic, socioeconomic, clinical and epilepsy-related data, obtained through structured interviews, were entered into multivariable linear regression and shift analysis to determine predictors of greater disability.

**Results:** Of 259 adults ( $\geq 18$  years), 190 (73%) had complete WHODAS at baseline (mean  $\pm$  SD scores  $4 \pm 6$ ) and follow-up ( $4 \pm 8$ ). After adjustment for age, sex and co-morbidity, greater overall disability at 12 months was associated with lower education ( $P = 0.05$ ), economic hardship ( $P = 0.004$ ), multiple antiepileptic medications ( $P = 0.02$ ) and greater disability ( $P < 0.001$ ) at the time of diagnosis; these variables explained 38.3% of the variance. Among the 12 WHODAS items, "being emotionally affected by health problems" was the most frequent disability problem identified at both time points (all  $P < 0.0001$ ). The proportion of participants without problems in that domain improved over 12 months (from 24% to 50%,  $P < 0.0001$ ), whereas the other 11 items remained relatively stable. Independent baseline predictors of a worse emotional outcome at 12 months were severe/extreme emotional distress (odds ratio [OR] 4.52, 95% confidence intervals [CI] 1.67–12.24), economic hardship (OR 2.30, 95% CI 1.24–4.25) and perceived stigma (OR 2.02, 95% CI 1.03–3.93).

**Conclusion:** Most people report problems with emotional health after a diagnosis of epilepsy but many recover over the next 12 months. Services addressing the social and psychological impact of diagnosis may be needed to improve outcome.

### 1. Introduction

Epilepsy is associated with a wide range of psychosocial issues, including emotional distress (e.g. depression and anxiety) [1,2], unemployment [3], driving restrictions [4], stigma [5], low self-esteem

[6], social phobia [7], cognitive dysfunction (e.g. apathy [8], altered self-identity, memory loss) [9], and marital and family problems [10]. The 2015 International League Against Epilepsy Asia-Oceania Research Task Force has highlighted the need to alleviate the psychosocial consequences of epilepsy as a research priority [11]. Epilepsy can have a

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critical impact of a person's life [12], with early frequent emotional problems and neuropsychological deficits [12–14], and ongoing financial burden [15], which can affect adjustment and patterns of disability. The aim of this study was to quantify disability experienced by people within the first 12 months after a new diagnosis of epilepsy, and to determine the predictors of greater disability.

## 2. Patients and methods

Data are from the Sydney Epilepsy Incidence Study to Measure Illness Consequences (SEISMIC), a prospective multicenter, community-based study of people with newly diagnosed epilepsy in the metropolitan region of Sydney, Australia. The study is registered (ANZCTR12609000059268) and outlined in detail elsewhere [16–18]. In brief, participants of all ages with a new diagnosis of epilepsy according to centrally adjudicated, standard criteria, were enrolled over an initial 6-month pilot phase from July 2008. The recruitment was extended into a 3.5-year main phase from June 2010. All patients or a legally approved surrogate (usually a family member for children who were included in the study) provided informed consent, and ethics committee approvals were obtained from all participating hospital sites and community clinics. Only adults ( $\geq 18$  years) were included in these analyses.

Trained researchers undertook in-person structured interviews with participants at “baseline” (defined as within 28 days of diagnosis), and at 12 months follow-up. Participants who had their baseline assessments undertaken beyond the 28-day period were asked to recall their situation within the first month of diagnosis. Information was collected on socio-demographic characteristics, clinical pattern of seizures and use of antiepileptic drugs (AEDs). Family function was assessed with the Family Adaptation, Partnership, Growth, Affection and Resolve (APGAR) questionnaire, with high scores indicating better family function [19]. Alcohol consumption was assessed using the World Health Organization's Alcohol Use Disorders Identification Test (WHO-AUDIT-c) [20], where a total score of  $\geq 5$  for males and  $\geq 4$  for females indicates ‘at risk’ consumption [16]. Economic hardship was defined as an instance of a household's inability to make a necessary household payment (e.g. gas, electricity or telephone bills, heat or cool home, mortgage or rent payments) or the demonstration of dissaving behavior (e.g. borrowing or use of savings, selling assets, borrowing money). Anxiety and depression were measured using the Hospital Anxiety and Depression Scale (HADS) subscales [21], with scores of  $\geq 8$  on corresponding subscales indicating significant anxiety or depression. Perceived stigma was determined by responses to the question “whether the participant thought that other people are uncomfortable, treat him/her differently, or prefer to avoid him/her because of his/her epilepsy”.

