Community Pharmacists' Knowledge Related To Women's Issues In Epilepsy: A Pilot Study To Inform Advances In Pharmaceutical Care In Peninsular Malaysia

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Abstract

Introduction: Despite the majority of epilepsy-related disease burden affecting patients in the Global South, there is limited data available on the comprehension and awareness of healthcare professionals regarding women's epilepsy-related issues from these countries. The aim of this pilot study was to assess the epilepsy-related knowledge – with a special focus on women's health and antiepileptic drug (AED) management – of community pharmacists in Peninsular Malaysia.

Methodology: A descriptive, cross-sectional survey was conducted from 15 March 2024 and 1 June 2024, using self-administered, standardized, open online questionnaire, in accordance with CHERRIES guidelines. Descriptive statistics, χ^2 and Fisher's exact tests, and regression analyses were performed using IBM SPSS 25.0.

Results: n=81 (response rate: 36.5%) pharmacists completed the questionnaire; the majority were female (64.2%; n=52), working in a pharmacy chain (69.1%; n=56) from the East Coast Economic Region of Malaysia (80.2%; n=65). 53.1% (n=43) showed adequate knowledge levels (scores ≥5) women's epilepsy-related issues; the mean knowledge score achieved by the participating pharmacists was 4.96±2.62 (out of 10). Not receiving training on epilepsy-related issues and AEDs (B=0.581; 95% CI: 0.400-0.762, p<0.001) had a strong influence on the knowledge scores; while no significant differences in epilepsy-related knowledge were shown on the basis of other demographic and professional characteristics of the participants (p>0.05).

Conclusions: The findings of our pilot study aid the triangulation of evidence in this field, indicating that community pharmacists in Peninsular Malaysia generally possess an adequate level of knowledge regarding women's issues with epilepsy, although aware-ness on specific, practical aspects of pharmacotherapy and care remain limited. Our results highlight the importance of implementing tailored educational and hands-on training programs for community pharmacists.

1. Introduction

Epilepsy is a group of chronic neurological disorders, characterized by the occurrence of recurrent, unprovoked seizures, resulting from anomalous electrical signals produced by brain cells [1]. Epilepsy may considerably alter the quality of life (QoL) of affected individuals, not only due to the unpredictable occurrence of seizures – which necessitates long-term use of antiepileptic medications – but also related to impaired physical and mental well-being, limited social participation and stigma, and restrictions in lifestyle [2,3]. Based on the Global Burden of Disease (GBD) estimates for 2021, there were ~ 51.7 million people overall affected by various subtypes (i.e. idiopathic and secondary combined) of epilepsy globally, corresponding to an age-standardized prevalence of ~658/100,000 population; furthermore, >80% of the epilepsy related burden (both in the context of incident and prevalent cases, fatal epilepsy and epilepsy-related disability-adjusted life years) affects patients in low- and middle-income countries (LMICs) [4]. Epilepsy presents added difficulties for women, including the impact of hormonal influences, the use of contraceptive medications and pregnancy, which may all impact seizure activity [5]. According to the most recent estimates of the World Health Organization (WHO), >20 million women are affected by epilepsy globally, with 85% of them living in LMICs [6]. Management of epilepsy is primarily done using antiepileptic drugs (AEDs; anticonvulsant or anti-seizure medications) – in conjunction with other medications to treat co-morbidities – which may act through various mechanisms of action [7]. However, the pharmacological management of epilepsy is not without challenges, due to the number of cases involving unexpected medication-related issues among patients [8]; previous studies highlighted that up to half of the patients receiving AEDs experience adverse effects, while 20-30% of cases exhibit therapy-resistant epilepsy against the commonly used AEDs [9,10]. Furthermore, the registry-based study by Battino et al. has revealed that managing epilepsy may become considerably more complex in certain subpopulations, such as in women of childbearing age, and in patients of Asian origin, due to the need for specific therapeutic considerations and contraindications [11]. Research highlights the need for special considerations when providing antiepileptic treatment to women with epilepsy, as factors such as hormonal changes (e.g., menstrual cycle, contraception, and menopause), reproductive concerns (e.g., fertility and pregnancy), and childcare conditions must be carefully addressed [12]. The prevalence of epilepsy during the gestational period is estimated to be around 0.3–0.7% [13,14]; during this period, management of the condition should focus on seizure control, in parallel with fetal protection [15]. However, several studies have shown that the risk of congenital malformations in infants of women with epilepsy is ~2-3-fold higher compared to their non-affected counterparts, especially those exposed to AEDs (often associated with low folate levels) [16,17]. Additionally, issues such as postpartum care, the genetic inheritance of epilepsy, and the child's development further emphasize the complexity of managing epilepsy in this population [18]. The above points highlight the importance healthcare professionals – including prescribing physicians and pharmacists – being well informed about AED medications, to provide safe and effective treatment, especially to vulnerable patients groups.

