



Maternal mood symptoms in pregnancy and postpartum depression: association with exclusive breastfeeding in a population-based birth cohort

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Abstract

Purpose This study aimed to evaluate the association between mood symptoms during pregnancy and exclusive breastfeeding at 3 months, as well as the association between exclusive breastfeeding at 3 months and maternal depression at 12 months postpartum.

Methods Data from the Pelotas 2004 Birth Cohort with 4231 live births were used. Maternal mood symptoms during pregnancy were assessed through the question "During pregnancy, did you have depression or nervous problems?" and depression symptomatology at 12 months postpartum was assessed with the Edinburg Postnatal Depression Scale (EPDS). Information on exclusive breastfeeding at 3 months was collected through a dietary recall questionnaire. Crude and adjusted relative risks (RR) with 95% confidence intervals (95% CI) were estimated by Poisson regression.

Results Prevalence of mood symptoms during pregnancy was 25.1% (95% CI 23.8; 26.4%) and prevalence of EPDS \geq 10 at 12 months after birth was 27.6% (95% CI 26.2; 29.0%). Prevalence of exclusive breastfeeding at 3 months was 26.5% (95% CI 25.2; 27.9%). In crude analyses, maternal mood symptoms during pregnancy were associated with non-exclusive breastfeeding at 3 months and non-exclusive breastfeeding at 3 months was associated with postpartum maternal depression at 12 months. In the adjusted analyses, both associations were lost after the inclusion of maternal education (RR 0.92; 95% CI 0.81–1.04 and RR 0.92; 95% CI 0.81–1.03, respectively).

Conclusion In our study, the crude association between mood symptoms in pregnancy, exclusive breastfeeding at 3 months, and postpartum depression was due more to the low maternal education than to a true relationship between them.

Keywords Maternal depression · Postpartum depression · Breastfeeding · Cohort study

Introduction

Breastfeeding has recognized beneficial effects on the physical and emotional child development aside from improving maternal health [1]. On the short term, breastfeeding can decrease infant's morbidity and mortality due to infectious diseases [1, 2], hospital admissions caused by diarrhea and respiratory infections [3], and gastrointestinal disorders

and food allergies when exclusive during the infant's first 6 months of life [4]. Mortality rates are six times higher among weaned babies aged 2 months or less, being the effect still able to be observed until the infant's second year of life when breastfed children have a 50% lower risk [2]. Long-term health improvements are associated with better cognitive development on children and adolescents, protective effect on overweight, obesity and type 2 diabetes risk until adulthood, and enhanced school performance, and intelligence quotient (IQ) in adolescents and adults [1, 5, 6].

Regarding maternal health, breastfeeding reduces the risk of breast and ovarian cancer and type 2 diabetes [1]. Previous studies have suggested that the act of nursing a child would have a protective effect on maternal mental health, acting on the neuroendocrine stress response, with breastfeeding having been linked to a lower prevalence of depressive symptoms in the perinatal period [7].

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Mood disorders are frequent during the peripartum period. Maternal perinatal depression is defined as depression occurring from the last gestational trimester until a year after giving birth [8, 9]. Maternal depression prevalence ranges from 18% during pregnancy [10] to 3–19% in the postpartum period [9–11]. Symptoms include low mood, irritability, difficulty concentrating, feeling overwhelmed, loss of appetite, sleeping problems, and weight loss or gain [12, 13].

Previous studies have reported that maternal depression was linked to reduced breastfeeding initiation and early cessation, and that not breastfeeding and early weaning were linked to increased risk of maternal postpartum depression [14, 15]. However, a consensus has not yet been reached on whether there is an association between maternal depression and breastfeeding and being one, in which direction it occurs [15]. Therefore, this study had two aims: first, to evaluate the association between maternal mood symptoms during pregnancy and exclusive breastfeeding at 3 months; and second, to evaluate the association between exclusive breastfeeding at 3 months and maternal depression at 12 months postpartum.