Disability was measured using the 12-item WHODAS, with responses to questions ranging from 0 “none” to 4 “extreme/cannot do”, where higher scores indicate greater dysfunction and disability in the last 30 days [22]. We adopted a ‘simple scoring’ method, where the scores assigned to each item: “none” (0), “mild” (1) “moderate” (2), “severe” (3) and “extreme/cannot do” (5), were summed. When only one item had a missing value, the mean of the other items was assigned as a surrogate score for the missing item. The WHODAS has a thirteenth question to indicate “How much do these difficulties [any endorsed] interfere with your life?”. The WHODAS 12-item assessment tool has been shown to be valid and reliable in rating disability [23], and has been used among people with epilepsy [24–30].

We compared the characteristics of participants with complete WHODAS scores at baseline and 12-month follow-up (hereafter, referred to as the study group) with those lost to follow-up or with missing WHODAS data. Kruskal-Wallis and Chi squared tests were used for continuous and categorical variables, respectively. Multivariable linear regression was conducted to determine the variables related to ‘greater overall disability’ at 12 months. Only variables with an association ( $P < 0.2$ ) with this outcome in univariate models were

considered for inclusion in multivariate models. We used chi-square tests to compare the distribution of answers to each item on the 12-item WHODAS at baseline and 12 months, and between each two items at the same time point. Shift analyses were completed for any item where statistically significantly greater difficulty was observed. Only variables having an association ( $P < 0.2$ ) with a shift in answers at 12 months and meeting the proportional odds assumption ( $P < 0.05$ ) in univariate models, were considered for inclusion in multivariate models. In multivariable linear regression and shift analyses, if there was high correlation between variables (defined as  $> 0.4$ ), only one was entered into the model. Stepwise removal of non-significant covariate identified through a Wald test was undertaken until all the remaining variables were statistically significant ( $P < 0.05$ ). All analyses were undertaken using SAS Enterprise Version 7.1 (SAS institute, Cary, NC).

## 3. Results

There were 259 eligible adults with a new diagnosis of epilepsy but 69 (27%) were excluded due to the absence of a valid WHODAS assessment at baseline and/or 12 months. Thus, 190 (73%) remained in the study group (mean  $\pm$  SD age  $42 \pm 18$  years, 53% male) with a mean  $\pm$  SD baseline total WHODAS score of  $4 \pm 6$  (Table 1 and Fig. S1). All participants self-completed the clinical and psychosocial assessments but with a nominated proxy present for 14 (7%) at baseline and 8 (4%) at 12 months. Sixty-five percent of the study group had baseline interviews conducted after 28 days post-diagnosis (median 48 days, and interquartile range [IQR] 15–117 days).

Compared to those participants who were lost to follow-up or had incomplete or missing WHODAS data, the study group were more likely to be in paid work ( $P < 0.001$ ), have lower WHODAS scores (i.e. less disability,  $P = 0.02$ ) at baseline, and to have waited for  $\geq 8$  weeks for neurologist review ( $P = 0.007$ ). Compared to those who had the baseline interview conducted within 28 days, more of those who were asked to recall their situation reported they had seizure frequency more than several times per year ( $P = 0.02$ ), perceived stigma ( $P = 0.05$ ), problems in learning a new task ( $P = 0.02$ ), community activities ( $P = 0.02$ ), and maintaining friendship ( $P = 0.008$ ), and had been on multiple AEDs ( $P = 0.03$ ) within the first month of diagnosis (Table S1).