Pharmacists – both in community and hospital settings – play crucial roles in managing and supporting AED treatment, thus, they possess the required competence on the management of epilepsy [19]: on one hand, during physician-pharmacist consultations, they should provide essential medicine-related information, risk-benefit analysis, highlight potential drug-drug interactions, and suggest reasonable doses to be dispensed, to make sure that the patients who receive medications may be satisfied with treatment outcomes [20,21]. Pharmacists should be able to provide advice on safe and highly tolerable AEDs in vulnerable patient groups, which are the most crucial considerations to be highlighted when selecting the treatment [9,10,22]. On the other hand, in addition to dispensing AEDs, community pharmacists play an essential role in educating epileptic patients about their disease, the specifics of their AED treatment and potential adverse events, disease-specific lifestyle counselling, and improving the patient's awareness, which may lead to increased compliance, decreased risk of potential drug-drug interactions and adverse outcomes, and improved QoL overall [23-25]. According to a review by Gidal et al. [26], the most frequently reported services performed by pharmacists for persons with epilepsy were medication management including the management of AED, followed by patient education and counselling, respectively. Pharmacists should recognize vulnerable patient populations –

such as women with epilepsy – where tailored counselling and educational interventions are necessary to address women's concerns related to the disease, AEDs and the corresponding issues during pregnancy [27]. Nonetheless, appropriate care and counseling may only be administered if healthcare-professionals are armed with the appropriate knowledge and skills to empower them towards meaningful clinical decision-making.

Many pharmacists obtain basic knowledge regarding epilepsy during their training, however, there is still a considerable gap occurring between the management of the condition in specific, high-risk individuals, especially when it comes to gender-specific issues, and pregnancy [26,27]. These paucities in understanding among healthcare-professionals regarding women's issue with epilepsy may correspond to disparities in the quality of care these patient receive, and may lead to long-term suffering and decreased QoL; thus, indicating an important actionable aspect of equity in healthcare [28]. The limited understanding of healthcare-professionals' regarding issues specific to women during epilepsy, particularly in relation to AED management, has been highlighted by previous studies [29]; while the treatment of epilepsy in vulnerable patient groups (including women) has been traditionally overlooked, pragmatic endeavors - including the appraisal of the knowledge among community pharmacists regarding women's issues in epilepsy– are crucial to inform tailored interventions to improve patient outcomes. Despite the majority of epilepsy-related disease burden affecting patients in the Global South, there is limited data available on the comprehension and awareness of healthcare professionals regarding women's epilepsy-related issues from these countries, especially from Malaysia [30]. The study of Al Anazi et al. – involving obstetricians and family medicine physicians – highlighted that their respondents had inadequate knowledge about several crucial aspects of AED management in women with epilepsy, particularly concerning hormonal influences, osteomalacia, and sexual dysfunction [31]. Their study also emphasized the importance of continuous training for all healthcare professionals to enhance their understanding and treatment of women with epilepsy, as a solid foundational knowledge in this area ensures better treatment outcomes [31]. Furthermore, the study of Jairoun et al. aimed to identify [29] information gaps among pharmacists working in the UAE navigating women's issues in epilepsy: while the overall knowledge of the respondents was good (scoring >80%), however, limited knowledge related to AEDs with liver-enzyme inducing and the effectiveness of contraceptives was shown among the participants.

To close the empirical and geographical evidence gap, the present pilot study aimed to evaluate the knowledge of community pharmacists in Peninsular Malaysia on women's issues health issues in epilepsy – involving AED medication management – enabling the identification of gaps and the implementation of measures to improve their understanding and competence in this area.

2. Aims and Objectives

2.1. Primary objectives

The principal aim of this study was to assess the epilepsy-related knowledge – with a special focus on women's health and AED medication management – of community pharmacists in Peninsular Malaysia.

2.2. Secondary objectives

To determine the effect of demographic and professional characteristics (i.e. gender, educational level, type of pharmacy, position in the pharmacy, years of professional experience, working hours/day, number of patients served/day, and whether they received training on epilepsy and AEDs) on the epilepsy-related knowledge of community pharmacists.

3. Material and methods

3.1. Study design, setting, and duration

The present descriptive, cross-sectional, questionnaire-based pilot study was carried out to assess knowledge of community pharmacists on women's issues health issues in epilepsy – involving AED medication management in Peninsular Malaysia (i.e. the part of Malaysia located on the southern portion

of the Malay Peninsula in Southeast Asia, covering ~ 40% of land area of the country [32]. Data collection was performed between 15 March 2024 and 1 June 2024.

