Differences in health-related quality of life and somatic symptoms in employed and unemployed patients with epilepsy

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ABSTRACT

This study compared overall and specific aspects of health-related quality of life (HRQOL) and self-report of somatic, anxiety, and depressive symptoms between employed (n = 71) and unemployed (n = 48) patients with epilepsy (PWE). The Quality of Life in Epilepsy (QOLIE-89) and the Personality Assessment Inventory (PAI) were examined. The unemployed group reported significantly worse overall HRQOL including aspects of HRQOL related to epilepsy, physical health, mental health, and cognitive function. Among these four, physical health related HRQOL revealed the most difference between groups. While there were no differences between the groups in the level of social support and social isolation, the unemployed group reported worse social function with respect to work and driving. The unemployed group reported significantly greater somatic symptoms, but not anxiety and depressive symptoms. When specifically examining the subscales of the Somatic Concerns scale, conversion and health concerns, but not somatization, were greater in the unemployed group. Among the Depression subscales, the unemployed group reported greater physiologically manifested depressive symptoms. These findings suggest that along with optimizing seizure control, identifying and addressing presence of physical limitations, dysfunction, and somatic symptoms are also of importance in the care of PWE, particularly for those who are unemployed.

1. Introduction

In the clinical setting of epilepsy care, a multidisciplinary team approach is utilized with the goal of promoting a patient's health-related quality of life (HRQOL), a construct examining the patient's self-evaluation of the impact of their health conditions on everyday function. Determinants of HRQOL are multifactorial and associated predictors may vary for each patient. The Quality of Life in Epilepsy (QOLIE) inventory was developed to assess HRQOL in patients with epilepsy [1]. Clinicians can administer this inventory to evaluate a patient's subjective experience on core clinical variables, such as seizure control, changes in physical and cognitive function, as well as other psychological and psychosocial variables that may have a direct or secondary effect on overall HRQOL.

A systematic review examining factors associated with HRQOL in PWE revealed that condition-related variables (i.e., seizure frequency and severity) and psychological comorbidities (i.e., anxiety and depression) were negatively associated with HRQOL [2]. While demographic factors such as age, gender, and marital status were generally

not significantly associated with HRQOL, there was inconsistent evidence for education level and employment status as significant predictors of HRQOL. Insufficient studies were available to evaluate a possible association between HRQOL and socioeconomic status. Because epilepsy is a chronic neurological disorder with seizures that are episodic, unpredictable, and may result in loss of consciousness, employment insecurity is widely observed in this population and recognized as a major stressor for PWE [3–7]. Barriers to employment are partly reflected in employer attitudes as surveys showed that epilepsy is a medical disability considered least favorably by prospective employers and that employing PWE would be a "major issue" [8,9]. As a consequence, epilepsy is not only a medical condition characterized by seizure activity but also leads to complex psychosocial debility with consequences across multiple dimensions.

Unemployment status poses a major threat to the financial status of PWE. With more recent findings suggesting unemployment is negatively correlated with specific (i.e., social function) and overall HRQOL, unemployment is a major social consequence of epilepsy that threatens HRQOL in PWE [10,11]. While anxiety and depression have been

established as significant psychological factors associated with HRQOL, less studied has been the physical functioning among PWE in relation to HRQOL [2]. Ictal, postical, and interictal activities often have direct effect on autonomic functions that result in potential cardiac and pulmonary changes [12]. It is estimated that PWE experience roughly 3 times as many physical, mental, or social limitations compared to those without epilepsy. With roughly 50% of these limitations relating to physical functioning (i.e., stooping/kneeling/crouching, standing for long periods of time), poor physical functioning may be potential barriers to employment; however, this relationship is not fully understood [13].

Furthermore, somatic symptoms are not uncommon in PWE and are significantly greater when compared to healthy individuals [14,15]. Additionally, PWE report significantly greater physiological manifestations of anxiety and depression compared to healthy individuals [14]. Somatic symptoms (i.e., headache, pain, fatigue) are physical symptoms that may be accompanied by spending an excessive amount of time, energy, emotion, and/or behavior related to the symptom, resulting in significant distress and dysfunction [16]. In a different context (non-PWE seen in primary care), patients with somatization reported having greater functional disability and role impairment (i.e., instrumental activities of daily living) than non-somaticizing patients, after controlling for psychological and medical comorbidities [17]. These findings suggest that there may be a higher likelihood that unemployed PWE may experience more somatic symptoms than those who are employed given the potential association between somatization and functional disability.

Recognizing that there may be a potential association between physical, condition-related, psychological, and cognitive factors on employment, the main objective of the present study was to compare HRQOL, somatic symptoms, and psychological symptoms between employed and unemployed PWE. We hypothesized that unemployed PWE will report significantly worse overall HRQOL compared to employed PWE, particularly in aspects related to physical and social function. We also predicted that the unemployed PWE would report relatively greater somatic, anxiety, and depressive symptoms and concerns compared to employed PWE.