As there was a high correlation between age and being a full- or part-time student ( $r = 0.47$ ), the latter variable was not included in models. The right-skewed WHODAS scores (mean  $\pm$  SD  $4 \pm 8$ ; median 1, and IQR 0–4) at 12 months were log transformed (natural logs). After adjustment for age, sex and co-morbidity, having greater disability was associated with a lower level of education (i.e. up to tertiary education,  $P = 0.05$ ), economic hardship ( $P = 0.004$ ), greater disability ( $P < 0.001$ ) and requiring multiple AEDs ( $P = 0.02$ ) at diagnosis; these variables explained 38.3% of the variance (Table 2). Assumptions over linearity, homoscedasticity and normality of residuals, were maintained for this model (Fig. S2).

At both time points, approximately one quarter of the study group reported some difficulties (ranging from mild to extreme/cannot do) with work and concentration. Around one in five subjects reported ‘some difficulties’ with standing, household responsibilities, learning a new task, and community activities (Fig. 1). Among the 12 WHODAS items, “being emotionally affected by health problems” was the most frequent problem identified (at both time points, all  $P < 0.0001$ ). There was a large reduction in emotional problems, with the proportion of participants reporting no emotional problems doubling (from 24% to 50%), and the proportion of those who considered their problems to be severe or extreme, nearly halving from baseline to 12 months post-diagnosis (from 13% to 7%,  $P < 0.0001$ ), whereas the other disability outcomes were generally stable. Approximately, one third (33%) of participants reported none or same level of emotional difficulties at both time points; nearly half (48%) improved over 12 months, whilst one-fifth (19%) reported an increase in such problems (Table S2).

**Table 1**  
Participants' characteristics and by attrition.

Variables at baseline (i.e. within 28 days after the diagnosis of epilepsy), unless specified	Eligible and consented (n = 259)	Study group (n = 190)	Lost to follow-up/ invalid WHODAS (n = 69)	P value
<i>Demographic and socioeconomic</i>				
Age, median (IQR), n	38 (26, 57), 259	40 (26, 57), 190	36 (27, 56), 69	0.85
Male	132 (51)	101 (53)	31 (45)	0.24
Married/partnered <sup>a</sup>	123/236 (52)	100/185 (54)	23/51 (45)	0.26
Up to secondary education	122/240 (51)	98 (52)	24/50 (48)	0.65
Risk drinking level (≥ 5 for men, ≥ 4 for women on WHO-AUDIT-c)	73/239 (31)	57/189 (30)	16/50 (32)	0.80
Family function (APGAR), median (IQR), n	15 (13, 15), 230	15 (13, 15), 184	15 (13, 15), 46	0.59
Not in paid occupation	61/216 (28)	40/173 (23)	21/43 (49)	< 0.001
Full-/part-time student	48/230 (21)	37/184 (20)	11/46 (24)	0.57
Annual household income < Aust\$100,401	128/222 (58)	99/180 (55)	29/42 (69)	0.10
Encounter economic hardship <sup>b</sup>	78/234 (33)	59/187 (32)	19/47 (40)	0.25
No private health insurance	105/240 (44)	78 (41)	27/50 (54)	0.10
Own accommodation	113/237 (48)	90/189 (48)	23/48 (48)	0.97
<i>Clinical</i>				
Co-morbidity <sup>c</sup>	85/244 (35)	65 (34)	20/54 (37)	0.70
Anxiety or depression (≥ 8 on HADS anxiety/depression subscale)	79/229 (34)	58/181 (32)	21/48 (44)	0.13
Disability (WHODAS), median (IQR), n	2 (1, 7), 238	2 (1, 6), 190	5 (1, 12), 48	0.02
<i>Epilepsy-related</i>				
Symptomatic	91 (35)	68 (36)	23 (33)	0.71
Seizure frequency more than several times per year	71/209 (34)	58/168 (35)	13/41 (32)	0.73
Number of AEDs ≥ 2	20/253 (8)	13/188 (7)	7/65 (11)	0.32
Family history of epilepsy	47/224 (21)	35/176 (20)	12/48 (25)	0.44
≥ 8 weeks for neurologist review	41/239 (17)	38/183 (21)	3/56 (5)	0.007
Perceived stigma <sup>d</sup>	55/233 (24)	46/187 (25)	9/46 (20)	0.47

