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ORIGINAL PAPER

The Prevalence and Risk of Polycystic Ovarian Syndrome (PCOS) in Women with Epilepsy: a Systematic Review and Meta-Analysis

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ABSTRACT

Background: *Women with epilepsy suffer from a wide range of endocrine dysfunctions such as polycystic ovarian syndrome (PCOS). The literature shows various prevalence rates of PCOS in women with epilepsy/seizures. So, we designed this study to estimate the pooled prevalence of PCOS in women with epilepsy/seizures.*

Methods: *PubMed, Scopus, EMBASE, Web of Science and Google Scholar were systematically searched by two independent researchers on March 1st 2023.*

Results: *A literature search revealed 1377 records, of which 120 full-texts were evaluated and finally, 28 studies remained for the present systematic review. Most studies were from India, followed by Finland and Italy. A total of 2587 cases with epilepsy and 607 controls were evaluated. Studies were published between 1984 and 2022. The estimated pooled prevalence of PCOS in women with epilepsy was 19% [95% confidence interval (CI) 14-23%] (I^2=91.7%, p<0.001). The estimated odds ratio of PCOS in women with epilepsy was 3.07 (95% CI 1.94-4.85) (I^2=43.6%, p=0.07). The estimated prevalence of PCOS in women treated with valproic acid (VAL) was 32% (95% CI 20-45%) (I^2=87.9%, P<0.001).*

Conclusion: *The results of this systematic review show that the pooled prevalence of PCOS in women with epilepsy is 19% and the risk of developing PCOS is three-fold higher than in healthy women.*

Keywords: polycystic ovarian syndrome, epilepsy, women.

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INTRODUCTION

Women with epilepsy or seizures suffer from a wide range of reproductive problems such as oligomenorrhoea, amenorrhoea, hyperandrogenism, functional hyperprolactinemia and polycystic ovarian syndrome (PCOS) (1).

Polycystic ovarian syndrome is the cause of infertility, associated with hirsutism, hyperandrogenism, hair loss and obesity (2). It affects 5-10% of the general population (3-5), but the prevalence is higher among women with epilepsy or seizures.

The etiology of PCOS in women with epilepsy or seizure is complex and is considered to be related to epilepsy itself and also to administration of medications (1). It has been reported that the prevalence of PCOS in women with partial seizure is higher than in those with generalized epilepsy, especially in cases with temporal lobe epilepsy (6-9).

Valproic acid (VAL), one of the most common medications administered in epilepsy, is related to hyperandrogenemia and hyperinsulinemia (10). It has been shown that dosage and duration of VAL administration were not associated with PCOS development, while younger age at VAL administration was a risk factor for developing PCOS (1). On the other hand, VAL administration is associated with weight gain and menstrual irregularities in women who are under treatment (11).

The literature shows various prevalence rates of PCOS in women with epilepsy/seizures.

So, we designed this study to estimate the pooled prevalence of PCOS in women with epilepsy/seizures. ❑

METHODS

We followed Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 for reporting our systematic review and meta-analysis (12).

Eligibility criteria

Inclusion criteria comprised cross-sectional studies or cohort studies reporting prevalence of PCOS in women with epilepsy. Case-control, letters to the editors and case reports were excluded.

Information sources

PubMed, Scopus, EMBASE, Web of Science and Google Scholar were systematically searched by two independent researchers on March 1st 2023. They also searched the gray literature, including theses, references of included studies and conference abstracts (Supplementary Table 1).