2. Methods

2.1. Subjects and clinical diagnosis

All patients admitted to the Epilepsy Monitoring Unit (EMU) at the University of Washington Regional Epilepsy Center between September 2016 and April 2023 were considered for this retrospective study (n = 288). Patients admitted to the EMU were each assigned a discharge diagnosis by the attending epileptologist, derived from electroencephalography (EEG) findings during the admission in conjunction with any previous EEG findings. Additionally, all patients were discussed and clinically diagnosed at a multidisciplinary team meeting consisting of epileptologists, neurosurgeons, neuropsychologists, and a neuroradiologist. Based on these diagnoses, only patients with confirmed epilepsy were considered for the study (n = 203). Those with a dual diagnosis of PNES and confirmed epilepsy (n = 36) were excluded. PWE who were non-English speaking (n = 9), had previous history of brain surgery (n = 29), incomplete QOLIE-89 and/or PAI (n = 36), and invalid PAI reports based on the Inconsistency and Infrequency validity scales (n = 5) were excluded from the study. Finally, those who were retired or students (n = 5) were excluded. Thus, analyses were conducted for a total of 119 PWE, grouped as either employed (n = 71) or unemployed (n = 48). A flowchart illustrating patients eligible for the purpose of this study is presented in Fig. 1. Examination of archival data for the purposes of this study was approved by the Human Subjects Division of the University of Washington Institutional Review Board (IRB).

2.2. Questionnaires on quality of life, psychopathology, and psychiatric symptomatology

HRQOL was assessed using the 89-item version of the Quality of Life in Epilepsy (QOLIE-89) inventory, the most comprehensive self-report instrument specifically developed for evaluating HRQOL in PWE [1]. The instrument consists of 89 questions distributed across 17 multi-item scales of health concepts. Most questions are answered on a Likert scale. The weighted average of the 17 multi-item scale scores are calculated to provide an Overall Score. Additionally, it provides four Composite Factor Scores that break down into the following HRQOL domains:
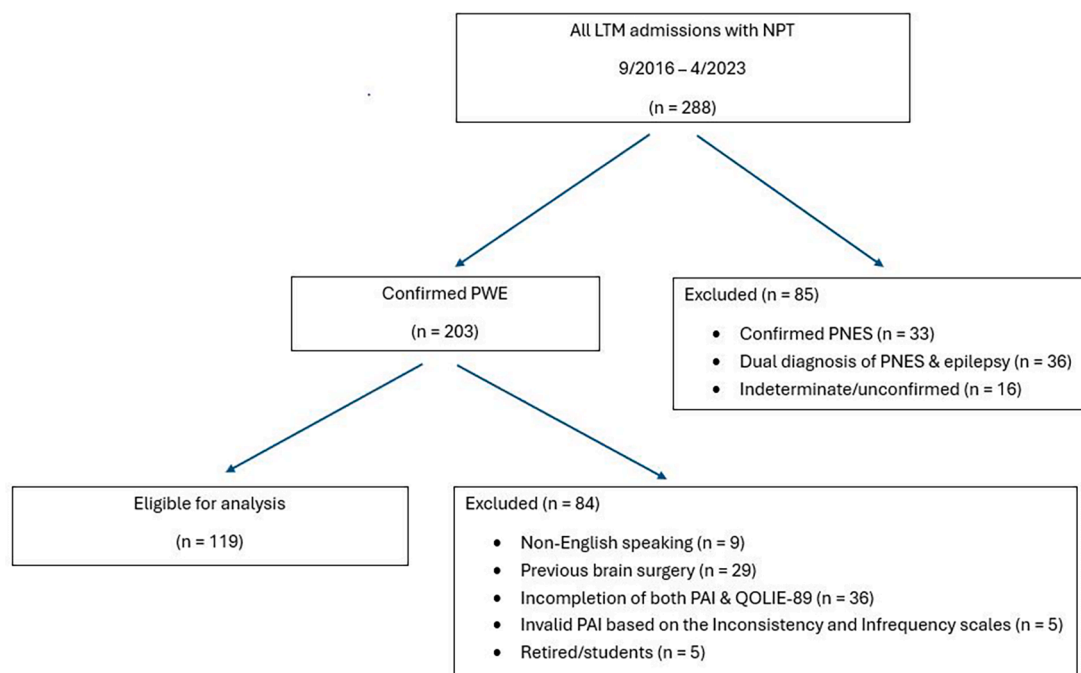

Fig. 1. Flowchart of eligible and excluded patients for the study.

Epilepsy-Targeted, Physical Health, Mental Health, and Cognitive. Scores are converted into T-scores with a mean of 50 and standard deviation of 10, normed on a cohort of 304 adults with epilepsy. Higher scores indicate reports of better quality of life.

The Personality Assessment Inventory (PAI) was utilized to assess the psychiatric profiles and personality features of patients [18]. This popular 344-item self-report instrument provides a variety of validity scales, clinical full scales, clinical subscales, and scales that provide treatment considerations. A higher score reflects greater endorsement of the clinical symptom. Raw scores are converted into T-scores, which were used to compare the groups in this study. Due to the large number of scales provided through the PAI, only the Negative and Positive Impression validity scales for evaluation of symptom validity and the Somatic Complaints, Anxiety, and Depression clinical full and subscales were examined given the aim of the study and previous studies that have investigated these commonly observed symptoms among PWE [2].

2.3. Clinical data

Condition-related variables including age at seizure onset, epilepsy duration, seizure frequency, and number of current antiseizure medications (ASMs) were obtained through review of weekly multidisciplinary meeting summaries, attending epileptologists' reports, and neuropsychologists' reports. All PWE were prescribed at least one ASM. Seizure frequency was recorded as one of the following: daily, weekly, monthly, and yearly. Psychiatric history was obtained as part of the neuropsychologists' clinical interview. Current, as well as prior history of depression, anxiety, psychological trauma, and/or participation in psychotherapy were coded dichotomously (Yes/No). For depression and anxiety, experiencing mild, intermittent symptoms, not at the level of clinical diagnosis, were also included as endorsing the associated psychiatric condition.

