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RESEARCH

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Risk factors-related first episode postpartum psychosis among Egyptian women: the role of psychosocial and the biological factors

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Abstract

Background The risks associated with postpartum psychosis (PP) are poorly recognized in Egyptian women. We aimed to study the role of sociodemographic, psychosocial, obstetric, and biological factors in the occurrence of PP within 4 weeks after delivery in a sample of Egyptian women. We included 60 women with PP and 30 postpartum women without psychosis. All participants underwent a full medical assessment and psychiatric assessment using the Holmes and Rahe Stress Scale, the Brief Psychiatric Rating Scale (BPRS), and hormonal assessment (including estrogen levels and thyroid function tests) were performed for each woman.

Results The mean age of pregnancy of women with PP was significantly younger than that of controls (19.2 ± 2.04 years versus 24.37 ± 4.92 years). PP was significantly more common among primipara (73.3%), women who underwent cesarean sections (58.3%) and had thyroid dysfunction. The rates of low birth weight, and premature delivery were significantly higher among women with PP than among those without PP. The mean time-lapse from parturition to the onset of PP symptoms was 6.11 ± 1.62 days. Sleep disturbance, and irritability symptoms were the earliest symptoms of PP in our study. Plasma estrogen levels were significantly correlated with the total BPRS scores in patients with PP ($P = 0.001$).

Conclusions Young age, primiparity, low birth weight, cesarean delivery, a rapid drop in the estrogen level and thyroid dysfunction all could contribute to the occurrence of PP.

Keywords Postpartum psychosis, Hormone, Risk factors

Background

Although postpartum psychosis (PP) is the most serious mental condition associated with childbirth [1], it is still unknown why some women experience symptoms after childbirth and others do not [2].

Unfortunately, the risks associated with PP are poorly recognized [3]. Several studies have identified several risk factors, including primiparity [4], pregnancy complications [5], obstetric complications [6], cesarean delivery [7], female baby [8], insufficient social support [9], history of affective illness [10], stressful life events [5], estrogen withdrawal [11], and family history of psychosis [12].

PP typically manifests itself within the first few weeks after childbirth; however, it frequently begins within days of delivery [13].

Psychosocial stress and the biological stress system are well-established contributors to the pathogenesis of affective and non-affective psychoses that are unrelated to childbirth. There is evidence of a link between

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childhood abuse and recent stressful life events (i.e., occurring months before the onset of the condition) and psychosis that is unrelated to pregnancy [14, 15], and it has been suggested that the biological stress system may be one of the underlying mechanisms of this link [15].

Prenatal stress and childhood trauma can cause hypothalamic–pituitary–adrenal axis dysregulation and stress-related brain changes, which increase the individual's sensitivity to subsequent psychosocial stress and risk for later psychopathology [15, 16].

It has long been hypothesized, although never proven, that hormones play an important role in the onset of PP [17].

The estrogen-protection hypothesis proposes that estradiol mediates antipsychotic effects in the central nervous system through a different set of mechanisms that are not fully understood [18].

Clinical thyroid dysfunction (transient) has also been identified in females suffering from PP, suggesting that it is an epiphenomenon of the normal physiological postpartum process in these women [19]. Acute psychotic presentations such as psychosis, on the other hand, have the potential to hinder the functioning of the hypothalamic–pituitary–thyroid axis, resulting in what is known as "non-thyroidal illness". Instead of being a sign of actual thyroid disease, this alteration in thyroid function appears to be a response to the underlying acute psychopathological process [20].

To our knowledge, only some studies have been conducted on PP. Still, none have been recorded from Egypt. In addition, the onset of PP was associated with sudden and unexpected drop in the serum estrogen level and the known effects of estrogen and thyroid function on the central nervous system, besides the psychosocial and the biological stress of pregnancy that could be considered risk factors for PP psychosis. We aimed to study the roles of sociodemographic factors, psychosocial factors, obstetric data, and postnatal hormonal changes (estrogen, progesterone, and thyroid hormones) in the pathogenesis of PP within 4 weeks after delivery in a sample of Egyptian women.