SUPPLEMENTARY TABLE 1. Search strategy

((Epilepsy[MeSH Terms]) OR (Seizures[MeSH Terms])) OR (Seizure*[Text Word])) OR (Single Seizure*[Text Word])) OR (Seizure, Single[Text Word])) OR (Seizures, Somatosensory[Text Word])) OR (Seizure, Somatosensory[Text Word])) OR (Somatosensory Seizure*[Text Word])) OR (Seizures, Vertiginous[Text Word])) OR (Seizure, Vertiginous[Text Word])) OR (Vertiginous Seizure*[Text Word])) OR (Seizures, Vestibular[Text Word])) OR (Seizure, Vestibular[Text Word])) OR (Vestibular Seizure*[Text Word])) OR (Seizures, Visual[Text Word])) OR (Seizure, Visual[Text Word])) OR (Visual Seizure*[Text Word])) OR (Nonepileptic Seizure*[Text Word])) OR (Seizure, Nonepileptic[Text Word])) OR (Seizures, Nonepileptic[Text Word])) OR (Non-Epileptic Seizure*[Text Word])) OR (Non Epileptic Seizure*[Text Word])) OR (Seizure, Non-Epileptic[Text Word])) OR (Generalized Absence Seizure*[Text Word])) OR (Absence Seizure, Generalized[Text Word])) OR (Absence Seizures, Generalized[Text Word])) OR (Seizure, Generalized Absence[Text Word])) OR (Tonic-Clonic Seizure*[Text Word])) OR (Seizure, Tonic-Clonic[Text Word])) OR (Tonic Clonic Seizure*[Text Word])) OR (Clonic Seizure, Tonic[Text Word])) OR (Clonic Seizures, Tonic[Text Word])) OR (Seizure, Tonic Clonic[Text Word])) OR (Seizures, Tonic-Clonic[Text Word])) OR (Generalized Tonic-Clonic Seizure*[Text Word])) OR (Generalized Tonic Clonic Seizure*[Text Word])) OR (Seizure, Generalized Tonic-Clonic[Text Word])) OR (Seizures, Generalized Tonic-Clonic[Text Word])) OR (Tonic-Clonic Seizure, Generalized[Text Word])) OR (Tonic-Clonic Seizures, Generalized[Text Word])) OR (Clonic Seizure*[Text Word])) OR (Seizure, Clonic[Text Word])) OR (Seizures, Clonic[Text Word])) OR (Tonic Seizure*[Text Word])) OR (Seizure, Tonic[Text Word])) OR (Seizures, Tonic[Text Word])) OR (Convulsion, Non-Epileptic[Text Word])) OR (Convulsion, Non Epileptic[Text Word])) OR (Convulsions, Non-Epileptic[Text Word])) OR (Non-Epileptic Convulsion*[Text Word])) OR (Convulsion*[Text Word])) OR (Atonic Absence Seizure*[Text Word])) OR (Absence Seizure, Atonic[Text Word])) OR (Absence Seizures, Atonic[Text Word])) OR (Seizure, Atonic Absence[Text Word])) OR (Convulsive Seizure*[Text Word])) OR (Seizure, Convulsive[Text Word])) OR (Seizures, Convulsive[Text Word])) OR (Seizures, Motor[Text Word])) OR (Motor Seizure*[Text Word])) OR (Seizure, Motor[Text Word])) OR (Jacksonian Seizure[Text Word])) OR (Seizure, Jacksonian[Text Word])) OR (Seizures, Auditory[Text Word])) OR (Auditory Seizure*[Text Word])) OR (Seizure, Auditory[Text Word])) OR (Seizures, Focal[Text Word])) OR (Focal Seizure*[Text Word])) OR (Seizure, Focal[Text Word])) OR (Partial Seizure*[Text Word])) OR (Seizure, Partial[Text Word])) OR (Seizures, Generalized[Text Word])) OR (Generalized Seizure*[Text Word])) OR (Seizure, Generalized[Text Word])) OR (Seizures, Gustatory[Text Word])) OR (Gustatory Seizure*[Text Word])) OR (Seizure, Gustatory[Text Word])) OR (Seizures, Olfactory[Text Word])) OR (Olfactory Seizure*[Text Word])) OR (Seizure, Olfactory[Text Word])) OR (Myoclonic Seizure*[Text Word])) OR (Seizure, Myoclonic[Text Word])) OR (Epileptic Seizure*[Text Word])) OR (Seizure, Epileptic[Text Word])) OR (Seizures, Epileptic[Text Word])) OR (Seizures, Sensory[Text Word])) OR (Seizure, Sensory[Text Word])) OR (Sensory Seizure*[Text Word])) OR (Absence Seizure*[Text Word])) OR (Seizure, Absence[Text Word])) OR (Petit Mal Convulsion[Text Word])) OR (Convulsion, Petit Mal[Text Word])) OR (Complex Partial Seizure*[Text Word])) OR (Partial Seizure, Complex[Text Word])) OR (Partial Seizures, Complex[Text Word])) OR (Seizure, Complex Partial[Text Word])) OR (Atonic Seizure*[Text Word])) OR (Seizure, Atonic[Text Word])) OR (Epileps*[Text Word])) OR (Seizure Disorder*[Text Word])) OR (Awakening Epilepsy[Text Word])) OR (Epilepsy, Awakening[Text Word])) OR (Epilepsy, Cryptogenic[Text Word])) OR (Cryptogenic Epileps*[Text Word])) OR (Epilepsies, Cryptogenic[Text Word])) OR (Aura*[Text Word])) AND (((((((((((((((((Polycystic Ovary Syndrome[MeSH Terms]) OR (Polycystic Ovary Syndrome[Text Word])) OR (polycystic ovar*[Text Word])) OR (Sclerocystic Ovar*[Text Word])) OR (PCO[Text Word])) OR (PCOS[Text Word])) OR (Ovary Syndrome, Polycystic[Text Word])) OR (Syndrome, Polycystic Ovary[Text Word])) OR (Stein-Leventhal Syndrome[Text Word])) OR (Stein Leventhal Syndrome[Text Word])) OR (Syndrome, Stein-Leventhal[Text Word])) OR (Sclerocystic Ovarian Degeneration[Text Word])) OR (Ovarian Degeneration, Sclerocystic[Text Word])) OR (Sclerocystic Ovary Syndrome[Text Word])) OR (Polycystic Ovarian Syndrome[Text Word])) OR (Ovarian Syndrome, Polycystic[Text Word])) OR (Polycystic Ovary Syndrome 1[Text Word])) OR (Ovary, Sclerocystic[Text Word]))