2.4. Statistical analysis

Statistical analyses were performed using the SPSS 29 software package. Normality of data was assessed through the Kolmogorov-Smirnov test and visual inspection of normal Q-Q plots. Categorical variables were examined using the chi-square test of independence. Group comparisons for nonparametric variables were assessed using the Mann-Whitney U test and Welch's t-test of unequal variances for parametric variables. Subsequently, the Benjamini-Hochberg procedure was conducted to assess for false discovery rate (FDR). Statistical significance was set at $p < 0.05$ and effect sizes for chi-squared tests were provided through Cramer's V, Cohen's d for Welch's t-test, and manual calculation for Mann-Whitney U test (r).

3. Results

3.1. Patient demographics and clinical variables

The employed and unemployed groups did not significantly differ in any demographic variables including age, sex, years of education, and ethnicity. Our PWE sample's age ranged between 18 and 74. The groups also did not significantly differ in any epilepsy-related variables including age at seizure onset, duration of epilepsy, number of prescribed antiseizure medications, and seizure frequency. There were also no group differences in endorsement of any psychiatric history including depression, anxiety, trauma, and participation in psychotherapy. Details of group demographics, epilepsy-related variables and psychiatric history variables are presented in Table 1.

3.2. Comparison of QOLIE-89 responses between employed and unemployed PWE

The QOLIE-89 Overall Score between the groups was significantly

Table 1
Summary of group demographics, epilepsy-related variables and psychiatric history variables.

	Employed (n = 71)		Unemployed (n = 48)		Effect size
	Median (IQR)	%	Median (IQR)	%	
Sex (% Female)[+]		32.4		47.9	−0.16
Age	33.0 (19.0)		33.5 (19.5)		−0.03
Education years	13.0 (3.0)		12.0 (2.0)		−0.14
Ethnicity[+]					0.25
Caucasian		78.9		83.3	
Native American		2.8		6.2	
Asian		0		2.1	
Black/African American		7.0		2.1	
Hispanic		7.0		0	
Mixed		4.2		6.3	
Age @ seizure onset	20.0 (16.0)		17.5 (15.0)		−0.08
Epilepsy duration	11.0 (16.0)		15.0 (16.2)		−0.03
# of prescribed ASMs	2.0 (1.0)		2.0 (1.0)		−0.01
Seizure frequency[+]					0.05
Daily		16.9		16.7	
Weekly		31.0		35.4	
Monthly		46.5		43.7	
Yearly		5.6		4.2	
Psychiatric history[+]					
History of depression		70.4		68.8	0.02
Current depression		54.9		60.4	0.05
History of anxiety		52.1		60.4	0.08
Current anxiety		45.1		50.0	0.05
History of psychological trauma		22.5		35.4	0.14
History of participation in psychotherapy		43.7		41.7	0.02
Current participation in psychotherapy		15.5		12.5	0.04

* = $p <.05$.
** = $p <.01$.
+ = Chi-square.
ASMs = antiseizure medications.

different, with the unemployed group reporting worse overall HRQOL than the employed group. Additionally, the unemployed group reported significantly worse on all four Composite Factors of HRQOL compared to the employed group. Examination across the multi-item subscales revealed significant lower scores among the unemployed group in 9 of the 17 subscales including Overall Quality of Life, Physical Function, Role Limitations-Physical, Role Limitations-Emotional, Pain, Work/Driving/Social Function, Attention/Concentration, Memory, and Language. Details of QOLIE-89 scores comparisons are presented in Table 2.

3.3. Comparison of PAI responses between employed and unemployed PWE

The two groups did not significantly differ in their Negative and Positive Impression scores and did not have significant elevations in group medians based on the cutoffs proposed in the PAI manual (NIM: < 73 T, PIM: < 57 T). Comparison of the clinical full scales showed that the unemployed group endorsed significantly higher on the Somatic Complaints scale, but not on the Anxiety and Depression scales. For both groups, there were no significant elevations in group medians for the three clinical full scales (<70 T), although the unemployed group was just slightly below the cutoff in the Somatic Complaints scale. Across the clinical subscales, the unemployed group scored significantly higher on the SOM-Conversion, SOM-Health Concerns, and DEP-Physiological subscales. The unemployed group's group median for the SOM-Health Concerns subscale reached clinical elevation (>70 T). Details of select PAI responses are presented in Table 3.

Table 2
QOLIE-89 overall, four composite factors, and 17 multi-item subscales scores.