Methods

Pelotas is a city with approximately 350,000 inhabitants located in southern Brazil, a middle-income country. In the year 2004, all hospital births between January 1 and December 31, from mothers that lived within the urban area, were included in a cohort. A total of 4231 newborns (representing 99.2% of all births in the city that year) were enrolled in the study. A standardized interview that included socioeconomic, demographic, cultural, obstetric, and pediatric information was carried out with the mothers during their stay at the hospital of delivery (perinatal study). Participants were visited at 3, 12, 24, and 48 months and at 6 and 11 years with follow-up rates varying from 99.2 to 86.6%. A detailed description of the methodology is given elsewhere [16, 17]. Data from maternal depression symptoms during pregnancy (collected at the perinatal interview) and at 12 months postpartum were included in this paper. These time-points were selected taking into account the availability of the information needed to assess the effect of maternal mood symptoms during pregnancy on exclusive breastfeeding at 3 months, as well as the effect of exclusive breastfeeding at 3 months over maternal depression at 12 months postpartum.

Maternal mood symptoms during pregnancy

The occurrence of maternal mood symptoms during pregnancy was defined as the positive answer to the question posed to the mother during the perinatal interview (99.2%

follow-up rate) regarding depression and/or nervous problems: “During pregnancy, did you have depression or nervous problems?” (no/yes). In previous analyses with mothers from the same cohort, this question was proven to have a high association with higher levels of depression during pregnancy [18]

Exclusive breastfeeding

During the 3-month follow-up (95.7% follow-up rate), a dietary recall questionnaire that included information on breastfeeding and age of introduction of liquids, solid, and semi-solid foods was collected. Based on this information, the variable “exclusive breastfeeding (no/yes)” was generated following the World Health Organization’s (WHO) definition as no other food or drink (not even water) being administered to the child, other than breast milk, with an exception for medications and vitamins [19].

Maternal postpartum depression

At 12 months postpartum (94.2% 12 month follow-up rate), maternal mood symptoms were assessed using the Edinburgh Postnatal Depression Scale (EPDS) [20]. EPDS is an instrument based on a questionnaire that expresses the intensity of depressive symptoms over the preceding 7 days. The scale includes 10 items; each item has four possible responses scored from 0 to 3, with a minimum total score of 0 and a maximum of 30. The EPDS Brazilian version has been previously validated in a sample of mothers from the Pelotas 2004 Cohort [21] and a cut-off point of ≥ 10 was shown to identify women at increased risk of depression in this population with 82.6% (95% CI 75.3; 89.9%) sensibility and 65.4% (95% CI 59.8; 71.1%) specificity.

Covariables

Information on maternal and child’s characteristics, recorded during the perinatal interview, was included in the analyses for confounding control. Maternal characteristics included education (full years of formal education, later categorized as 1–4, 5–8, 9–11, ≥ 12 years), age (< 20 , 20–34, ≥ 35 years), self-reported skin color (white, black, or brown/other), family monthly income (quintiles), marital status (married/living with a partner or single/divorced/widowed), parity (number of viable prior gestations, later categorized as primiparous, 1 and ≥ 2), and planning of the pregnancy (no/yes). Information on maternal smoking (at least one cigarette a day during any pregnancy trimester), alcohol consumption (any alcohol doses consumed during pregnancy), and type of delivery (vaginal, c-section) was also collected.

Child’s characteristics comprised sex and gestational age (GA) (estimated through an algorithm proposed by the

National Center for Health Statistics (NCHS) [22] according to the first day of the last menstrual period). If the last menstrual period was unknown, GA was based on the Dubowitz neurological evaluation [23]. GA was categorized as < 34, 34–36, 37–41, and ≥ 42 gestational weeks. Birth weight was measured by hospital staff with 10 g precision pediatric scales that were weekly calibrated by the research team. Children were classified as being low birth weight when born with less than 2500 g. The type of hospital admission for the newborn was classified as “together with mother”, “intermediate care unit”, and “intensive care unit”. Information on hospital admission, after birth discharge until 3 months of age, was collected at the 3-month follow-up and categorized into “yes” (having been hospitalized at least once in between that period) and “no” (not hospitalized during the period).