Methods

This is a cross-sectional study that was conducted during the period from January 2018 to January 2021. All women delivered at the obstetric department of Aswan University Hospital at this period were asked to do follow up with her relative at the out-patients clinic of department of psychiatry through the first 4 weeks after delivery if there was any psychotic symptom as described before. Sixty females were consecutively recruited with recent of PPP from the outpatient clinic of the psychiatry department, of the Aswan University Hospital. Diagnosis was made by DSM-5 criteria [21]. The inclusion criteria: age ranging from 16 to 35 years old, within the first 4 weeks after delivery with no history of pre-natal psychiatric or neurological disorders, severe infection or drug abuse. Exclusion criteria including: any patient with severe postpartum complications (cardiovascular diseases, infection or sepsis, excessive bleeding after giving birth (hemorrhage), cardiomyopathy, stroke, pulmonary embolism, or anesthesia complications), history of pre-natal psychiatric or neurological disorders, severe infection or drug abuse or women under antipsychotic drugs. Thirty women without any current/lifetime psychiatric diagnosis with the same inclusion and exclusion criteria for patients' group were recruited as a control group.

Our study participants were classified, using DSM 5 criteria of postpartum psychosis to diagnosis and categorization into two groups as follows: Group I was made up of 60 women with PP, and group II (the control group) was made up of 30 postpartum women without psychosis.

Procedure

All participants underwent a full psychiatric and medical assessment:

A semi-structured form was prepared by the investigators to collect sociodemographic and obstetrical data, and the medical history of each participant was reviewed. An assessment of each patient's psychiatric history was done using the DSM-5 criteria as patients experience disorganization, confusion, depersonalization, insomnia, irritability, abnormal thought content (including delusions or hallucinations), and an abnormal mood within the first 2 weeks after childbirth [21].

Sociodemographic variables included age, level of education, past history of psychiatric disorders, and past history of medical and neurological diseases.

The obstetric history included: obstetrical variables such as stillbirth, pre-eclampsia, the birth order (primipara or multipara), obstetrical trauma to the mother, route of delivery (vaginal or cesarean delivery), major congenital anomalies, diabetes mellitus (gestational and pre-gestational diabetes), preterm delivery (< 37 weeks), low birth weight (< 2500 g), (large birth weight ≥ 4500 g), birth trauma to the infant, postpartum hemorrhage, severe neonatal asphyxia (Apgar score one minute after birth), neonatal jaundice, and gender of the neonate. This information was obtained from the mother in the obstetrics and gynecology department, obstetric clinic, and neonatal unit.

Psychometric scales

The Socioeconomic Scale [22]: when determining the social burden and socioeconomic classes, the Socioeconomic Scale is used. This scale is made up of four key variables: the father's and mother's levels of education, their occupations, the total family income, and their way of life.

The Holmes and Rahe Stress Scale (stressful life event scale) [23]: it entails identifying frequent stressful occurrences and randomly attributing a value of 50 "life-changing units." It is a parameter used to quantify the impact of a wide variety of common stressors. The scale is based on the observation that significant life events (whether positive or negative) such as marriages or the death of close friends, all result in stress.

A total score of 150 or less is good, indicating low stress and a low risk of stress-related disorders. A score of 300 and above is associated with a nearly 80% chance of getting sick soon. A score of between 150 and 299 is associated with an approximately 50% chance of falling sick.

Brief Psychiatric Rating Scale (BPRS) expanded version (4.0) [24]

It is used to monitor the progress of psychotic patients and covers a wide range of symptoms, including thought disturbances, emotional withdrawal, retardation, anxiety, depression, hostility, and suspiciousness. This test has 24 items that are scored from 1 to 7 on a seven-point Likert scale, with a possible total score of 24–168 points. We used to cut point equal 30 to distinguish as previous study reported "mildly ill" corresponded to a BPRS total score of 31, "moderately ill" to a BPRS score of 41, and "markedly ill" to a BPRS score of 53 [25].

Laboratory investigations

Serum hormonal essay: a 10-ml blood sample was collected via venipuncture from the antecubital space using a vacutainer tube. The blood was immediately centrifuged to separate the serum, which was stored at − 25 °C for subsequent assays.

The serum levels of estrogen (E2), progesterone (p), free T3, T4, and TSH were assayed in the biochemistry laboratory of the clinical pathology department of the Aswan University Hospital.