	Employed (n = 71)		Unemployed (n = 48)		Effect size
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	
Overall Score**	50.0 (17.0)		38.5 (18.5)		−0.31
Epilepsy-targeted*		45.4 (10.4)		40.6 (10.5)	−0.46
Physical-Health**		49.2 (9.4)		41.0 (11.7)	−0.79
Mental-Health*		48.5 (9.9)		43.9 (11.6)	−0.44
Cognitive*		48.9 (11.3)		42.3 (11.3)	−0.58
Health Perceptions	47.0 (17.0)		41.0 (17.0)		−0.18
Overall Quality of Life*	49.0 (13.0)		43.0 (13.5)		−0.21
Physical Function**	55.0 (5.0)		47.0 (22.2)		−0.39
Role Limitations- Physical*	54.0 (17.0)		42.0 (23.0)		−0.27
Role Limitations- Emotional**	59.0 (12.0)		42.0 (23.0)		−0.34
Pain*	51.0 (18.0)		42.5 (21.2)		−0.24
Work/Driving/Social Function**		46.4 (9.6)		39.7 (9.9)	−0.68
Energy/Fatigue		46.8 (9.3)		44.4 (10.1)	−0.25
Emotional Well-being	50.0 (17.0)		48.0 (17.0)		−0.14
Attention/Concentration*	51.0 (17.0)		44.5 (15.5)		−0.23
Health Discouragement	46.0 (15.0)		39.0 (25.0)		−0.17
Seizure Worry	47.0 (17.0)		40.5 (16.0)		−0.15
Memory*		49.6 (10.0)		44.8 (10.8)	−0.47
Language*	53.0 (15.0)		43.0 (13.5)		−0.29
Medication Effects	49.0 (15.0)		48.5 (13.7)		−0.02
Social Support	51.0 (11.0)		48.0 (19.2)		−0.11
Social Isolation	47.0 (20.0)		47.0 (16.0)		−0.01

* = *p* <.05, after multiple comparisons correction.
** = *p* <.01, after multiple comparisons correction.

Table 3
PAI impression validity scales & clinical full scales and subscales of somatic complaints, anxiety, and depression.

	Employed (n = 71)		Unemployed (n = 48)		Effect size
	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	
Negative Impression (NIM)	51.0 (12.0)		59.0 (22.0)		−0.16
Positive Impression (PIM)	52.0 (14.0)		50.0 (20.0)		−0.01
Somatic Complaints (SOM)**	60.0 (16.0)		68.5 (17.5)		−0.26
Conversion**	57.0 (17.0)		60.0 (21.0)		−0.23
Somatization	54.0 (19.0)		59.0 (22.7)		−0.20
Health Concerns**	64.0 (22.0)		71.0 (14.0)		−0.23
Anxiety (ANX)	53.0 (17.0)		57.0 (19.5)		−0.13
Cognitive	55.0 (21.0)		58.0 (20.3)		−0.15
Affective	52.0 (16.0)		52.0 (20.3)		−0.09
Physiological	52.0 (17.0)		56.5 (20.5)		−0.15
Depression (DEP)	57.0 (18.0)		62.0 (18.5)		−0.20
Cognitive	55.0 (21.0)		58.0 (19.3)		−0.17
Affective	53.0 (14.0)		55.0 (20.5)		−0.15
Physiological**		57.7 (10.9)		63.2 (12.6)	0.48

* = *p* <.05, after multiple comparisons correction.
** = *p* <.01, after multiple comparisons correction.

4. Discussion

Epilepsy is a complicated neurological condition not simply due to the intractable nature of seizures for some individuals, but due to the wide array of adverse consequences that lead to reduced HRQOL. Previous studies have revealed that unemployment is one of several social consequences of epilepsy closely associated with HRQOL, emphasizing the need for further investigation into the relationship between employment status and HRQOL [10,11,19,20]. Interestingly, one study reported that unemployment was more closely associated with poor HRQOL than seizure frequency [19], suggesting the importance that employment status has on HRQOL, perhaps over seizure characteristics. Pertinent to our study, our groups had no significant difference in seizure frequency or in any other epilepsy-related, demographic, and psychiatric history variables (i.e., well-matched employed and unemployed groups), allowing stronger conclusions to be drawn about the differences between the groups. The goal of our study was to compare

overall and specific aspects of HRQOL between employed and unemployed PWE. We also assessed whether there were significant differences in the groups' self-report of somatic, anxiety, and depressive symptoms and concerns.

As we hypothesized, the unemployed PWE reported significantly worse overall HRQOL than did employed PWE with a medium effect size. Although employment status as a predictor of HRQOL has yielded mixed results in previous studies, our finding was consistent with studies that relied on group comparisons of employed and unemployed PWE that utilized the QOLIE-31 inventory [6,10,21–26]. With respect to the four Composite Factor scores that are uniquely provided through the QOLIE-89, the unemployed group reported significantly worse HRQOL on all four composites. A large effect was observed between the groups on the Physical Health Composite Factor, while medium effect sizes were present in the Cognitive, Epilepsy-targeted, and Mental Health Composite Factors. These findings suggest that concerns and limitations attributed to physical function may be more pervasive for unemployed PWE than they are for employed PWE. It is also possible that unemployed PWE may experience more seizure-related physical injuries ranging from mild (i.e., abrasions) to more severe injuries (i.e., burns, fractures, and head trauma) as demonstrated in a study by Bifftu and colleagues [27]. While the predictive nature of employment status on physical health was not investigated by this study, our findings raise the possibility that those who are not employed may be hindered to work or return to work because of limitations in their physical function.