IQR denotes interquartile range, WHO-AUDIT-c World Health Organization's Alcohol Use Disorders Identification Test alcohol consumption part, Family APGAR Family Adaptation, Partnership, Growth, Affection and Resolve questionnaire, HADS Hospital Anxiety and Depression Scale, WHODAS World Health Organization's Disability Assessment Schedule. The P values are for the comparisons of the study group with those lost to follow-up or those who had invalid WHODAS assessments. Kruskal-Wallis and Chi squared tests were used for continuous and categorical variables, respectively. If there were missing values, the actual denominators were presented.

- <sup>a</sup> Versus no current partner (i.e. never married, widowed, divorced or separated but not divorced).
- <sup>b</sup> Either an instance of a household's inability to make a necessary household payment (i.e. gas, electricity or telephone bills, heat or cool home, mortgage or rent payments, etc.) or the demonstration of dissaving behavior (i.e. borrowing or use of savings, sell assets, borrow money, etc.).
- <sup>c</sup> Includes self-reported cardiovascular, respiratory, ophthalmology, otorhinolaryngology, gastrointestinal, hepatic, renal, genito-urinary, musculoskeletal and endocrine-metabolic diseases, but not including neurological (e.g. epilepsy) and psychiatric/behavioral diseases.
- <sup>d</sup> As a result of epilepsy, the participants think that other people are uncomfortable, treat them differently or prefer to avoid them.

**Table 2**  
Multivariable linear regression for associations with disability at 12 months after adjustment of age, gender and co-morbidity.

Variable at baseline or intercept	Parameter estimate <sup>a</sup>	Standard error	P-value
Intercept	0.0746	0.1922	0.70
Age, per 1 year increase	0.0048	0.0039	0.21
Female	0.1554	0.1196	0.20
Co-morbidity <sup>b</sup>	0.1548	0.1465	0.29
No tertiary education	0.2449	0.1215	0.05
Encounter economic hardship <sup>c</sup>	0.3824	0.1293	0.004
Disability (WHODAS), per 1 point increase	0.0722	0.0103	< 0.001
Number of AEDs ≥ 2	0.6015	0.2561	0.02

AEDs denotes anti-epileptic drugs.

<sup>a</sup> Log-transformed due to right skewness of raw data. *Disability at 12 months (WHODAS)* =  $e^{0.0746 + 0.0048 \cdot \text{Age} + 0.1554 \cdot \text{Female} + 0.1548 \cdot \text{Co-morbidity} + 0.2449 \cdot \text{No tertiary education} + 0.3824 \cdot \text{Encounter economic hardship} + 0.0722 \cdot \text{Disability at baseline (WHODAS)} + 0.6015 \cdot \text{Number of AEDs} \geq 2}$ . This model explains 38.3% of the variability of disability at 12 months measured on WHODAS.

<sup>b</sup> Includes self-reported cardiovascular, respiratory, ophthalmology, otorhinolaryngology, gastrointestinal, hepatic, renal, genito-urinary, musculoskeletal and endocrine-metabolic diseases, but not including neurological (e.g. epilepsy) and psychiatric/behavioral diseases.

<sup>c</sup> Either an instance of a household's inability to make a necessary household payment (i.e. gas, electricity or telephone bills, heat or cool home, mortgage or rent payments, etc.) or the demonstration of dissaving behavior (i.e. borrowing or use of savings, sell assets, borrow money, etc.).

Responses to the question 'Overall, how much did these difficulties interfere with your life?' were very similar to the distribution of responses to the emotional distress item at baseline and 12 months.