3.2. Study population, inclusion and exclusion criteria

The target study population of the study consisted of community pharmacists in Peninsular Malaysia. To identify eligible respondents of the study, the list of community pharmacists working in the region were obtained from the Malaysian Pharmacists Society (MPS) website; overall, n=5245 community pharmacists were registered at the study period [33]. The inclusion criteria for the study included the following: (i) fully registered pharmacists (FRPs) under the Malaysian Pharmacy Board, who (ii) worked in a community pharmacy in Peninsular Malaysia during the study period, with (iii) ≥1 year of experience working in community pharmacy setting, (iv) possessing adequate proficiency in English to participate, (v) who were willing to participate and were available at the time of the data collection period. The exclusion criteria were as follows: (i) provisionally registered pharmacists (PRPs), (ii) pharmacy assistants, drug promoters or sales assistants, (iii) <1 year of experience working in community pharmacy setting, (iv) insufficient English proficiency, (v) unwilling or unable to participate at the time of the study. To achieve the highest possible response rate, a convenience sampling approach was applied [34]. Due to the pilot nature of our study, sample size determination was not carried out.

3.3. Questionnaire

A self-administered, standardized, open online questionnaire was used for data collection, which was accessible through the Google Forms API for the convenience of completing the survey. For the purposes of our study, the validated, English version of the questionnaire of Jairoun et al. [29] – with permission obtained from the original authors – was adopted. The questionnaire consisted of the following sections: (i) 8 items to collect information demographic and professional characteristics, i.e. gender, educational level (bachelor/master/postgraduate), location of practice, type of pharmacy (independent/pharmacy chain), position in the pharmacy (chief pharmacist/staff pharmacist/assistant pharmacist), years of professional experience (1-5 years/6-10 years/>10 years), working hours/day (≤8 hours/day/>8 hours/day), mean number of patients served/day (1-10 patients/11-20 patients/>20 patients), and whether they received training on epilepsy and AEDs (yes/no); (ii) the respondents' understanding of women's issues in epilepsy were assessed using 10 items, were respondents could select "Yes"/"No"/"I'don't know" responses, respectively. Based on the correct answer for each statement, responses were scored (0=incorrect answer/"I'don't know"; 1=correct answer), resulting in scores ranging between 0-10 for each respondent. Based on the scores received, community pharmacists' level of knowledge was dichotomized as "adequate knowledge level" if their scores were ≥5, while "poor knowledge level" if their scores were <5, respectively [29]. No adaptive questioning or conditionally appearing questions were used. Participants were able to review and change their answers before submitting their final answers.

3.4. Data collection

As all pharmacies/pharmacy outlets are expected to have at least one attending FRP on duty, the contact details (i.e. e-mail addresses or phone numbers) of the eligible respondents were obtained from the available information on their official websites, in addition to visiting pharmacies in person to obtain contact information. The link to the online survey was distributed via e-mail addresses or phone numbers; the purpose of the research, its objectives and the informed consent statement were included in the beginning of the questionnaire. Reminders to complete the survey were sent as follows: firstly, ten days after the initial distribution of the questionnaire links to the participants who did not yet complete the survey, followed by reminder e-mails five days later, for any unresponsiveness from the participants. Unresponsive pharmacists, and those who were unable to complete the online questionnaire after numerous reminders were excluded. IP addresses were used to identify unique visitors; only one response from one IP address were accepted.

3.5. Statistical analysis

Data collected from the Google Forms API were converted into spreadsheets (Microsoft Excel; Microsoft Corp. Redmond, WA, USA) and then transferred to the Statistical Package for Social Sciences v.25.0 (SPSS; IBM Corp., Endicott, NY, USA) for analysis. During descriptive statistics, all categorical variables were described as frequencies and percentages (n, %), while knowledge scores were expressed as means (with standard deviations). Normality testing was performed using the Q-Q diagram and Kolmogorov–Smirnov tests. During univariate analysis, associations between categorical variables were assessed using χ^2-tests and Fisher's exact tests. Regression analysis was performed to assess the association between independent variables (demographic and professional factors) and the outcome variable (knowledge score of pharmacists about women with epilepsy). During analyses, p-values < 0.05 were considered statistically significant (95% confidence interval).

3.6. Ethical considerations, informed consent

This study was conducted in accordance with the Declaration of Helsinki (1975, last revised in 2013) and national and institutional ethical standards. Ethical approval for this study was obtained from the UniSZA Human Research & Ethics Committee (UHREC) (reference number UniSZA/UHREC/2024/624; approval date: 14th of March, 2024).

Before participating in the study, individuals were informed about the nature and objectives of the study, privacy and anonymity, and confidentiality of their data; participants were made aware that their participation in the research is voluntary, and they may withdraw from the study at any time without any consequences. To protect the privacy and confidentiality of the participants, no identifiable information was recorded during data collection. Before data collection, written informed consent (through the online survey collection platform) were obtained from the patients who agreed to participate. Participants did not receive any incentives (monetary or otherwise) to take part in the study. Data collected throughout the study were stored securely, and was accessible only to those involved in the research.