Additionally, the significantly worse cognitive aspect of HRQOL among unemployed PWE, which was the composite factor revealing second highest group difference and effect size in our study, calls attention to the need to better understand the role of cognitive impairment on employment. Our observed finding of differences in cognitive function was consistent with the findings by Gu and colleagues who similarly reported a major difference in the Cognition scale on the

QOLIE-31, also revealing the second highest group difference, after the Social Function scale [10]. A study examining surgical PWE reported that errors on executive function tasks and poorer working memory post-surgery were the cognitive factors that differentiated patients whose employment status remained unchanged from those who saw improvement in their employment status [28]. Studies investigating how these cognitive deficits translate to performance in different work environments and how cognitive dysfunction is related to underemployment may be warranted. The role of cognitive dysfunction on employment may be difficult to examine due to the wide array of general and epilepsy-related covariates (i.e., age, ASM effects, MRI abnormalities, comorbid neurodegeneration) that can potentially impact cognitive functions, but it is an issue that has important implications for HRQOL in PWE.

Across the QOLIE-89 subscales, as hypothesized, there were significant differences in scales related to physical health (Physical Function, Role Limitations-Physical, Pain). There were also significant differences in three cognitive scales (Attention/Concentration, Memory, and Language) and one mental health scale (Role Limitations-Emotional). Unsurprisingly, the "Work/Driving/Social Function" subscale revealed the greatest effect size. While the unemployed PWE reported significantly worse on this scale than did employed PWE, it should be noted that both groups reported nearly one standard deviation below the normative sample of epilepsy patients (M = 66.9, SD = 22.9) [1]. One potential explanation may be that our sample was PWE evaluated in the EMU who may be experiencing relatively greater burden of uncontrolled seizures (~95 % of both groups experiencing either daily, weekly, or monthly seizures) that restrict their ability to work and drive. These limitations on work, driving, and social activities may be concerning for both groups, but even more so for unemployed PWE. However, it should be noted that there were insignificant differences between our groups in the Social Support and Social Isolation subscales, suggesting that work, over social activities, may be driving the significant difference in the "Work/ Driving/Social Function" subscale. An item-by-item analysis of the subscale in future studies may provide clarity.

On the PAI, we included the Negative and Positive Impression validity scales in anticipation of differences in overly exaggerated and/or under-reporting of symptoms, concerns and shortcomings that would obscure the interpretation of the clinical scales, but there were no groups differences. Contrary to our hypothesis, only the Somatic Complaints clinical full scale was significantly higher in the unemployed group, while Anxiety and Depression clinical full scales were not significantly different between groups. The Somatic Complaints group median was just below the cutoff for clinical significance, which indicates "significant concerns about somatic functioning and probable impairment arising from somatic symptoms" [18]. On the Somatic Complaints subscales, the unemployed group reported significantly greater Conversion and Health Concerns, but not Somatization. This finding illustrates that the two groups do not significantly differ in the occurrence of somatic symptoms, but the unemployed group appears to endorse more conversion symptoms and concerns regarding their health status. Conversion symptoms are closely associated with physical health complaints and therefore should be monitored and addressed as potential barriers to employment [29]. Applying the practical considerations raised by Smeets and colleagues to our finding, it could also be inferred that unemployed PWE could benefit from cognitive restructuring interventions specifically targeting improved self-esteem, coping skills, and self-efficacy [25]. This is applicable for psychological factors as well, considering that while an insignificant difference in anxiety and depressive symptoms was observed between the groups on the PAI, a significantly different Mental Health Composite Factor of the QOLIE-89 was observed. In addition, while the unemployed group did not score higher on the overall Depression clinical full scale, they endorsed significantly greater depression manifested in physiological symptoms that can be reflected in experiences such as decreased appetite, decreased sexual interest, change in overall activity and energy, and

sleep disturbances. While concerns for sports and physical activity have been raised in the past due to fear of injury and inducement of seizures, physical activity and regular exercise should be encouraged as previous studies report that physical activity is positively associated with HRQOL and negatively associated with mood symptoms [30–35]. Additionally, sleep disorders (i.e., insomnia, hypersomnia, restless leg syndrome, obstructive sleep apnea) should be carefully monitored and addressed given their prevalence among PWE and their association with seizures and mood symptoms [36–41]. In summary, the unemployed PWE report commensurate level of psychological symptoms in anxiety and depression as do employed PWE, but differences lie in somatic symptoms, particularly in conversion and health concerns.

There are several limitations to this study. A limitation of the study was that we only investigated group differences on HRQOL, somatic and psychological symptoms between employed and unemployed PWE. Future studies may employ regression methods to elucidate further the relationship between these factors. It can be inferred from our findings that there may be a significant association between the presence and severity of somatic symptoms and employment status, which as a result may be associated with HRQOL. Study designs for establishing a causal relationship may be important also due to the possibility that there may be a bidirectional relationship between employment status and physical functioning. While physical limitations may lead to unemployment, studies also demonstrate that unemployment is a major determinant of physical inactivity in PWE, a clinical population that is less active compared to the general population [34,35,42]. Another statistical limitation to consider is that due to our sample size, the study may have been slightly underpowered according to our post-hoc power analysis using G* Power version 3.1.9.7. (power = 0.76) [43]; this may limit the generalizability of our findings.