Selection process and collection

After obtaining the relevant studies, results were imported to ENDNOTE. Duplicates were deleted, then titles and abstracts of potential studies were assessed. Potential full texts were obtained and evaluated. Data were then extracted and entered in the Excel file by two independent researchers. If discrepancies were present, the third researcher solved the issue.

Data items

The first author of the published article, country of the study, publication year, number of study participants, type of epilepsy, study design, mean duration of the disease, type of medications, number of controls, frequency of PCOs in controls were extracted.

Study risk of bias assessment

Newcastle–Ottawa scale (NOS) checklist for cross sectional studies or cohort studies was used to assess the risk of potential bias in included studies (13, 14).

Effect measures

We estimated the pooled prevalence and odds of PCOS in women with epilepsy (extracted data from studies including controls).

Synthesis methods

We extracted the prevalence of PCOS in included studies and the pooled prevalence based on *per* 100,000 population. We also assessed heterogeneity by the I-square index (I^2). Random effect model was used.

All statistical analysis were done using STATA (Version 14.0; Stata Corp LP, College Station, TX, USA). P-values less than 0.05 were considered significant.

Pooled odds ratio (OR) was estimated for developing PCOS in women with epilepsy (compared to controls).

Certainty assessment

For all estimated effect sizes, we reported 95% CI. ❑

RESULTS

A literature search revealed 1377 records, 120 full-texts were evaluated and finally, 28 studies remained for systematic review (Figure 1).

Most studies were from India, followed by Finland and Italy. A total of 2587 cases with epilepsy and 607 controls were evaluated. Studies were published between 1984 and 2022 (Table 1).

The estimated pooled prevalence of PCOS in women with epilepsy was 19% (95% CI 14-23%) (I^2=91.7%, p<0.001) (Figure 2).

Nine studies included controls, so we could estimate the OR of PCOS in women with epilepsy, which was 3.07 (95% CI 1.94-4.85) (I^2=43.6%, p=0.07) (Figure 3).

The estimated prevalence of PCOS in women treated with VAL was 32% (95% CI 20-45%) (I^2=87.9%, P<0.001) (Figure 4). ❑

DISCUSSION

To our knowledge, this is the first systematic review and meta-analysis reporting the pooled prevalence of PCOS in women with epilepsy. Our results show that, in women with epilepsy, the pooled prevalence of PCOS is 19% and the OR of PCOS is three-fold higher in women with epilepsy than healthy ones.

Bilo *et al* evaluated fifty women with epilepsy and found that the prevalence of PCOS among them was 26% (15). In another study, the estimated prevalence of PCOS in Chinese women with epilepsy was 12.7%, which is 2-3 fold higher than the general population (1). This rate is similar to the rate of Indian women (11.8%) (16). In a study by Zhou *et al*, the estimated incidence of PCOS in women with epilepsy was 34% (1).

The exact etiology of PCOS in women with epilepsy is not clearly defined. However, electrical discharges during seizures may alter the secretion of pituitary and gonadal hormones, resulting in endocrine dysfunction(17).