Data analyses

Initially, the prevalence with 95% confidence intervals (95% CI) of maternal mood symptoms during pregnancy, exclusive breastfeeding at 3 months, and maternal depression at 12 months postpartum was calculated according to maternal and child’s characteristics. Then, “mood symptoms during pregnancy” was analyzed as the exposure of interest to the outcome “exclusive breastfeeding at 3 months”. Later, “exclusive breastfeeding at 3 months” was analyzed as the exposure of interest to the outcome “maternal depression at 12 months postpartum”. To ensure temporality, for the later analyses, only mothers with no mood symptoms during pregnancy were eligible.

Relative risks (RR) with 95% CI were estimated from crude and adjusted analyses by Poisson regression. Multivariable analyses followed a hierarchical model, according to a theoretical model of causality created by the authors. Maternal socio-demographic characteristics (age, skin color, education, income, and marital status) were in the highest level of determination, followed by maternal reproductive and behavioral characteristics (gestational planning, parity, smoking, alcohol consumption during pregnancy, and type of delivery) on the second level, and the infant relating characteristics (sex, gestational age, low birth weight, and type of hospital admission at birth) in the lowest more proximal level. For the analyses of the association between exclusive breastfeeding at 3 months and maternal postpartum depression at 12 months, besides the previously mentioned potential confounders, the infant’s hospital admissions until the age of 3 months were included in the most proximal level.

Ethical considerations

All Pelotas 2004 Birth Cohort follow-ups were approved by the Research Ethics Committee of the Medical School from

the Federal University of Pelotas, affiliated with the National Research Ethics Committee (CONEP—Comissão Nacional de Ética em Pesquisa). All children’s parents or legal guardian gave written informed consent at each follow-up.

Results

Maternal mood symptoms were assessed in 4229 mothers at the perinatal interview and depression symptomology was assessed in 3838 mothers at 12 months postpartum. One-quarter of the mothers (25.1%; 95% CI 23.8; 26.4%) reported mood symptoms during pregnancy and 27.6% (95% CI 26.2; 29.0%) scored ≥ 10 in the EPDS at 12 months postpartum. A total of 446 women (11.6%) with mood symptoms during pregnancy scored EPDS ≥ 10 at 12 months postpartum, 503 (13.1%) women felt depressed only during pregnancy, whereas 613 (16.0%) were depressed only at 12 months postpartum (Fig. 1). Prevalence of exclusive breastfeeding at 3 months was 26.5% (95% CI 25.2; 27.9%) (Table 1).

At the perinatal interview, 67.8% of the mothers were 20–34 years old; 61.7% classified themselves as white and 41.3% had 5–8 years of formal education (Table 1). Almost 40% were primiparous; 56.4% had planned their pregnancy, 27.5% reported having smoked, and 3.3% consumed alcoholic beverages during the pregnancy. Among the newborns, 51.9% were male and 14.6% were preterm. Low birth weight prevalence was about 10%, 6% of the newborns were admitted at an intensive care unit at birth, and 1.2% had at least one hospital admission until 3 months of age.

Wealthier mothers with more years of formal education, who did not smoke or consume alcohol during pregnancy and whose children had not been admitted to the hospital until 3 months of age had a higher prevalence of exclusive breastfeeding at the 3-month evaluation. Maternal depression at 12 months postpartum was more prevalent among the poorest mothers with fewer years of education that had had an unplanned pregnancy and a vaginal delivery (Table 1).

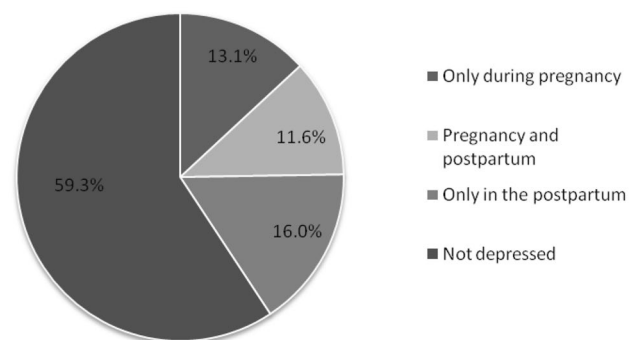


Fig. 1 Prevalence of mood symptoms in pregnancy and maternal depression at 12 months postpartum

Table 1 Sample characteristics and prevalence with 95% confidence interval (95% CI) of maternal mood symptoms during pregnancy, exclusive breastfeeding at 3 months, and maternal depression at 12 months postpartum