Another limitation is that we cannot determine if the endorsed somatic symptoms by the unemployed PWE are reflective of perceived physical debility from seizure effects versus symptoms caused by comorbid illnesses, as we did not investigate possible medical comorbidities (e.g., vascular, endocrinological, orthopedic difficulties, etc.) present in our sample. Future studies may wish to elucidate this further. Along with making this distinction on physical effects, different possible etiologies for cognitive difficulties should also be considered. One consideration may be potential ASM effects, given adverse cognitive effects of certain medications that have been established, that may contribute to employment status and HRQOL [44–49]. Future studies may also wish to consider the potential role of other epilepsy-related variables (i.e., type of epilepsy, seizure frequency/severity) on employment status. On another note, in our group of unemployed PWE, roughly half of the individuals were receiving social security disability income (SSDI) while the other half was not. Among the employed PWE, four were receiving SSDI. Given the challenges of unemployment and underemployment in leading to financial strains in the lives of PWE, future studies might consider evaluating the potential moderating role of SSDI or other forms of disability income and yearly income on HRQOL among PWE. In addition, future studies should consider stratifying employed PWE into part-time and full-time for a more refined understanding of the role of employment status on HRQOL given the prevalence of underemployment in epilepsy population.

This study also comes with several strengths, including a well-matched employed and unemployed group across all baseline features examined, including demographics, epilepsy-related variables, psychiatric history variables, and symptom validity (PAI Negative and Positive Impression). This allows for stronger conclusions to be drawn about the QOLIE-89 and PAI differences observed between our groups. Our study was also the first study to compare employed and unemployed PWE using the QOLIE-89, which allowed us to recognize more specific aspects of HRQOL that are different between the groups as shown across the various subscales.

Taking our findings together on the QOLIE-89 and the PAI, unemployed PWE report significantly worse HRQOL across multiple

dimensions compared to those who are employed. Differences in the two groups are most pronounced in somatic symptoms that reflect the significantly worse physical aspect of HRQOL among unemployed PWE. In conjunction with identifying optimal methods of seizure control, medical providers involved in the care of PWE should also address any physical dysfunction or limitations and the presence of somatic symptoms that may reduce HRQOL. Also, cognitive-behavioral treatment for improving coping skills and self-efficacy, particularly for those who are struggling to work or return to work, should be considered for better psychosocial adaptation.

Ethical statement

Examination of archival data for the purposes of this study was approved by the Human Subjects Division of the University of Washington Institutional Review Board (IRB).

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CRediT authorship contribution statement

Hyun Jin Kang: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Karen Torres:** Writing – review & editing, Writing – original draft, Supervision, Resources, Investigation. **Michelle S. Kim:** Writing – review & editing, Writing – original draft, Supervision, Resources, Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Devinsky O, Vickrey BG, Cramer J, Perrine K, Hermann B, Meador K, et al. Development of the quality of life in epilepsy inventory. Epilepsia 1995;36: 1089–104. https://doi.org/10.1111/j.1528-1157.1995.tb00467.x.

[2] Taylor RS, Sander JW, Taylor RJ, Baker GA. Predictors of health-related quality of life and costs in adults with epilepsy: a systematic review. Epilepsia 2011;52: 2168–80. https://doi.org/10.1111/j.1528-1167.2011.03213.x.

[3] Gilliam F, Kuzniecky R, Faught E, Black L, Carpenter G, Schrodt R. Patient-validated content of epilepsy-specific quality-of-life measurement. Epilepsia 1997; 38(2):233–6. https://doi.org/10.1111/j.1528-1157.1997.tb01102.x.

[4] England MJ, Liverman CT, Schultz AM, Strawbridge LM, editors. Institute of Medicine (US) Committee on the Public Health Dimensions of the Epilepsies. Epilepsy Across the Spectrum: Promoting Health and Understanding. Washington (DC): National Academies Press (US); 2012.

[5] Moran NF, Poole K, Bell G, Solomon J, Kendall S, McCarthy M, et al. Epilepsy in the United Kingdom: seizure frequency and severity, anti-epileptic drug utilization and impact on life in 1652 people with epilepsy. Seizure 2004;13(6):425–33. https://doi.org/10.1016/j.seizure.2003.10.002.

[6] Loring DW, Meador KJ, Lee GP. Determinants of quality of life in epilepsy. Epilepsy Behav 2004;5(6):976–80. https://doi.org/10.1016/j.yebeh.2004.08.019. PMID: 15582847.

[7] Baker GA, Hargis E, Hsih MM, Mounfield H, Arzimanoglou A, Glauser T, et al. International Bureau for Epilepsy. Perceived impact of epilepsy in teenagers and young adults: an international survey. Epilepsy Behav 2008;12(3):395–401. https://doi.org/10.1016/j.yebeh.2007.11.001.

[8] Hicks RA, Hicks MJ. Attitudes of major employers toward the employment of people with epilepsy: a 30-year study. Epilepsia 1991;32(1):86–8. https://doi.org/10.1111/j.1528-1157.1991.tb05617.x.

[9] Jacoby A, Gorry J, Baker GA. Employers' attitudes to employment of people with epilepsy: still the same old story? Epilepsia 2005;46(12):1978–87. https://doi.org/10.1111/j.1528-1167.2005.00345.x.

[10] Gu XM, Ding CY, Wang N, Xu CF, Chen ZJ, Wang Q, et al. Influence of occupational status on the quality of life of Chinese adult patients with epilepsy. Chin Med J (Engl) 2016;129(11):1285–90. https://doi.org/10.4103/0366-6999.182827.

[11] Chen YY, Huang S, Wu WY, Liu CR, Yang XY, Zhao HT, et al. Associated and predictive factors of quality of life in patients with temporal lobe epilepsy. Epilepsy Behav 2018;86:85–90. https://doi.org/10.1016/j.yebeh.2018.06.025.