No high correlations were identified amongst the variables. Experiencing severe or extreme emotional difficulties at baseline (odds ratio [OR] 4.52, 95% confidence intervals [CI] 1.67–12.24), economic hardship (OR 2.3, 95% CI 1.24–4.25) and perceived stigma (OR 2.02, 95% CI 1.03–3.93) were the independent predictors of greater emotional problems at 12 months (C statistic 0.68, proportional odds assumption  $P < 0.0001$ ; Table S3 and Fig. 2). Twenty-five participants (13%) reported severe/extreme emotional distress at baseline, 59 (32%) reported economic hardship, and 46 (25%) reported perceived stigma.

#### 4. Discussion

In this prospective population-based cohort study, after adjustments were made for age, sex and co-morbidity, the factors that predicted greater overall disability at 12-months after a diagnosis of epilepsy were greater baseline disability, lower level of education, economic hardship, and use of multiple AEDs. Emotional difficulties were the most commonly reported problem, and those experiencing severe/extreme baseline emotional difficulties, economic hardship, and perceived stigma at baseline reported more emotional difficulties at 12 months.

The SEISMIC WHODAS-12 average total score at diagnosis was comparable with normative Australia data [31], showing that people with a physical disorder have scores (mean ± SD 4.3 ± 6.1) lower

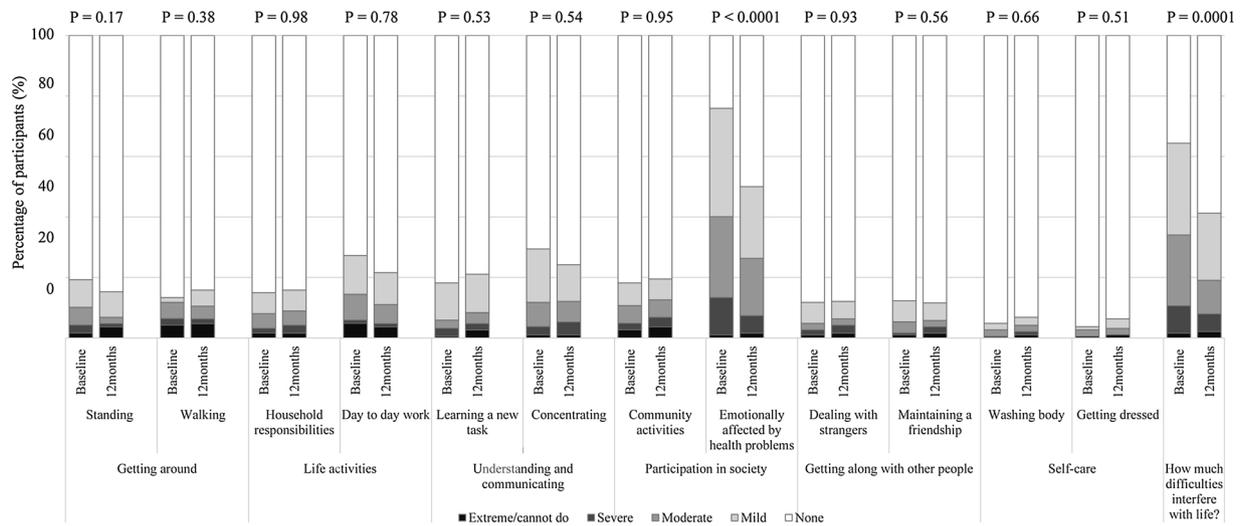


Fig. 1. Distribution of psychosocial disability measured using the 12-item World Health Organization Disability Assessment Schedule (WHODAS) at baseline and 12 months.

than those with mental health disorders, but higher than those free of any health problems (although, epilepsy and other neurological conditions were not included as physical disorders in that study). The SEISMIC data are also comparable to results of a study of people with a variety of brain disorders: similar proportions of people with epilepsy had problems with daily work, concentration, learning, activities, mobility and household tasks [29]. However, the frequency of our participants reporting disability was lower than in people with spinal cord injury [32], multiple sclerosis [29], Parkinson’s disease [29], mental illness [29,33], and substance abuse [33].