3.7. Reporting guidelines

The present manuscript adheres to the CHERRIES (Checklist for Reporting Results of Internet E-Surveys) guidelines for online surveys to ensure methodological rigor, transparency, and reproducibility [35]; the CHERRIES checklist is provided in Supplementary Material S1.

4. Results

4.1. Response rate, demographic and professional characteristics

Overall, n=222 community pharmacists from Peninsular Malaysia were contacted to participate in our study, out of which, n=81 (response rate: 36.5%) completed the questionnaire. The majority of the respondents were female (64.2%; n=52), working in a pharmacy chain member (69.1%; n=56), from the East Coast Economic Region of Malaysia (Kelantan, Terengganu and Pahang; 80.2%; n=65), with all of them possessing a bachelor's degree (100.0%; n=81) in pharmacy; most had between 6-10 years (71.6%; n=58) of work experience in community pharmacy, working as chief pharmacists (100.0%; n=81). 79.0% (n=64) consistently works >8 hours/day, serving >20 patients/day (76.5%, n=62). A detailed summary of the characteristics of the pharmacists involved in our study is shown in Table 1. 48.1% (n=39) reported receiving no prior training on epilepsy and AEDs.

4.2. Pharmacists' knowledge related to women's issues with epilepsy

The statements used to assess pharmacists' knowledge related to women's issues with epilepsy – and the corresponding ratio of correct answers for each statement – is presented in Table 2. Overall, statement 2 ("Women with epilepsy are more likely to experience sexual dysfunction than those without epilepsy.") was most commonly identified correctly by the respondents (65.4%; n=53), while statement 10 ("Exposure to valproic acid during pregnancy does not increase the risk of the child developing autism.") were least commonly answered correctly (29.6%; n=24); statements 1-8 were correctly identified by >50% of pharmacists.

Table 1. Demographic and professional characteristics of the respondents

Characteristics	Groups	n (%)
Gender	Male	29 (35.8%)
	Female	52 (64.2%)
Location of practice	Terengganu, Kelantan Pahang	65 (80.2%)
	Kedah, Perlis, Perak, Pulau Pinang	5 (6.2%)
	Johor, Melaka, Negeri Sembilan	4 (5.0%)
	Selangor, Wilayah Persekutuan, Kuala Lumpur	7 (8.6%)
Type of pharmacy	Independent	25 (30.9%)
	Chain	56 (69.1%)
Working experience (years)	1-5 years	19 (23.5%)
	6-10 years	58 (71.6%)
	>10 years	4 (4.9%)
Working hours/day	≤8 hours/day	17 (21.0%)
	>8 hours/day	64 (79.0%)
Mean number of patients served/day	11-20 patients	19 (23.5%)
	>20 patients	62 (76.5%)
Received training on epilepsy and AEDs	Yes	39 (48.1%)
	No	42 (51.9%)

AEDs: antiepileptic drugs

Table 2. Community pharmacists' knowledge of women's issues during epilepsy (Statements 1-10)

Statements	Correct answers n (%)
In terms of the menstrual cycle, endogenous estrogen is known to have proconvulsant properties, while progesterone has anticonvulsant properties. **(Correct answer: Yes)**	52 (64.2%)
Women with epilepsy are more likely to experience sexual dysfunction than those without epilepsy. **(Correct answer: Yes)**	53 (65.4%)
Certain antiepileptic drugs are linked to osteomalacia (reduced bone mass). **(Correct answer: Yes)**	51 (53.0%)
Switching to a different form of the same antiepileptic drug can trigger increased side effects or seizures. **(Correct answer: Yes)**	50 (61.7%)
A 200 mg dose of topiramate triggers enzymatic induction, and thus may diminish the effectiveness of certain contraceptives. **(Correct answer: Yes)**	46 (56.8%)

The effectiveness of certain contraceptives may be reduced by antiepileptic drugs that induce enzymes. **(Correct answer: Yes)**	44 (54.3%)
Women who have epilepsy and who become pregnant should discontinue their antiepileptic medication. **(Correct answer: No)**	43 (53.1%)
The best antiepileptic medication for a woman who is pregnant is that which is most suitable for her syndrome and type of seizure. **(Correct answer: Yes)**	45 (55.6%)
In most cases, the children of women with epilepsy are born healthy. **(Correct answer: Yes)**	39 (48.1%)
Exposure to valproic acid during pregnancy does not increase the risk of the child developing autism. **(Correct answer: No)**	24 (29.6%)

53.1% (n=43) achieved adequate knowledge level (scores ≥5); during the analysis of dichotomous outcomes (adequate vs. poor knowledge), no significant differences were observed based on respondents' gender, location of practice, type of pharmacy, years of professional experience, working hours/day and mean number of patients served/day ($p>0.05$). On the other hand, individuals who reported receiving training on epilepsy and AEDs were more likely to achieve adequate knowledge level (61.5% vs. 45.2%; $p=0.003$).