Some studies in Western countries showed that reproductive endocrine and sexual dysfunction in women with epilepsy was more prevalent than in those with general epilepsy, especially in women with temporal lobe lesions (8, 9, 18, 19), while other studies did not confirm these findings. Two Italian and Austrian studies showed that the rate of reproductive endocrine disorders did not differ significantly in women with various types of seizure (20, 21).

We also found that the pooled prevalence of PCOS in women who are under treatment with

VAL is 32%. It is well known that VAL may change serum level of endocrine hormones which may result in reproductive dysfunction such as developing PCOS (22, 23). An Indian study showed an increased incidence of menstrual disturbance and PCOS by two years of VAL administration (24).

TABLE 1. Study characteristics and sample description

Author	Year	Country	Study design	PCOS criteria	Drugs	Number of cases	Epilepsy type	Mean age of cases	No. of controls	Mean age of control	Quality assessment
Ayyagari et al (15)	2012	India	Cross sectional	Rotterdam criteria	CBZ, VAL, DPH	60 (20 CBZ, 20 VAL, 20 DPH)			20		7/9
Bauer et al (16)	2000	Germany	Cross sectional	Fox criteria	CBZ, VAL	93 (20 CBZ, 18 VAL, 36 polytherapy)	All focal epilepsy				8/9
Betts et al (17)	2003	UK	Cross sectional	Speroff L, Glass R and Kase N. *Clinical Gynecological Endocrinology and Infertility*, 6th ed. criteria		105 (54 VAL, 51 LTG or CBZ)			50		7/9
Bilo et al (18)	2001	Italy	Cross sectional	PCOS was diagnosed in the presence of echographic picture of polycystic ovaries, irregular menstrual pattern, clinical and/or biochemical hyperandrogenism, and exclusion of other diseases leading to this picture	PHN, CBZ, VAL	50 (9 PHN, 7 CBZ, 3 VAL, 15 polytherapy)	25 generalized, 25 focal	23.4±6.2	18	27.4±5.6	7/9
Chen et al (19)	2019	China	Cross sectional			119		With PCOS: 20.2±4.6 Without PCOS: 24.7±8.3			-
El-Khayat et al (20)	2004	Egypt	Cross sectional	National Institutes of Child Health and Human Development (NICHHD)	17 CBZ, 15 VAL, 34 polytherapy	66	42 focal with secondary generalization, 17 generalized, 7 focal	13.47±3.53			8/9
Erdogan et al (21)	2011	Turkey	Cross sectional	European Society of Human Reproduction and Embryology (ESHRE) guidelines	34 VAL, 14 CBZ	48	39 idiopathic generalized epilepsy with tonic-clonic seizures, 9 cryptogenic generalized tonic-clonic epilepsy	24.2±5.5			8/9
Gorkemli et al (22)	2009	Turkey	Cross sectional	2003 ESHRE/ASRM revised Rotterdam criteria	40 VAL, 31 non-VAL	71	45 generalized, 20 partial onset	Median (range) 21 (17-39)			7/9
Herzog et al (23)	1984	Israel	Cross sectional	A history of oligomenorrhea and hirsutism, with androgen and LH elevation, or the finding of ovarian cysts by laparotomy, laparoscopy, or ultrasound		20	All complex partial seizures	27.2±3.56			7/9
Herzog et al (24)	1986	Israel	Cross sectional			50	All partial seizures				6/9
Ilic et al (25)	2010	Serbia	Prospecti ve study	Hyperandrogenism combined with oligomenorrhea (cycle length >35 days) or amenorrhea	30 VAL, 30 CBZ, 30 LTG	90					-
Kalinin et al (26)	2007	Russia	Cross sectional			80	13 catamenial seizure, 67 non-catamenial seizure	26.13±7.12			7/9
Lekomtsev a et al (27)	2010	Ukraine	Cross sectional			30	11 catamenial epilepsy, 19 non-catamenial epilepsy				7/9