Characteristics	<i>N</i> (%)	Maternal mood symptoms during pregnancy % (95% CI)	<i>N</i> (%)	Exclusive breastfeeding at 3 months % (95% CI)	<i>N</i> (%)	Maternal depression at 12 months postpartum (EPDS ^a ≥ 10) % (95% CI)
Maternal age						
<20	800 (18.9)	23.9 (20.9; 26.8)	770 (18.8)	18.1 (15.3; 20.8)	713 (18.6)	34.1 (30.6; 37.6)
20–34	2864 (67.8)	24.1 (22.5; 25.7)	2772 (67.8)	28.1 (26.5; 29.8)	2,600 (67.8)	26.2 (24.5; 27.8)
≥35	563 (13.3)	31.8 (27.9; 35.6)	548 (13.4)	30.3 (26.4; 34.1)	523 (13.6)	26.0 (22.2; 29.8)
Skin color						
White	2581 (61.7)	22.9 (21.2; 24.5)	2511 (62.1)	28.4 (26.6; 30.1)	2358 (62.2)	25.7 (24.0; 27.5)
Black	688 (16.5)	26.3 (23.0; 29.6)	662 (16.3)	26.3 (22.9; 29.6)	622 (16.4)	30.0 (26.1; 33.3)
Brown/other	912 (21.8)	29.9 (27.0; 32.9)	873 (21.6)	21.4 (18.7; 24.1)	813 (21.4)	30.8 (27.6; 33.9)
Income (Quintiles)						
1° (poorest)	873 (20.7)	30.5 (27.4; 33.5)	832 (20.3)	18.4 (15.8; 21.0)	753 (19.6)	38.4 (34.9; 41.9)
2°	855 (20.2)	29.0 (26.0; 32.1)	817 (20.0)	22.3 (19.4; 25.1)	760 (19.8)	32.6 (29.3; 36.0)
3°	815 (19.3)	25.2 (22.2; 28.1)	794 (19.4)	27.3 (24.2; 30.4)	764 (19.9)	27.7 (24.6; 30.9)
4°	856 (20.2)	23.7 (20.9; 26.6)	840 (20.5)	30.0 (26.9; 33.1)	805 (21.0)	23.0 (20.1; 25.9)
5° (wealthiest)	830 (19.6)	16.6 (14.1; 19.2)	809 (19.8)	34.9 (31.6; 38.1)	756 (19.7)	16.5 (13.9; 19.2)
Schooling						
1–4 years	654 (15.6)	33.2 (29.6; 36.8)	623 (15.4)	16.4 (13.5; 19.3)	575 (15.1)	39.5 (35.5; 43.5)
5–8 years	1730 (41.3)	28.5 (26.4; 30.6)	1667 (41.1)	21.5 (19.5; 23.4)	1555 (40.9)	32.9 (30.5; 35.2)
9–11 years	1382 (33.0)	20.6 (18.5; 22.8)	1354 (33.4)	32.4 (29.9; 34.9)	1281 (33.7)	21.1 (18.8; 23.3)
≥12 years	420 (10.0)	14.5 (11.1; 17.9)	408 (10.1)	41.7 (36.9; 46.5)	389 (10.2)	11.8 (8.6; 15.0)
Living with a partner						
No	695 (16.4)	31.8 (28.3; 35.3)	659 (16.1)	18.7 (15.7; 21.6)	602 (15.7)	33.4 (29.6; 37.2)
Yes	3534 (83.6)	23.7 (22.3; 25.1)	3433 (83.9)	28.1 (26.5; 29.6)	3236 (84.3)	26.5 (25.0; 28.0)
Parity						
Primiparous	1665 (39.4)	20.4 (18.5; 22.4)	1613 (39.4)	25.0 (22.9; 27.2)	1524 (39.7)	23.6 (21.4; 25.7)
1	1111 (26.3)	22.2 (19.8; 24.7)	1082 (26.5)	29.4 (26.7; 32.1)	1002 (26.1)	23.8 (21.1; 26.4)
≥2	1452 (34.3)	32.6 (30.2; 35.0)	1396 (34.1)	26.1 (23.8; 28.4)	1311 (34.2)	35.2 (32.7; 37.8)
Planned pregnancy						
No	2396 (56.7)	27.4 (25.6; 29.2)	2309 (56.4)	25.3 (23.6; 27.1)	2154 (56.1)	31.1 (29.1; 33.0)
Yes	1832 (43.3)	21.9 (20.0; 23.8)	1782 (43.6)	28.1 (26.0; 30.2)	1683 (43.9)	23.2 (21.2; 25.2)
Smoking						
No	3067 (72.5)	22.6 (21.1; 24.1)	2981 (72.9)	29.7 (28.0; 31.3)	2815 (73.4)	23.9 (22.3; 25.5)
Yes	1162 (27.5)	31.6 (28.9; 34.3)	1111 (27.1)	18.2 (15.9; 20.5)	1023 (26.6)	37.7 (34.8; 40.7)
Alcohol consumption						
No	4091 (96.7)	24.6 (23.2; 25.9)	3959 (96.8)	26.9 (25.5; 28.3)	3716 (96.8)	27.3 (25.9; 28.7)
Yes	140 (3.3)	40.0 (31.9; 48.1)	133 (3.2)	15.8 (9.6; 22.0)	122 (3.2)	36.9 (28.3; 45.5)
Type of delivery						
Vaginal	2308 (54.6)	25.3 (23.6; 27.1)	2229 (54.5)	26.1 (24.2; 27.9)	2104 (54.8)	30.0 (28.0; 31.9)
C-section	1921 (45.4)	24.7 (22.8; 26.7)	1863 (45.5)	27.1 (25.1; 29.1)	1734 (45.2)	24.7 (22.7; 26.7)
Sex						
Male	2196 (51.9)	25.4 (23.5; 27.2)	2120 (51.8)	25.6 (23.7; 27.4)	1989 (51.8)	27.5 (25.5; 29.5)
Female	2033 (48.1)	24.7 (22.9; 26.6)	1972 (48.2)	27.6 (25.6; 29.6)	1849 (48.2)	27.7 (25.6; 29.7)
Gestational age						
<34	141 (3.4)	38.3 (30.2; 46.4)	103 (2.5)	12.6 (6.2; 19.1)	93 (2.4)	23.7 (15.0; 32.3)
34–36	472 (11.2)	30.5 (26.3; 34.7)	450 (11.0)	19.8 (16.1; 23.5)	410 (10.7)	30.7 (26.3; 35.2)
37–41	3335 (79.1)	23.7 (22.2; 25.2)	3272 (80.1)	28.2 (26.6; 29.7)	3091 (80.6)	27.1 (25.6; 28.7)
≥42	267 (6.3)	24.3 (19.2; 29.5)	260 (6.4)	23.8 (18.7; 29.0)	240 (6.3)	30.0 (24.2; 35.8)