Serum estrogen levels: it was assayed by automated competitive immunoassay direct chemiluminescence using the VIDAS Estradiol II kit (Biomerieux SA Corporation). The minimum sensitivity and range of this assay were 9–3000 pg/ml.

Serum progesterone levels (p): it was assayed by automated competitive immunoassay direct chemiluminescence using the VIDAS Progesterone (PRG) kit (Biomerieux SA Corporation). The minimum sensitivity and range of this assay were 0.25–80 ng/ml.

Serum levels of thyroid hormones (free T3, T4, TSH): it was assayed by automated competitive immunoassay direct chemiluminescence using the VIDAS FT3 kit (Biomeriex SA Corporation) with a range of 1.8–4.6 pg/ml, VIDAS FT4 kit (Biomerieux SA Corporation) with a range of 0.93–1.79 ng/dl, the VIDAS TSH kit (Biomerieux SA Corporation) with a range of 0.25–5.0 uIU/ml. Patients with abnormal serum levels of the three hormones were considered to have thyroid dysfunction.

Statistical analysis

Quantitative variables were presented using mean values with standard deviations for normally distributed data and median values with interquartile ranges for variables with skewed data distributions. The Mann–Whitney *U* test was used to compare quantitative variables with skewed data distributions, respectively. The Chi-square test was used to compare proportions between categorical variables while spearman correlation coefficient was used to quantify the correlation between two quantitative variables in one group. Also, we used linear regression to identify possible risk factors of postpartum psychosis. We used a statistical software program (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp) for data analysis. *P*-values of less than 0.05 were considered statistically significant.

Results

Characteristics of the study participants: patients with PP were younger and married earlier than those in the control group. Most of our study participants were illiterate, housewives, and non-smokers, and there were no significant differences in these categories between the two groups (Table 1).

Most of our study participants had marriages in which they wanted kids and lived with the fathers of their children.

There was a statistically significant difference in the parity, type of delivery, rate of maternal diabetes, gestational age (LGA), birth weight, and the rate of prematurity (gestational age at delivery < 37 weeks) between the two groups. There were significantly more patients with PP among primipara (73.3%), those who underwent cesarean sections (58.3%) than those without PP. The rates of low birth weight (birth weight < 2500 g), and preterm deliveries (delivery at < 37 weeks of gestation) were significantly higher among women with PP than among those without PP. In contrast, diabetes was higher in women without PP than those with PP (Table 2).

Table 1 Sociodemographic among studied groups

	Patients (*n* = 60) ***N* (%)**	**Controls (*n* = 30)** ***N* (%)**	***P*-value**
Age (mean ± SD)	19.2 ± 2.04	24.37 ± 4.92	0.001*
Age of marriage (mean ± SD)	17.35 ± 1.65	21.27 ± 3.76	0.001*
Educational level			
Illiterate	21 (35)	10 (33.3)	0.96
Low educational level ≤ 9 educational years	18 (30)	8 (26.7)	
Moderate educational level 10–12 educational years	17 (28.3)	10 (33.3)	
High educational level > 12 educational years	4 (6.7)	2 (6.7)	
Occupation			
Housewife	52 (86.7)	25 (83.3)	0.75
Working	8 (13.3)	5 (16.7)	
Residence			
Rural	37 (61.7)	19 (63.3)	0.87
Urban	23 (38.3)	11 (36.7)	
Smoking			
Active smoking	5 (8.3)	2 (6.7)	0.93
Passive smoking	20 (33.3)	11 (36.7)	
Nonsmoker	35 (58.3)	17 (56.7)	
Socioeconomic level			
Low	40 (66.7)	19 (63.3)	0.06
Middle	18 (30)	6 (20)	
High	2 (3.3)	5 (16.7)	
Family history of psychiatric illness			
Absent history of psychiatric illness	52 (86.7)	29 (96.7)	0.26
Presence of history of psychiatric illness	8 (13.3)	1 (3.3)	
Mood disorders	6 (10)	1 (3.3)	
Psychosis	2 (3.3)	0(0)	
Family history of postpartum psychosis			
Present	1 (1.7)	0 (0)	0.47
Absent	59 (98.3)	30 (100)	
Type of marriage			
Arranged marriage	41 (68.33)	19 (63.33)	0.64
Loved marriage	19 (31.66)	11 (36.66)	
Father of child			
Father of infant living with mother	51 (85)	25 (83.3)	0.83
Father of infant not living with mother	9 (15)	5 (16.7)	
Pregnancy status			
Wanted pregnancy	55 (91.7)	28 (93.3)	0.78
Unwanted pregnancy	5 (8.3)	2 (6.7)	