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Lofgren et al (28)	2007	Finland	Cross sectional	The diagnosis of PCOS was made after non-PCOS causes of hyperandrogenism had been excluded and two of the three following criteria were fulfilled: appearance of PCO on the ultrasonogram, elevated serum testosterone levels and irregular (oligo-/amenorrhea) menstrual cycles	67 CBZ, 48 VAL, 2 DPH	148	90 localization-related epilepsy, 57 idiopathic generalized epilepsy, 1 non-defined	30.1±6.6	170	33.3±5.0	8/9
Lofgren et al (29)	2006	Finland	Cross sectional	Rotterdam criteria	19 OXC, 16 CBZ	35	4 idiopathic generalized epilepsy, 12 localization-related epilepsy		36	30	8/9
Luef et al (30)	2002	Austria	Cross sectional	NTH/NICHD conference criteria	22 VAL, 21 non-VAL	43	24 idiopathic generalized epilepsy, 19 partial epilepsy	31±5			7/9
Maggio et al (31)	2010	Italy	Cross sectional		30 VAL	30					-
Mikkonen et al (32)	2004	Finland	Cross sectional	Homburg criteria	7 VAL, 20 other medication, 42 without medication	69	18 partial, 27 partial secondary generalized, 24 primary generalized		51		7/9
Murialdo et al (33)	1997	Italy	Cross sectional		20 CBZ, 19 PHN, 11 VAL, 3 DPH	101	65 partial epilepsy, 36 idiopathic generalized epilepsy	28.4±7.9			7/9
Ogunjimi et al (34)	2021	Nigeria	Cross sectional	Rotterdam criteria	50 CBZ, 50 LEV	100	40 focal to bilateral tonic-clonic, 32 generalized, 16 focal, 12 unclassified		50		7/9
Prabhakar et al (35)	2007	India	Cohort	PCOS, *i.e.*, the coexistence of menstrual abnormalities with hyperandrogenism or hyperandrogenemia, was diagnosed using the criteria laid down at NIH conference (Zawadski and Dunaif, 1992)	25 VAL	25	All generalized epilepsy	18.3±3.7			8/9
Sahota et al (36)	2008	India	Cross sectional	criteria laid down at NIH conference (Zawadski & Dunaif, 1992)	169 VAL, 118 CBZ, 131 DPH, 8 PHN	427	229 primary generalized, 60 partial with secondary generalization, 14 complex partial, 4 simple partial, 120 unclassified	22.1±6.6			7/9
Sidhu et al (11)	2018	India	Cohort	Rotterdam criteria	30 VAL, 27 LTG	57	25 generalized motor, 20 focal aware, 11 focal motor seizure, 7 focal impaired awareness, 3 awareness unknown				7/9
Zhou et al (1)	2012	China	Cross sectional	PCOS was diagnosed based on a coexistence of two or more of: polycystic ovaries, hyperandrogenism, and a/ oligomenorrhoea	21 VAL, 13 CBZ, 6 LTG, 5 TPM, 4 OXC, 23 multidrug therapy	102	60 primary generalized seizure / partial with secondary generalized seizure 17 simple partial seizure / complex partial seizure	22.0±6.9			8/9

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Ahmad et al (37)	2021	India	Cross sectional	Rotterdam criteria	35 VAL, 28 DPH	63		VAL: 23.02±3.48 DPH: 21.71±2.48	43	23.27±3.64	7/9
Amini et al (38)	2018	Iran	Cross sectional			169			169		7/9
Lai et al (39)	2022	China	Cross sectional	Rotterdam criteria		248	103 focal impaired awareness seizure, 51 focal impaired awareness seizure progressed to bilateral tonic–clonic seizure, 17 focal aware seizure, 11 focal aware seizure progressed to bilateral tonic-clonic seizure, 61 generalized-onset seizure, 5 unknown-onset seizure	Median (IQR) 23.5 (19-29)			7/9
de Vries et al (40)	2007	Israel	Cross sectional	Gungor criteria	43 VAL, 45 untreated	88	61 generalized seizure, 25 partial epilepsy	VAL: 14.9±3.3 Untreated: 13.3±3.2			8/9

PCOS=polycystic ovarian syndrome; VAL=valproate; DPH=phenytoin; CBZ=carbamazepine; LTG=lamotrigine; PHN=phenobarbital; LEV=levetiracetam; TPM=topiramate; OXC=oxcarbazepine; PRM=primidone.