Table 1 (continued)

Characteristics	<i>N</i> (%)	Maternal mood symptoms during pregnancy % (95% CI)	<i>N</i> (%)	Exclusive breastfeeding at 3 months % (95% CI)	<i>N</i> (%)	Maternal depression at 12 months postpartum (EPDS ^a ≥ 10) % (95% CI)
Birth weight						
<2500	431 (10.2)	32.5 (28.1; 36.9)	374 (9.1)	16.3 (12.6; 20.1)	323 (8.4)	28.5 (23.6; 33.4)
≥2500	3795 (89.8)	24.2 (22.9; 25.6)	3717 (90.9)	27.6 (26.1; 29.0)	3514 (91.6)	27.5 (26.0; 29.0)
Type hospital admission at birth						
With the mother	3813 (90.4)	23.7 (22.4; 25.1)	3734 (91.5)	27.2 (25.8; 28.6)	3511 (91.7)	27.3 (25.8; 28.8)
Intermediate care	149 (3.5)	36.2 (28.5; 44.0)	140 (3.4)	25.7 (18.4; 33.0)	130 (3.4)	27.7 (20.0; 35.4)
Intensive-care unit	254 (6.0)	37.4 (31.4; 43.4)	209 (5.1)	16.3 (11.3; 21.3)	188 (4.9)	32.4 (25.7; 39.2)
Hospital admissions until 3 months of age						
No	3857 (98.8)	24.9 (23.5; 26.3)	3859 (98.8)	27.8 (26.4; 29.2)	3790 (98.8)	27.4 (26.0; 28.8)
Yes	47 (1.2)	21.3 (9.4; 33.1)	47 (1.2)	14.9 (4.6; 25.2)	47 (1.2)	42.6 (28.3; 56.8)
Total	4229	25.1 (23.8; 26.4)	4092	26.5 (25.2; 27.9)	3838	27.6 (26.2; 29.0)