[12] Devinsky O. Effects of seizures on autonomic and cardiovascular function. Epilepsy Curr 2004;4(2):43–6. https://doi.org/10.1111/j.1535-7597.2004.42001.x.

[13] Terman SW, Hill CE, Burke JF. Disability in people with epilepsy: A nationally representative cross-sectional study. Epilepsy Behav 2020;112:107429. https://doi.org/10.1016/j.yebeh.2020.107429.

[14] Testa SM, Lesser RP, Krauss GL, Brandt J. Personality Assessment Inventory among patients with psychogenic seizures and those with epilepsy. Epilepsia 2011;52(8): e84–8. https://doi.org/10.1111/j.1528-1167.2011.03141.x.

[15] Shen S, Dong Z, Sander JW, Zhou D, Li J. Somatic symptoms and related disorders in a large cohort of people with epilepsy: A cohort study. Epilepsia 2023;64(2): 320–34. https://doi.org/10.1111/epi.17453. Epub 2022 Dec 26 PMID: 36318105.

[16] D'Souza RS, Hooten WM. Somatic Symptom Disorder. 2023 Mar 13. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan–.

[17] Harris AM, Orav EJ, Bates DW, Barsky AJ. Somatization increases disability independent of comorbidity. J Gen Intern Med 2009;24(2):155–61. https://doi.org/10.1007/s11606-008-0845-0.

[18] Morey LC. Personality Assessment Inventory professional manual. Florida: Psychological Assessment Resources. Odessa; 1991.

[19] Elsharkawy AE, Thorbecke R, Ebner A, May TW. Determinants of quality of life in patients with refractory focal epilepsy who were not eligible for surgery or who rejected surgery. Epilepsy Behav 2012;24(2):249–55. https://doi.org/10.1016/j.yebeh.2012.03.012.

[20] Gilliam F. Optimizing health outcomes in active epilepsy. Neurology 2002;58(8 Suppl 5):S9–20. https://doi.org/10.1212/wnl.58.8_suppl_5.s9. PMID: 11971128.

[21] Thomas SV, Koshy S, Nair CR, Sarma SP. Frequent seizures and polytherapy can impair quality of life in persons with epilepsy. Neurol India 2005;53(1):46–50. https://doi.org/10.4103/0028-3886.15054.

[22] Meldolesi GN, Picardi A, Quarato PP, Grammaldo LG, Esposito V, Mascia A, et al. Factors associated with generic and disease-specific quality of life in temporal lobe epilepsy. Epilepsy Res 2006;69(2):135–46. https://doi.org/10.1016/j.eplepsyres.2006.01.010.

[23] Mosaku KS, Fatoye FO, Komolafe M, Lawal M, Ola BA. Quality of life and associated factors among adults with epilepsy in Nigeria. Int J Psychiatry Med 2006;36(4):469–81. https://doi.org/10.2190/R80G-580X-X1H2-6936.

[24] Zhao Y, Zhang Q, Tsering T, Sangwan HX, Liu L, Shang H, et al. Prevalence of convulsive epilepsy and health-related quality of life of the population with convulsive epilepsy in rural areas of Tibet Autonomous Region in China: an initial survey. Epilepsy Behav 2008;12(3):373–81. https://doi.org/10.1016/j.yebeh.2007.10.012. Epub 2008 Jan 3.

[25] Smeets VM, van Lierop BA, Vanhoutvin JP, Aldenkamp AP, Nijhuis FJ. Epilepsy and employment: literature review. Epilepsy Behav 2007;10(3):354–62. https://doi.org/10.1016/j.yebeh.2007.02.006.

[26] Choi-Kwon S, Chung C, Kim H, Lee S, Yoon S, Kho H, et al. Factors affecting the quality of life in patients with epilepsy in Seoul, South Korea. Acta Neurol Scand 2003;108(6):428–34. https://doi.org/10.1046/j.1600-0404.2003.00151.x.

[27] Bifftu BB, Tadesse Tiruneh B, Mekonnen Kelkay M, Bayu NH, Tewolde AW, Takele WW, et al. Seizure-related injuries among people with epilepsy at the outpatient Department of the University of Gondar Hospital, Northwest Ethiopia: Cross-sectional institutional-based study. Neurol Res Int 2017;2017:4970691. https://doi.org/10.1155/2017/4970691.

[28] Partanen E, Laari S, Kantele O, Kämppi L, Nybo T. Associations between cognition and employment outcomes after epilepsy surgery. Epilepsy Behav. 2022;131(Pt A): 108709. https://doi.org/10.1016/j.yebeh.2022.108709. Epub 2022 May 5. PMID: 35526464.

[29] O'Neal MA, Baslet G. Treatment for Patients With a Functional Neurological Disorder (Conversion Disorder): An Integrated Approach. Am J Psychiatry. 2018; 175(4):307–14. https://doi.org/10.1176/appi.ajp.2017.17040450. PMID: 29606068.

[30] Carrizosa-Moog J, Ladino LD, Benjumea-Cuartas V, Orozco-Hernández JP, Castrillón-Velilla DM, Rizvi S, et al. Epilepsy, physical activity and sports: A narrative review. Can J Neurol Sci. 2018;45(6):624–32. https://doi.org/10.1017/cjn.2018.340. PMID: 30430971.