The mean knowledge score achieved by the participating pharmacists was 4.96±2.62 (out of 10). To determine the association between independent variables (demographic and professional factors) and the outcome variable (knowledge score of pharmacists about women with epilepsy), regression analysis has been carried out (Table 3). Based on our model (R^2: 0.423; $p<0.001$), not receiving training on epilepsy-related issues and AEDs (B=0.581; 95% CI: 0.400-0.762, $p<0.001$) had a strong influence on the outcome variable; in contrast, other factors, such as gender (B=0.011; 95% CI: -0.169 – 0.191), location of practice (B=0.167; 95% CI: -0.014 – 0.348), type of pharmacy (B=-0.096; 95% CI: -0.282 – 0.089), working experience (years) (B=0.009; 95% CI: -0.176 – 0.194), working hours/day (B=0.111; 95% CI: -0.075 – 0.297), and mean number of patients served/day (B=-0.056; 95% CI: -0.130 – 0.130) did not have a significant effect on the knowledge score of pharmacists about women with epilepsy ($p>0.05$).

Table 3. Association between independent variables and disease-related knowledge scores in regression analysis

Variables	**Beta coefficient (B)**	**95% CI (lower-upper bound)**	**p-value**
Gender	0.011	-0.169 – 0.191	0.905
Location of practice	0.167	-0.014 – 0.348	0.170
Type of pharmacy	-0.096	-0.282 – 0.089	0.305
Working experience (years)	0.009	-0.176 – 0.194	0.926
Working hours/day	0.111	-0.075 – 0.297	0.239
Mean number of patients served/day	-0.056	-0.130 – 0.130	0.549
Received training on epilepsy and AEDs	0.581	0.400 – 0.762	<0.001

R^2	**SEM**	**Frequency**	**p-value**
0.423 (42.3%)	0.795	7.653	<0.001

R^2: coefficient of determination; CI: confidence interval; SEM: standard error of the mean; AEDs: antiepileptic drugs

5. Discussion

Seizure disorders are complex conditions, characterized by altered neurological activity, which may result in unpredictable focal involuntary movements or convulsions, altered sensations and loss of consciousness, having a considerable effect on the QoL and functionality [36]. In addition to determining the exact cause of the seizures (involving clinical examinations, neuroimaging, electroencephalographs (EEG) or laboratory analysis), management of epilepsy entails the long-term use of AEDs. Epilepsy in women of childbearing age requires careful management and monitoring – especially in the context of the administration of AEDs, due to the complex interplay of hormonal activity, fertility and other comorbidities with seizure occurrence [37]. In order to ascertain the gaps in knowledge regarding this vulnerable patient group, and to provide better pharmaceutical care, this study sought to assess community pharmacists' knowledge of treatment issues specific to women with epilepsy, and its potential influencing factors. Given that there is limited empirical evidence available from this geographical region, the importance of performing the present pilot study is not only in assessing the knowledge regarding women's issues in epilepsy among community pharmacists in Peninsular Malaysia, but also in highlighting the importance of continuous professional training (CPT) and on the management of pharmacological treatment for the epileptic patients. Due to their accessibility and competence in pharmacological treatments, community pharmacists have an indispensable role in supporting individuals with chronic conditions, including women affected by epilepsy [27,38]; if done competently, patients will have the best experience though consultations and pharmaceutical care interventions, while reducing their concerns about their health.

Despite the limited sample size, our study has provided useful insights: more than half (53.1%) of pharmacists showed adequate levels of knowledge on women's issues in epilepsy; our respondents' scored lower compared to the earlier study by Jairoun et al. performed in the UAE [29], where 81% of community pharmacists achieved a good knowledge score. Nonetheless, other studies from the Global South have highlighted the limited knowledge of pharmacists about the epilepsy-related women's health issues [39,40]. According to the study of Roth et al., considerable knowledge gaps were identified among Israeli pharmacists, as only 48% of them received an adequate knowledge score [19]. Additionally, Yeo et al. showed that pharmacists evaluated in Sarawak (Northwest Malaysia) only had a passable understanding of the topic [30]. The study of Al Anazi et al. also identified potential knowledge gaps among healthcare providers (obstetricians and family medicine physicians) on women's issues in epilepsy, with the average knowledge scores barely reaching 50% [31]. Their study concluded that one effective way to address these knowledge gaps in healthcare, and to provide sufficient care for women, training of community pharmacists about women's issues in epilepsy would be crucial. Furthermore, a recent study by Ali et al. conducted in Khartoum University, Sudan, about knowledge of, the results indicated that the majority of pharmacists have poor knowledge about antiepileptic drugs in a developing country [41]. Further research is needed to investigate the actual factors behind this knowledge gap and to propose interventions to improve pharmacist's knowledge and practice for them to provide improved pharmaceutical care to their patients.