*significant *P* value

The mean time-lapse from parturition to the onset of PP symptoms was 6.11 ± 1.62 days. Sleep disturbances and irritability are the earliest symptoms of PP followed by anxiety, confusion, and somatic complaints (Table 3).

Holmes and Rahe Stress Scale: there was significant difference in the Holmes and Rahe Stress Scale scores between the two groups. The frequency of stressful events in women with PP was classified into: mild score (33.3%), moderate score (38.3%), and high score (28.3%). In contrast, the frequency of stressful events in the control group was mild score (60%), moderate score (20%) and high score (20%) (see Table 4).

Hormonal essay among studied groups: the mean level of estrogen was significantly lower in women with PP than in women without PP ($P < 0.001$). A higher percent of thyroid dysfunction was recorded among

Table 2 Obstetric history among studied groups

	Patients ($n=60$) *N* (%)	Controls ($n=30$) *N* (%)	*P*-value
Parity history			
Primipara	44 (73.3)	14 (46.7)	0.019*
Multipara	16 (26.7)	16 (53.3)	
Type of delivery			
Caesarian section	35 (58.3)	1 (3.3)	< 0.001*
Vaginal delivery	25 (41.7)	29 (96.7)	
History of postpartum hemorrhage	1 (1.7)	0 (0)	0.477
Pre-eclampsia	3 (5)	2 (6.7)	0.745
Diabetic	2 (3.3)	5 (16.7)	0.039*
Number of births			
Multiple birth	3 (5)	2 (6.7)	0.745
Single birth	57 (95)	28 (93.3)	
History of still birth	1 (1.7)	0 (0)	0.477
Major congenital anomalies	1 (1.7)	0 (0)	0.477
Infant large for gestational age (L G A)			
Not LG A < 4500 g	58 (96.7)	25 (83.3)	0.039*
Large for gestational age ≥ 4500 g	2 (3.3)	5 (16.7)	
Birth weight			
Low birth weight < 2500	15 (25)	2 (6.7)	0.046*
Birth weight ≥ 2500	45 (75)	28 (93.3)	
Infant variables			
Neonatal jaundice present	5 (8.3)	2 (6.7)	0.781
History of sever birth asphyxia	5 (8.3)	2 (6.7)	0.781
Preterm infant < 37	16 (26.7)	1 (3.3)	0.009*
Normal breast feeding	57 (95)	28 (93.3)	0.745
Male infant	33 (55)	16 (53.3)	0.881

*significant *P* value

Table 3 Early symptoms of postpartum psychosis in patients' group

Early symptoms	No.	%
Confusion	20	33.3
Irritability	39	65.0
Sleep disturbance	40	66.7
Anxiety	35	58.3
Somatic complain	18	30.0

women with PP than among those without PP (see Table 4).

Correlation: correlation analysis between hormonal essay and BPRS in patients with PP was performed, and plasma estrogen levels had a significant correlation with the total BPRS score in patients with PP ($r=-0.666$, $P=0.001$) (see Fig. 1).

Regression study: the linear regression analysis of the Brief Psychiatric Rating Scale with other parameters is demonstrated in Table 5. Women with PP were more likely to be younger ($p=0.0001$), early marriage ($p=0.0001$), delivered by caesarian section ($p=0.0001$), low estrogen ($p=0.0001$) and progesterone ($p=0.015$) or high thyroid level ($p=0.0001$) and had preterm infant ($p=0.0008$), low birth weight ($p=0.047$), and less gestational age ($p=0.021$). In contrast, women with diabetes ($p=0.021$), high parity ($p=0.014$), and belong to high socioeconomic level ($p=0.037$) were less vulnerable for PP.