Lower education level has been associated with a “moderate or higher level of disability” (i.e. scores > 26, after re-scaling on a 100 point scale) among a sample of elderly Polish people [34]. Being wealthy had lower odds of “severe disability” (i.e. over 90<sup>th</sup> percentile), among older adults in South Africa, where the measurement of wealth

(types of floors and walls, access to water, ownership of bicycles, internet and refrigerators, etc) [35] and “economic hardship” in our study both measured households’ financial circumstances by incorporating a range of economic aspects in day-to-day life.

There are few studies of disability and functional impairment in people with newly diagnosed epilepsy. Thirteen percent (24 participants, data not shown) of our study group had WHODAS scores > 9, indicating clinically significant disability [31], which is a comparable proportion that seen (10%) in the normative Australia data [31]. However, we were unable to build a stable logistic regression model to identify these cases, who may have clinically significant disability [31], because we adjusted for age, sex and co-morbidity [31], and > 30 cases are required to avoid over-fitting (i.e. a minimum of 10 cases per independent variable) [36].

Most of the SEISMIC participants reported emotional difficulties

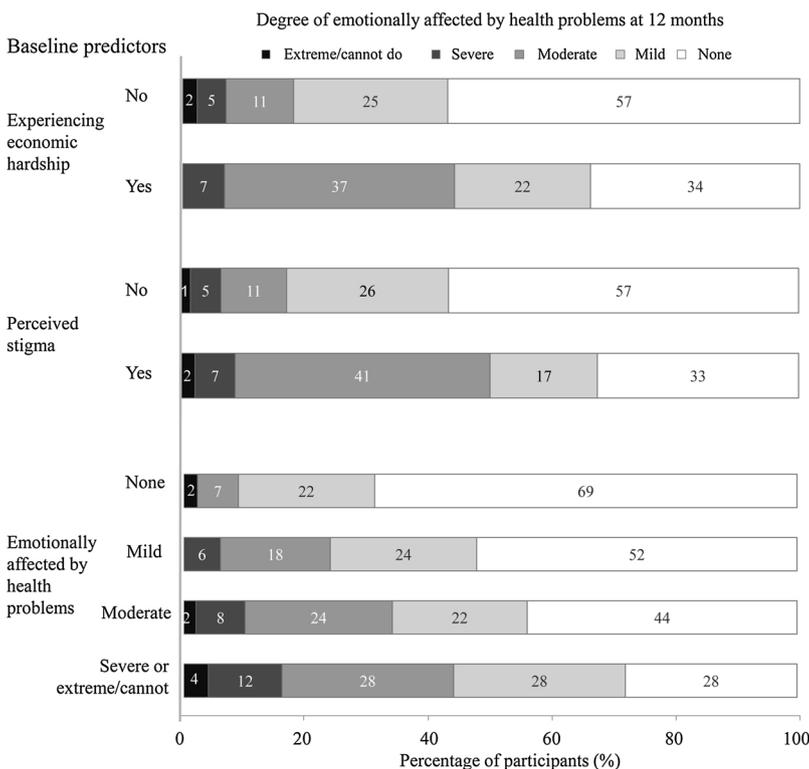


Fig. 2. Baseline predictors of being emotionally affected by health problems at 12 months.

Experiencing economic hardship was defined by an instance of a household’s inability to make a necessary household payment (e.g. gas, electricity or telephone bills, heat or cool home, mortgage or rent payments) or the demonstration of dissaving behavior (e.g. borrowing or use of savings, sell assets, borrow money). Perceived stigma was determined by a single question: as a result of epilepsy, whether participants thought that other people are uncomfortable, treat them differently or prefer to avoid them. Being emotionally affected by health problems is one of the 12 World Health Organization Disability Assessment Schedule (WHODAS) items.