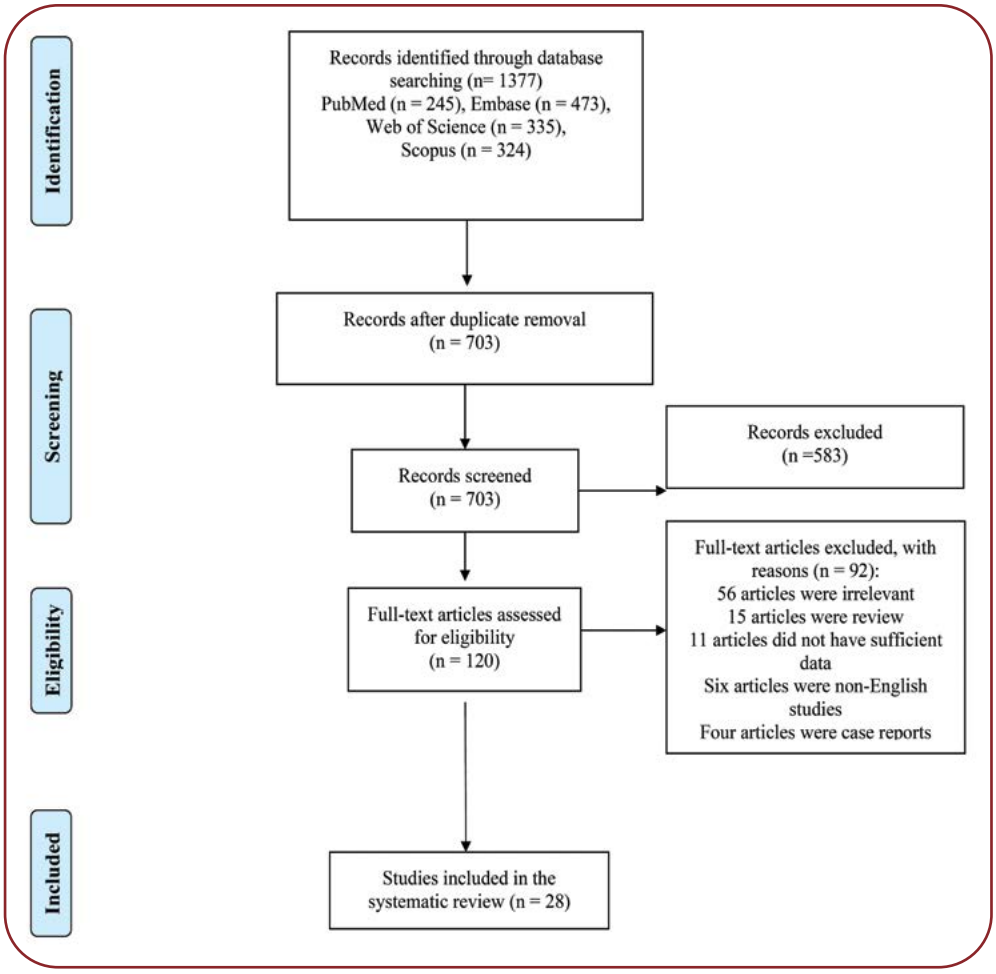

FIGURE 1. Flow chart of study inclusion

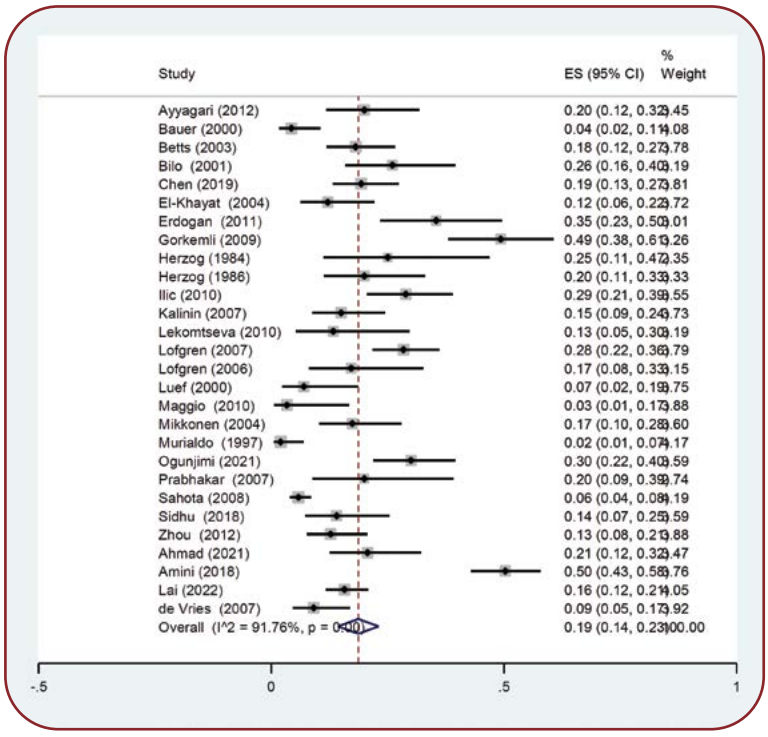

FIGURE 2. Estimated pooled prevalence of polycystic ovarian syndrome in women with epilepsy