Overall, findings of this study revealed that the community pharmacists in Peninsular Malaysia were knowledgeable about certain aspects of epilepsy in women. The most correct answers – similarly in the study of Al Anazi et al [31] – were associated with the awareness that during the menstrual cycle, estrogen was found to be a proconvulsant, while progesterone has anticonvulsant properties; this means, community pharmacists are capable to encounter the situation where the epileptic women are expressing their concerns regarding their menstrual cycle with their comorbidity. Besides this, majority of the participants in this study agreed – concurring with the results of McAuley et al. (86.8%) [22] and Shawahna et al. (58.1%) [42] – that pregnant women should not discontinue their AEDs during their pregnancies for managing their seizure frequencies. These findings suggest that pharmacists were aware that dispensing appropriate AED regimens to pregnant WWE can significantly enhance the quality of life for both mothers and their fetus. This underscores the importance of pharmacists' role in ensuring optimal treatment outcomes for this vulnerable population. Additionally, majority of the pharmacists in this current study believed that epilepsy and AEDs may cause a higher risk for sexual dysfunction: some AEDs may affect normal sexual function [43,44]. The study of Mansour et al. [23] revealed that most

of their respondents were knowledgeable that appropriate choice and dose of antiepileptic drugs may manage epilepsy well without interrupting the women's normal sexual function, in addition, that there are AEDs that improve sexual dysfunction in WWE, such as oxcarbazepine [44]. In contrast, Yeo et al. [30] showed that only less than half of the total participants were aware of the interaction between AEDs and sexual dysfunction among epileptic women. This suggested that our participants have better knowledge and understanding about AEDs' interactions with sexual function in a woman with epilepsy. Consistent with our results, the mentioned study [30] showed that most of their participants were highly knowledgeable and aware that some AEDs may cause reductions in bone density.

Around half of participants were aware of the potential drug-drug interactions between AEDs and effectiveness of the contraceptives; this highlights a considerable, and targetable gap in knowledge, as pharmacists should be aware with AED-contraceptive interactions, as a lack of such knowledge could lead to unintended pregnancies in women with epilepsy [29,45]. Similar results were found by Jairoun et al. where their concerns towards their pharmacists were lacking knowledge about the same issue. This might be due to lack of experience or updated guidelines on managing drug-drug interactions in this patient population. Factors such as improper AED selection [46], non-adherence to AEDs [47] and drug–drug interactions [48] may impact seizure control and the patient's QoL [49]. Unexpectedly, the participants in this study exhibited a remarkable knowledge gap (48.1% answered correctly) in regards to that most babies were born healthy from a mother with epilepsy, a considerably lower results than Jairoun et al. (69.9%) [29]. There is an urgent need to address the prevailing misconceptions on epilepsy and pregnancy as these are causing fear and anxiety among women with epilepsy who wish to bear children. Most of the participants answered incorrectly about the effect of consuming valproic acid among pregnant women; this is consistent with the study by Mansour et al. [23], as their findings also highlighted better training and education for the pharmacists to address the knowledge gap occurred regarding the proper AEDs regimen especially valproic acid for pregnant WWE. Similarly, these results are supported by Roth et al. [19].

In our study, individuals who reported receiving training on epilepsy and AEDs were more likely to achieve adequate knowledge levels, both in univariate and regression analyses, while no significant differences in epilepsy-related knowledge were shown on the basis of other demographic and professional characteristics of the participants (including gender, location of practice, type of pharmacy, years of professional experience, working hours/day and mean number of patients served/day). Conversely, Roth et al. [19] showed that the more time passed since the graduation of pharmacists, the larger the epilepsy-related knowledge gap, especially when they did not receive continuous training and education which lead to the absence of updated knowledge about epilepsy and AEDs. Meanwhile Jairoun et al. showed that with extensive work experience (> 15 years) contributed to significantly higher scores on the topic of women's issues in epilepsy [29]. The same study also established the effect having training on epilepsy and AEDs had on knowledge-levels. The findings of this study show that receiving training specifically on epilepsy significantly improved pharmacists' knowledge of women's issues in epilepsy. It is important to acknowledge that challenges exist not only for women with epilepsy but also for healthcare professionals involved in their care [50]. This suggested that having sufficient skills and knowledge may improve pharmacists' efficiency in their performances in counselling patients from all walks of life.