[31] Ablah E, Haug A, Konda K, Tinius AM, Ram S, Sadler T, et al. Exercise and epilepsy: a survey of Midwest epilepsy patients. Epilepsy Behav 2009;14(1):162–6. https://doi.org/10.1016/j.yebeh.2008.09.019. Epub 2008 Oct 31 PMID: 18926931.

[32] Collard SS, Ellis-Hill C. How do you exercise with epilepsy? Insights into the barriers and adaptations to successfully exercise with epilepsy. Epilepsy Behav 2017;70(Pt A):66–71. https://doi.org/10.1016/j.yebeh.2017.03.004. Epub 2017 Apr 12 PMID: 28411518.

[33] Dubow JS, Kelly JP. Epilepsy in sports and recreation. Sports Med 2003;33(7): 499–516. https://doi.org/10.2165/00007256-200333070-00003. PMID: 12762826.

[34] Green R, Abe C, Denney DA, Zhang R, Doyle A, Gadelmola K, et al. Physical activity status and quality of life in patients with epilepsy - Survey from level four epilepsy monitoring units. Epilepsy Res 2021;173:106639. https://doi.org/10.1016/j.eplepsyres.2021.106639. Epub 2021 Apr 9 PMID: 33865047.

[35] van den Bogard F, Hamer HM, Sassen R, Reinsberger C. Sport and physical activity in epilepsy. Dtsch Arztebl Int 2020;117(1–2):1–6. https://doi.org/10.3238/arztebl.2020.0001.

[36] Buysse DJ, Reynolds 3rd CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res 1989;28(2):193–213. https://doi.org/10.1016/0165-1781(89)90047-4. PMID: 2748771.

[37] Piperidou C, Karlovasitou A, Triantafyllou N, Terzoudi A, Constantinidis T, Vadikolias K, et al. Influence of sleep disturbance on quality of life of patients with epilepsy. Seizure 2008;17(7):588–94. https://doi.org/10.1016/j.seizure.2008.02.005. Epub 2008 Apr 8 PMID: 18396419.

[38] Moser D, Pablik E, Aull-Watschinger S, Pataraia E, Wöber C, Seidel S. Depressive symptoms predict the quality of sleep in patients with partial epilepsy–A combined retrospective and prospective study. Epilepsy Behav 2015;47:104–10. https://doi.org/10.1016/j.yebeh.2015.04.021. Epub 2015 May 13 PMID: 25982882.

[39] Khatami R, Zutter D, Siegel A, Mathis J, Donati F, Bassetti CL. Sleep-wake habits and disorders in a series of 100 adult epilepsy patients–a prospective study. Seizure 2006;15(5):299–306. https://doi.org/10.1016/j.seizure.2006.02.018. Epub 2006 Mar 20 PMID: 16546407.

[40] Bialasiewicz P, Nowak D. Obstructive sleep apnea syndrome and nocturnal epilepsy with tonic seizures. Epileptic Disord 2009;11(4):320–3. https://doi.org/10.1684/epd.2009.0277. Epub 2009 Nov 23 PMID: 19933056.

[41] Staniszewska A, Mąka A, Religioni U, Olejniczak D. Sleep disturbances among patients with epilepsy. Neuropsychiatr Dis Treat 2017;10(13):1797–803. https://doi.org/10.2147/NDT.S136868. PMID: 28744129; PMCID: PMC5513823.

[42] Ben J, Pagani AG, Marques BS, Fialho GL, Wolf P, Walz R, et al. Employment status as a major determinant for lower physical activity of patients with epilepsy: A case-control study. Epilepsy Behav 2021 Feb;115:107655. https://doi.org/10.1016/j.yebeh.2020.107655.

[43] Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods 2007;39(2):175–91. https://doi.org/10.3758/bf03193146. PMID: 17695343.

[44] Ortinski P, Meador KJ. Cognitive side effects of antiepileptic drugs. Epilepsy Behav 2004;5(Suppl 1):S60–5. https://doi.org/10.1016/j.yebeh.2003.11.008. PMID: 14725848.

[45] Park SP, Kwon SH. Cognitive effects of antiepileptic drugs. J Clin Neurol. 2008;4(3):99-106. doi: 10.3988/jcn.2008.4.3.99. Epub 2008 Sep 30. PMID: 19513311; PMCID: PMC2686875.

[46] Mula M. Topiramate and cognitive impairment: evidence and clinical implications. Ther Adv Drug Saf 2012;3(6):279–89. https://doi.org/10.1177/2042098612455357. PMID: 25083242; PMCID: PMC4110841.

[47] Diamond M, Dahlöf C, Papadopoulos G, Neto W, Wu SC. Topiramate improves health-related quality of life when used to prevent migraine. Headache 2005;45(8):1023–30. https://doi.org/10.1111/j.1526-4610.2005.05183.x. PMID: 16109116.

[48] Dodick DW, Silberstein S, Saper J, Freitag FG, Cady RK, Rapoport AM, et al. The impact of topiramate on health-related quality of life indicators in chronic migraine. Headache 2007;47(10):1398–408. https://doi.org/10.1111/j.1526-4610.2007.00950.x. PMID: 18052949.

[49] Silberstein S, Lipton R, Dodick D, Freitag F, Mathew N, Brandes J, et al. Topiramate treatment of chronic migraine: a randomized, placebo-controlled trial of quality of life and other efficacy measures. Headache 2009;49(8):1153–62. https://doi.org/10.1111/j.1526-4610.2009.01508.x. PMID: 19719543.