Discussion

The main finding of the present study was that younger mothers were at a higher risk of developing PP than older mothers. Consistent with the present results, Lopez et al. [5] and Upadhyaya et al. in India [3] also found that that PP was more common in the 18–25 years age group. This is probably because pregnancy is more stressful for younger women who are usually not as psychologically prepared as the older ones for it [26, 27]. In contrast, Valdimarsdóttir et al. and Abdel Latif et al. found

Table 4 Assessment of stressful life events by Holmes and Rahe Stress Scale and hormonal essay among studied groups

	Patients ($n=60$) N(%)	Control ($n=30$) N(%)	*P*-value
High score 300 or more	20 (33.3)	6 (20)	0.014*
Moderate score 150–300	23 (38.3)	6 (20)	
Mild score 150 or less	17 (28.3)	18 (60)	
Estrogen level, mean + SD	53.1 ± 13.92	141.67 ± 21.19	< 0.001*
Progesterone level, mean + SD	2.2 ± 1.05	1.76 ± 0.63	0.06
Thyroid function, number (%)			
Normal thyroid function	49 (81.7)	29 (96.7)	0.048*
Thyroid dysfunction	11 (18.3)	1 (3.3)	
Hypofunction	7 (11.7)	1 (3.3)	0.460
Hyperfunction	4 (6.7)	0 (0)	

*significant *P* value

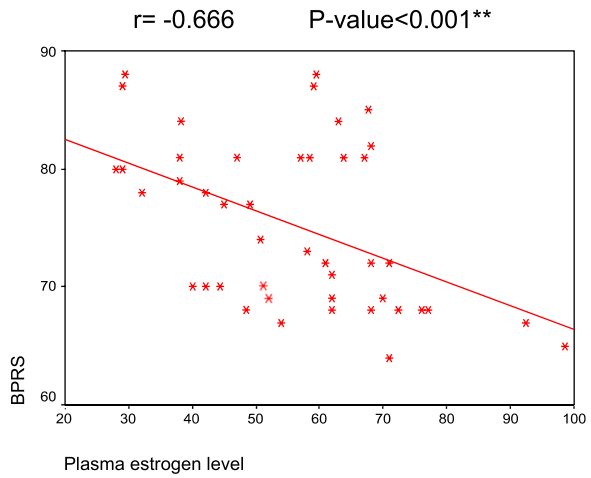

Fig. 1 Correlation between plasma estrogen level and BPRS in patients with postpartum psychosis

that mothers at the age of 35 years or older were at a higher risk of PP [28, 29]. This finding, which is contrary to ours, may be attributed to the higher incidence of medical complications of pregnancy and delivery that is recorded among older mothers than among younger ones; for example, the higher rates of cesarean delivery and preterm birth that may be associated with a slightly increased risk of PP [30].

In this study, there were no statistically significant differences in the occupations, educational levels, socioeconomic profiles, rate of smoking during pregnancy, and residences of the mothers between the two groups. Our finding was in agreement with those of Upadhyaya et al. in India [3]. Furthermore, the high socioeconomic level was considered as a protective factor of PP.

In this study, the mean age of marriage of patients with PP was significantly lower than that of controls. The linear regression model found that women with PP were more likely to be younger and have early marriage. This is probably because getting married too early in life is a stressor for the young woman, and the average adolescent girl is not yet prepared, mentally and psychologically, for the burden of marriage [31]. This finding is in line with those of Upadhyaya et al., Langan et al., and Abdel Latif et al. [3, 29, 32].

Regarding the type of marriage, there are higher rates of PP among women in arranged marriages than among those who married out of love but not significant. This finding is in line with those of Abdel Latif [29].

There were significantly more women with a family history of psychiatric illness among patients with PP than among healthy controls. This finding agreed with studies conducted in different countries [3, 29, 33]

The result of this study showed that primiparity was associated with a higher risk for PP in agreement with other studies [3, 32, 34]. A possible explanation for that finding is that first pregnancies are a greater psychosocial stressor than subsequent ones as the transition to first-time parenthood causes greater stress than having further children with the same explanation reported by Blackmore et al. [6].

In this study, there was a significant higher rate of cesarean delivery among PP than controls, similar with those of Abdel Latif et al., Upadhyaya et al., and Meltzer et al. [3, 29, 35]. Cesarean deliveries are more common in first pregnancies, and most patients with PP are primipara women.