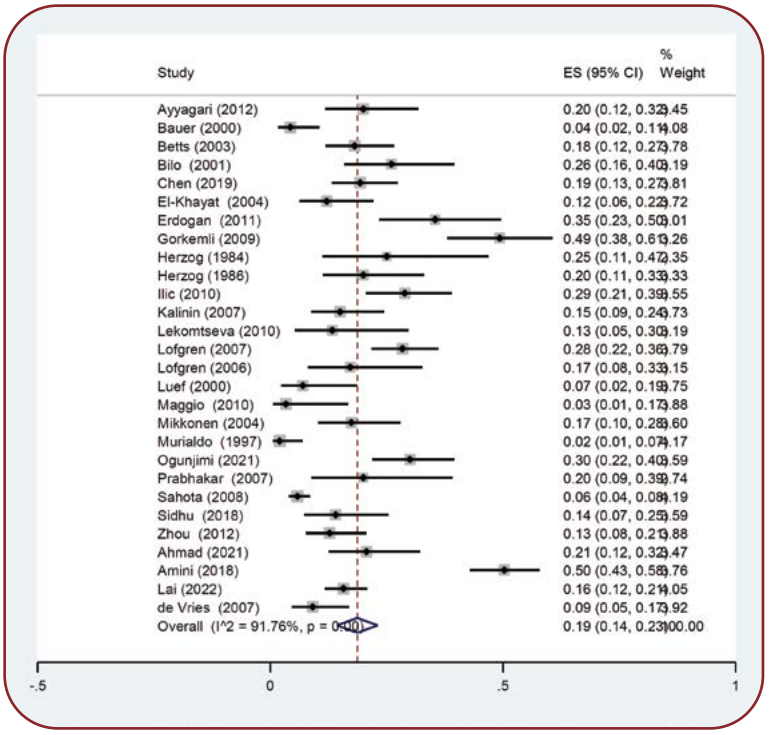

FIGURE 3. Estimated odds ratio of polycystic ovarian syndrome in women with epilepsy

The prevalence of PCOS in studies included in the present review varies significantly as PCOS development differs based on race and ethnicity as obesity, metabolic disorders and other factors play a role (1). Another factor is the various diagnostic criteria used in different studies.

PCOS is an important issue to be considered in women of reproductive age as it is one of the main causes of infertility (25) which is associated with depression, anxiety and sexual dysfunction (26). Sexual dysfunction estimated to be 2.8-fold higher in women with PCOS

TABLE 2. Polycystic ovarian syndrome (PCOS) frequency and treatment exposure details

Authors, reference	PCOS in cases	PCOS in control	Mean drug dose (mg)	Seizure duration (year)	Drug duration (year)
Ayyagari et al (15)	CBZ: 4 VAL: 6 DPH: 2	3	CBZ: 640±264.4 VAL: 645±270.9 DPH: 260±59.8	CBZ: 7.68±6.79 VAL: 6.43±4.67 DPH: 7.29±6.14	CBZ: 5.485±3.506 VAL: 4.88±4.63 DPH: 4.51±4.55
Bauer et al (16)	CBZ: 2 VAL: 2 No medication: 2		Daily CBZ: 1447 VAL: 1414		
Betts et al (17)	VAL: 16; LTG or CBZ: 3	7			
Bilo et al (18)	13	0			
Chen et al (19)	23				
El-Khayat et al (20)	8				
Erdogan et al (21)	VAL: 14 CBZ: 3			VAL: 6.9±4.6 CBZ: 7.4±5.3	Months VAL: 45.5±28 CBZ: 52.5±33.2
Gorkemli et al (22)	VAL: 25; non-VAL: 10				
Herzog et al (23)	5				
Herzog et al (24)	10				
Ilic et al (25)	VAL: 13; CBZ: 8; LTG: 5				
Kalinin et al (26)	2 catamenial epilepsy, 10 non-catamenial epilepsy				
Lekomtseva et al (27)	2 catamenial epilepsy, 2 non-catamenial epilepsy				
Lofgren et al (28)	17 localization-related epilepsy, 25 idiopathic generalized epilepsy	19		14.1±8.4	8.8±6.4
Lofgren et al (29)	4 OXC, 2 CBZ	3			
Luef et al (30)	2 VAL, 1 non-VAL				12±6.6
Maggio et al (31)	0				
Mikkonen et al (32)	VAL: 4; other medication: 5; without medication: 3	6			
Murialdo et al (33)	2			14.9±8.7	
Ogunjimi et al (34)	CBZ: 8, LEV: 22	2			
Prabhakar et al (35)	5		724±150.8	3.3±3.9	
Sahota et al (36)	20 VAL, 5 CBZ, 0 DPH, 1 PHN				
Sidhu et al (11)	VAL: 8; LTG: 0				
Zhou et al (1)	13				
Ahmad et al (37)	VAL: 9; DPH: 4	3			
Amini et al (38)	85	25			
Lai et al (39)	39			Median (IQR): 6 (2-11)	
de Vries et al (40)	VAL: 4; untreated: 4			VAL: 4.6±2.8 Untreated: 2.9±2.8	