Limitations of the study should be acknowledged, including the relatively small sample size, which affects the generalizability of our findings; nonetheless, the results may provide an important basis to inform advances in pharmaceutical care for women affected by epilepsy, and to plan a wider-ranging, nationally-representative survey of Malaysian pharmacists on this topic. With only pharmacists from Peninsular Malaysia being involved in our research, and the use of a cross-sectional design, drawing a general conclusion on the epilepsy-related knowledge of healthcare professionals may be limited. Furthermore, the limitations include self-reporting, which may introduce biases such as social desirability and recall biases in our research.

5. Conclusions

Despite the concentration of epilepsy-related disease burden in LMICs, there is limited data available on the comprehension and awareness of healthcare professionals regarding women's epilepsy-related issues, which may affect the level of care provided to this vulnerable population. There is a noticeable lack of proactive pursuit of additional skill training or continuous education on epilepsy management among many pharmacists. This gap is particularly pronounced when it comes to addressing the unique needs of female patients. The findings of our pilot study aid the triangulation of evidence in this field, and indicate that community pharmacists in Peninsular Malaysia generally possess an adequate level of knowledge regarding women's issues with epilepsy, although awareness on specific, practical aspects of pharmacotherapy and care remain limited. Results of our study provide valuable information to inform training, healthcare decision making, and the management of patient pathways. The most important determinant of appropriate knowledge-levels in our sampled population were the receipt of training on epilepsy and AEDs, while other studied variables had a limited effect of epilepsy-related competencies. Intensive and comprehensive exposure to the proper management of women with epilepsy would enhance the knowledge and competence of community pharmacists, ultimately improving the quality of pharmaceutical care services in Malaysia. This highlights the importance of implementing tailored educational and hands-on training programs for community pharmacists across Malaysia, including during their undergraduate pharmacy studies and during compulsory CPT activities. Such programs could incorporate workshops and specialized modules focusing on the challenges faced by women with epilepsy (and issues pertaining to women's health, thereby further enhancing the knowledge and competence of pharmacists in this critical area of healthcare.

Supplementary Materials: The following supporting information can be downloaded at: Supplementary Material S1: CHERRIES checklist.

Author Contributions: Conceptualization, S.I., U.I.I., and A.A.J.; Methodology, K.K., M.G., A.A.J. and S.J.; Software, K.K. and M.G.; Validation, M.J.A. and M.G.; Formal Analysis, S.I., U.I.I., L.P.L. and M.G.; Investigation, S.I., U.I.I., L.P.L. and M.J.A.; Resources, A.A.J. and S.J.; Data Curation, S.I., U.I.I., L.P.L. and A.A.J. Writing—Original Draft Preparation, S.I., U.I.I., L.P.L., A.A.J.; Writing—Review and Editing, K.K., M.G., M.J.A. and S.J.; Visualization, S.I. and U.I.I.; Supervision, A.A.J. and S.J.; Project Administration, M.J.A. and M.G.; Funding Acquisition, M.G. and S.J. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Before participating in the study, individuals were informed about the nature and objectives of the study, privacy and anonymity, and confidentiality of their data; participants were made aware that their participation in the research is voluntary, and they may withdraw from the study at any time without any consequences. To protect the privacy and confidentiality of the participants, no identifiable information was recorded during data collection. Before data collec-tion, written informed consent (through the online survey collection platform) were obtained from the patients who agreed to participate. Participants did not receive any incentives (mone-tary or other-wise) to take part in the study. Data collected throughout the study were stored securely, and was accessible only to those involved in the research.

Data Availability Statement: All data generated during the study are presented in this paper.

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Checklist for Reporting Results of Internet E-Surveys (CHERRIES)