In this study, diabetes mellitus (both gestational and pre-gestational) and neonatal overweight (birth weight of more than 4500 g) appeared as protective factors for PP in regression model. In addition, there was a significantly lower incidence of diabetes mellitus and proportion of overweight infants among patients with PP than among healthy controls, which is in line with the findings of Valdimarsdóttir et al. [28]. This could be explained by the fact that most diabetic mothers tend to have large babies and pregnancies involving large

Table 5 Univariate linear regression analysis of the Brief Psychiatric Rating Scale with other parameters

	B	Std. error	Beta	*t*	*P* value	95% CI	
						Upper bound	Lower bound
Age in years	−5.077	0.733	−0.594	−6.930	0.0001*	−6.533	−3.621
Age of marriage in years	−6.613	0.949	−0.596	−6.970	0.0001*	−8.499	−4.728
Educational level							
Illiterate	1.413	7.778	0.019	0.182	0.856	−14.045	16.871
Low educational level	1.126	8.155	0.015	0.138	0.890	−15.081	17.333
Moderate educational level	−3.164	8.060	−0.042	−0.393	0.696	−19.182	12.854
High educational level	1.833	14.819	0.013	0.124	0.902	−27.616	31.283
Occupation	−4.683	10.504	−0.047	−0.446	0.657	−25.558	16.192
Residence	1.742	7.623	0.024	0.228	0.820	−13.407	16.890
Smoking	−0.895	7.484	−0.013	−0.120	0.905	−15.768	13.978
Socioeconomic level							
Low	2.130	7.776	0.029	0.274	0.785	−13.324	17.584
Middle	8.015	8.316	0.102	0.964	0.338	−8.511	24.541
High	−28.558	13.463	−0.221	−2.121	0.037*	−55.313	−1.802
Family history of psychiatric illness	16.840	12.191	0.146	1.381	0.171	−7.388	41.067
Type of marriage	−3.233	7.835	−0.044	−0.413	0.681	−18.803	12.336
Father of child	−3.190	10.194	−0.033	−0.313	0.755	−23.449	17.069
Pregnancy status	2.114	13.801	0.016	0.153	0.879	−25.314	29.541
Parity history	−18.665	7.462	−0.258	−2.501	0.014*	−33.495	−3.835
Type of delivery	36.833	6.444	0.520	5.716	0.0001*	24.027	49.640
History of postpartum hemorrhage	14.539	35.234	0.044	0.413	0.681	−55.480	84.559
Pre-eclampsia	−9.976	16.104	−0.066	−0.620	0.537	−41.980	22.027
Diabetic	−31.501	13.389	−0.243	−2.353	0.021*	−58.108	−4.894
Number of births	−9.976	16.104	−0.066	−0.620	0.537	−41.980	22.027
Still birth	14.539	35.234	0.044	0.413	0.681	−55.480	84.559
Large for gestational age (L G A)	−31.501	13.389	−0.243	−2.353	0.021*	−58.108	−4.894
Birth weight	−18.596	9.234	−0.210	−2.014	0.047*	−36.947	−0.245
Neonatal jaundice present	1.959	13.802	0.015	0.142	0.887	−25.469	29.387
History of sever birth asphyxia	1.959	13.802	0.015	0.142	0.887	−25.469	29.387
Preterm infant	24.543	9.075	0.277	2.704	0.008*	6.508	42.578
Normal breast feeding	5.106	16.130	0.034	0.317	0.752	−26.949	37.161
Male infant	0.740	7.423	0.011	0.100	0.921	−14.011	15.491
Holmes and Rahe Stress Scale							
High score	−20.842	7.251	−0.293	−2.874	0.210	−35.250	−6.433
Moderate score	12.768	7.793	0.172	1.638	0.105	−2.719	28.254
Mild score	10.537	8.079	0.138	1.304	0.196	−5.517	26.592
Estrogen level	−0.708	0.033	−0.917	−21.496	0.0001*	−0.774	−0.643
Progesterone level	−10.860	4.360	−0.257	−2.491	0.015*	−19.523	−2.196
Thyroid level	23.224	10.590	0.228	2.193	0.031*	2.180	44.269

*significant *P* value

babies have been associated with high serum levels of estrogen that may act as a protective effect [30].