The size of bars and numbers in bars show the frequency of participants with and without a particular baseline characteristic that reported a corresponding severity of being emotionally affected by health problems at 12 months.

early (baseline, 76%) and late (12 months, 50%) after a diagnosis of epilepsy. This is consistent with an earlier UK general practice study, where 47% of 192 participants reported some degree of negative emotional impact within 3 years of diagnosis [37]. Another European study indicated that 74% of those with epilepsy had some emotional difficulties reported on the WHODAS [29]. Evidence based upon eight randomized control trials showed that psychological treatments (i.e. epilepsy education, nurse-led counselling, cognitive, memory and self-management training, and cognitive behavioral and mindfulness therapy) enhanced emotional well-being in adults and adolescents with epilepsy [38]. Our finding that the mood of participants improved over time is similar to the attenuation of anxiety [39,40], and other forms of emotional distress [41], seen in those with acute stroke [40], newly diagnosed multiple sclerosis [39], and rheumatoid arthritis [41].

Our study suggests that interventions to manage the psychological sequelae of epilepsy and other external stressors, such as economic hardship and perceived stigma, may be needed to improve adjustment and clinical management of this common condition. Financial stress/strain is a strong risk factor for depression in epilepsy [42,43], and almost one-third of our participants encountered economic hardship at baseline. Financial costs peak in the first year after diagnosis [15], mostly related to the cost of investigations [44]. Lost wage-based productivity associated with epilepsy is nearly equal to the combined wage losses associated with diabetes, depression, anxiety, and asthma [45].

Equally, perceived stigma has previously been associated with depression [43,46] and anxiety [47]. The finding that one quarter of SEISMIC participants reporting perceived stigma is lower than in a Korean cohort, where 69% reported keeping their diagnosis secret from others [48], while 90% of those in Turkish study reported stigma as the main reason to conceal their diagnosis from others [49]. Educational videos and peer support groups may be useful in reducing epilepsy-related stigma [50,51].

Key strengths of this study are the prospective assessment of a broad range of health outcomes using validated tools in adults recruited from a variety of health centers early after the diagnosis and over the ensuing 12 months. Even so, we acknowledge 27% attrition and selection bias may have influenced participation and follow-up assessments, reflected in those with higher baseline WHODAS scores and those unemployed being more likely to be lost to follow-up or excluded from the study because of incomplete or missing WHODAS data. This may have led to an underestimate of overall disability and the degree of emotional difficulties, as lower baseline WHODAS scores were associated with lower follow-up scores and unemployment was associated with depression [43]. Our results may have been influenced by recall bias, as over two thirds of the participants had their baseline interviews completed more than 28 days after diagnosis. Answers to questionnaires, especially to psychosocial items (e.g. WHO-AUDIT-c, APGAR, HADS, WHODAS), may have been influenced by the presence of a proxy for the < 10% who had one present. Furthermore, because the WHODAS assessed disability “in the past 30 days”, for those participants who had baseline interviews completed within 30 days after diagnosis, this may include certain period before the diagnosis. Our sample was also too small to validate our model in a split sample approach.

## 5. Conclusion

In summary, our study has provided an overview of the spectrum of disability after a diagnosis of epilepsy, and re-emphasized the importance of emotional adjustment. Emotional problems were by far the most commonly reported disability after a diagnosis of epilepsy. Although many people showed recovery, there was a large proportion with new and ongoing problems at 12 months. Services targeting psychological support for people with epilepsy, including the incorporation of economic hardship and stigma reduction, may be needed to improve recovery and management of this common condition. People with epilepsy may be encouraged to contact their general practitioners and

community services if any disabilities are of concern, and may be educated on strategies for saving, planning ahead, and provided information on available financial supports. Educational videos and pamphlets helping epilepsy patients achieve correct understanding of the disease and peer support groups enhancing social supports may reduce perceived stigma.

## Disclosures of conflicts of interest

The authors report no disclosures.

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## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.clineuro.2019.02.022>.

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