PCOS=polycystic ovarian syndrome; VAL=valproate; CBZ=carbamazepine; DPH=phenytoin; LTG=lamotrigine; LEV=levetiracetam; OXC=oxcarbazepine; IQR=interquartile range.

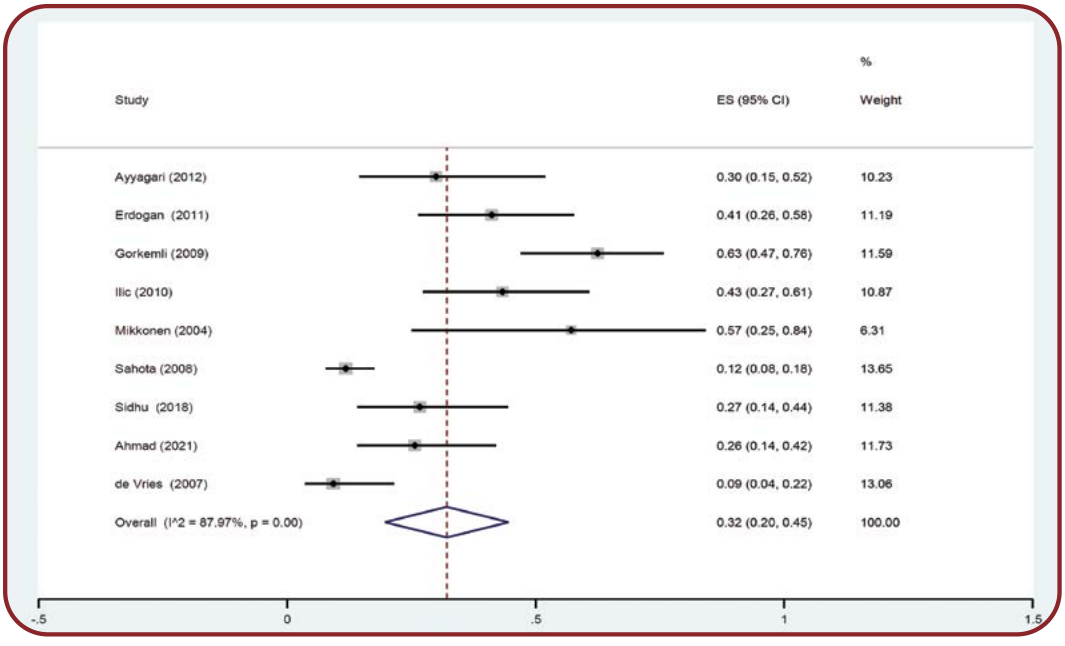

FIGURE 4. Estimated prevalence of polycystic ovarian syndrome in women treated with valproic acid

than healthy controls (27). So, assessment of women for PCOS and proper treatment is necessary.

This systematic review had some strengths. Firstly, it is the first one in the field. Secondly, we included a large body of studies.

It also has some limitations. Firstly, the diagnostic criteria were not the same in all studies. Secondly, not all studies reported the prevalence of PCOS in all medication subgroups. ❑

CONCLUSION

The results of the present systematic review show that, in women with epilepsy, the pooled prevalence of PCOS is 19% and the risk of developing PCOS is three-fold higher than in healthy women. ❑

Conflicts of interest: none declared.
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