In this study, we found no association between stillbirth, different birth complications (multiple births, birth trauma, major congenital anomalies, and neonatal jaundice) and PP. These findings agreed with those of Nager et al. and Zhong et al. [30, 36].

In the present study, low-birth-weight infants are a risk factor for PP. This is probably because the pregnancy that led to the birth of the low-birth-weight infant was

associated with a different hormonal environment. This finding is in line with those of other studies [28, 30, 36]. In contrast to these findings, Bergink et al. reported that low-birth-weight babies were not a risk factor for PP [4]. The difference between studies may be related to the small sample size of our study.

Severe birth asphyxia was significantly associated with PP in our study, which was the case in the studies carried out by previous studies [3, 4, 30, 36].

This study identified preterm delivery as a risk factor for PP. It had previously been reported by Annagur et al. and Nager et al. that preterm delivery may be associated with puerperal psychosis [30, 33]. A possible explanation is the fact that preterm infants often require extra medical care and a longer hospital stay. The resulting stress and worry for the preterm infant may predispose certain vulnerable mothers to PP.

The mean time-lapse between parturition and the onset of PP symptoms was less than 1 week (6.11 days) in this study that was consistent with Valdkmarsdottir et al. [28, 37]. However, many other studies (Bergink et al. and Lusskin et al.) reported that the onset of PP symptoms more commonly occurred within the second week after delivery [4, 34].

This study shows a significant association between stressful life events (measured by Holmes and Rahe Stress Scale) and PP. This finding is in line with those of Warselius et al. reported that the death of a close relative is one of the most common predisposing factors for PP [38]. On the other hand, Brockington et al. reported no association [37].

In the present study, the significantly lower mean plasma estrogen level in patients with PP than in controls and the significant correlation between plasma estrogen levels and the severity of the PP symptoms rated by the BPRS. In addition, women with PP had lower estrogen level in regression model in this study. These results confirm that estrogen could contribute as a risk factor for developing PP. Our result was in agreement with the findings of the studies by Jones et al. [1]. Ahokas et al. reported low serum concentrations of estradiol in his patients with PP and that treatment with estradiol leads to a decline in the rate of occurrence of psychiatric symptoms [39–41].

The absence of a significant difference in the progesterone level between patients with PP and normal controls this means that progesterone has no definite role in the pathogenesis of PP. However, in univariate linear regression, lower progesterone was risk for increase score of BPRS. Buckwalter et al. and Nappi et al. who reported that the role of progesterone and its metabolites were not involved in the pathogenesis of PP, and the level of evidence and equivalent results showed did not identify progesterone as a risk factor for PP [42, 43].

The significant association of thyroid dysfunction with PP in 18% of our participants and the higher thyroid level in women with PP than without PP may suggested that thyroid function play an important risk factor of PP. This was consistent with the findings of Bergink et al., who reported that autoimmune thyroid disease occurred in 19% of patients with PP as compared to 5% of healthy controls [44] and postpartum immune activation is thought to be responsible for the clinical symptoms of thyroid dysfunction as well as psychiatric disease [45].

This study had several limitations. First, the sample size was small. Second, the cross-sectional study design meant we could only identify associations, not causal relationships. So, future prospective cohort studies with larger study samples are recommended to identify the causes of PP.

Conclusions

Young age, primiparity, preterm delivery, cesarean delivery, and giving birth to low-birth-weight babies are all risk factors for PP. PP is more likely to occur early in the first week of the puerperium. Low plasma estrogen levels and thyroid dysfunction could contribute to the occurrence of PP.

Abbreviations

PP	Postpartum psychosis
E2	Estrogen
p	Progesterone
BPRS	Brief Psychiatric Rating Scale

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Author contributions

EMK, ER, MO, GA contributed to study concept and design, acquisition of data, draft and revision of the report, statistical analyses, and interpretation of data. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author reasonable on request.

Declarations

Ethics approval and consent to participate

The study received ethical approval from the Aswan University faculty of medicine's institutional review board. All participants gave their written informed consent to participate in the study. All participants' personal details were kept confidential, and all patients' personal data were anonymized immediately after data collection. We confirmed that all methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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