Checklist Item	***Explanation***	***Page Number***
Describe survey design	Describe target population, sample frame. Is the sample a convenience sample? (In "open" surveys this is most likely.)	4
IRB approval	Mention whether the study has been approved by an IRB.	5-6
Informed consent	Describe the informed consent process. Where were the participants told the length of time of the survey, which data were stored and where and for how long, who the investigator was, and the purpose of the study?	5-6
Data protection	If any personal information was collected or stored, describe what mechanisms were used to protect unauthorized access.	not relevant
Development and testing	State how the survey was developed, including whether the usability and technical functionality of the electronic questionnaire had been tested before fielding the questionnaire.	4-5
Open survey versus closed survey	An "open survey" is a survey open for each visitor of a site, while a closed survey is only open to a sample which the investigator knows (password-protected survey).	4
Contact mode	Indicate whether or not the initial contact with the potential participants was made on the Internet. (Investigators may also send out questionnaires by mail and allow for Web-based data entry.)	5
Advertising the survey	How/where was the survey announced or advertised? Some examples are offline media (newspapers), or online (mailing lists – If yes, which ones?) or banner ads (Where were these banner ads posted and what did they look like?). It is important to know the wording of the announcement as it will heavily influence who chooses to participate. Ideally the survey announcement should be published as an appendix.	5
Web/E-mail	State the type of e-survey (eg, one posted on a Web site, or one sent out through e-mail). If it is an e-mail survey, were the responses entered manually into a database, or was there an automatic method for capturing responses?	5
Context	Describe the Web site (for mailing list/newsgroup) in which the survey was posted. What is the Web site about, who is visiting it, what are visitors normally looking for? Discuss to what degree the content of the Web site could pre-select the sample or influence the results. For example, a survey about vaccination on a anti-immunization Web site will have different results from a Web survey conducted on a government Web site	4-5
Mandatory/voluntary	Was it a mandatory survey to be filled in by every visitor who wanted to enter the Web site, or was it a voluntary survey?	5-6
Incentives	Were any incentives offered (eg, monetary, prizes, or non-monetary incentives such as an offer to provide the survey results)?	6
Time/Date	In what timeframe were the data collected?	4
Randomization of items or questionnaires	To prevent biases items can be randomized or alternated.	4
Adaptive questioning	Use adaptive questioning (certain items, or only conditionally displayed based on responses to other items) to reduce number and complexity of the questions.	5
Number of Items	What was the number of questionnaire items per page? The number of items is an important factor for the completion rate.	5
Number of screens (pages)	Over how many pages was the questionnaire distributed? The number of items is an important factor for the completion rate.	5

Completeness check	It is technically possible to do consistency or completeness checks before the questionnaire is submitted. Was this done, and if "yes", how (usually JAVAScript)? An alternative is to check for completeness after the questionnaire has been submitted (and highlight mandatory items). If this has been done, it should be reported. All items should provide a non-response option such as "not applicable" or "rather not say", and selection of one response option should be enforced.	5
Review step	State whether respondents were able to review and change their answers (eg, through a Back button or a Review step which displays a summary of the responses and asks the respondents if they are correct).	5
Unique site visitor	If you provide view rates or participation rates, you need to define how you determined a unique visitor. There are different techniques available, based on IP addresses or cookies or both.	5
View rate (Ratio of unique survey visitors/unique site visitors)	Requires counting unique visitors to the first page of the survey, divided by the number of unique site visitors (not page views!). It is not unusual to have view rates of less than 0.1 % if the survey is voluntary.	not relevant
Participation rate (Ratio of unique visitors who agreed to participate/unique first survey page visitors)	Count the unique number of people who filled in the first survey page (or agreed to participate, for example by checking a checkbox), divided by visitors who visit the first page of the survey (or the informed consents page, if present). This can also be called "recruitment" rate.	6
Completion rate (Ratio of users who finished the survey/users who agreed to participate)	The number of people submitting the last questionnaire page, divided by the number of people who agreed to participate (or submitted the first survey page). This is only relevant if there is a separate "informed consent" page or if the survey goes over several pages. This is a measure for attrition. Note that "completion" can involve leaving questionnaire items blank. This is not a measure for how completely questionnaires were filled in. (If you need a measure for this, use the word "completeness rate".)	6
Cookies used	Indicate whether cookies were used to assign a unique user identifier to each client computer. If so, mention the page on which the cookie was set and read, and how long the cookie was valid. Were duplicate entries avoided by preventing users access to the survey twice; or were duplicate database entries having the same user ID eliminated before analysis? In the latter case, which entries were kept for analysis (eg, the first entry or the most recent)?	not relevant
IP check	Indicate whether the IP address of the client computer was used to identify potential duplicate entries from the same user. If so, mention the period of time for which no two entries from the same IP address were allowed (eg, 24 hours). Were duplicate entries avoided by preventing users with the same IP address access to the survey twice; or were duplicate database entries having the same IP address within a given period of time eliminated before analysis? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	5
Log file analysis	Indicate whether other techniques to analyze the log file for identification of multiple entries were used. If so, please describe.	not relevant
Registration	In "closed" (non-open) surveys, users need to login first and it is easier to prevent duplicate entries from the same user. Describe how this was done. For example, was the survey never displayed a second time once the user had filled it in, or was the username stored together with the survey	not relevant

	results and later eliminated? If the latter, which entries were kept for analysis (eg, the first entry or the most recent)?	
Handling of incomplete questionnaires	Were only completed questionnaires analyzed? Were questionnaires which terminated early (where, for example, users did not go through all questionnaire pages) also analyzed?	5
Questionnaires submitted with an atypical timestamp	Some investigators may measure the time people needed to fill in a questionnaire and exclude questionnaires that were submitted too soon. Specify the timeframe that was used as a cut-off point, and describe how this point was determined.	not relevant
Statistical correction	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for the non-representative sample; if so, please describe the methods.	not relevant