Pelotas 2004 Birth Cohort

^aEPDS Edinburgh Postnatal Depression Scale

Table 2 Crude and adjusted relative risk (RR) with 95% confidence interval (95% CI) for exclusive breastfeeding at 3 months according to mood symptoms during pregnancy

	Exclusive breastfeeding at 3 months		
	RR	95% CI	<i>p</i>
Crude	0.83	0.73; 0.94	0.004
Adjusted ^a	0.95	0.84; 1.08	0.405
Adjusted ^b	0.92	0.81; 1.04	0.188

Pelotas 2004 Birth Cohort

^aAdjusted according to the hierarchical model with backwards selection to maternal (age, schooling, income, living with a partner, type of delivery, parity, smoking, and alcohol consumption) and child's characteristics (sex, gestational age, and low birth weight)

^bAdjusted only to maternal years of schooling

Mood symptoms during pregnancy and exclusive breastfeeding at 3 months

Among mothers with mood symptoms during pregnancy, the prevalence of exclusive breastfeeding at 3 months was 23.0% (95% CI 20.4; 25.6%), whereas among those who did not present this symptomatology, the prevalence was 27.7% (95% CI 26.1; 29.3%). In the crude analyses, women with mood symptoms during pregnancy had a risk 17% higher of not exclusively breastfeeding at 3 months (RR 0.83; 95% CI 0.73; 0.94) (Table 2). After adjusting for maternal and child characteristics, the effect of maternal mood symptoms during pregnancy on exclusive breastfeeding at 3 months was lost (RR 0.95; 95% CI 0.84; 1.08) (Table 2).

Table 3 Crude and adjusted relative risk (RR) with 95% confidence interval (95% CI) for maternal depression at 12 months postpartum (EPDS^a ≥ 10) according to exclusive breastfeeding at 3 months

	Maternal depression at 12 months postpartum		
	RR	95% CI	<i>p</i>
Crude	0.81	0.72; 0.92	0.001
Adjusted ^b	0.96	0.85; 1.08	0.475
Adjusted ^c	0.92	0.81; 1.03	0.159

Pelotas 2004 Birth Cohort

^aEPDS Edinburgh Postnatal Depression Scale

^bAdjusted according to the hierarchical model with backwards selection to maternal (age, schooling, income, living with a partner, planned pregnancy, smoking, and parity) and child's characteristics (hospital admissions at birth)

^cAdjusted only to maternal years of schooling

Exclusive breastfeeding at 3 months and postpartum depression at 12 months

Prevalence of depression at 12 months postpartum among mothers who did not exclusively breastfed at 3 months was 29.1% (95% CI 27.4; 30.8%), whereas among those who exclusive breastfed, the prevalence was 23.6% (95% CI 21.1; 26.1%). Mothers that exclusively breastfed until 3 months had a 19% decrease in the risk of depression at 12 months postpartum (RR 0.77; 95% CI 0.66; 0.91), compared to those that stopped exclusively breastfeeding before 3 months postpartum (Table 3). The effect of exclusive breastfeeding at 3 months on maternal depression at 12 months postpartum was no longer observed after controlling for confounders (RR 0.94; 95% CI 0.80; 1.11) (Table 3). When including in the analyses those women who answered positively to the

presence of mood symptoms during pregnancy, no differences were observed, compared to the restricted analyses (Crude RR 0.81; 95% CI 0.72; 0.92; RR adjusted to maternal education: 0.92; 95% CI 0.81; 1.04).

Complementary analyses

To identify the most important confounding factors affecting the crude associations, we repeated the adjusted analyses including one-by-one each of the independent variables. In these analyses, the effect of maternal mood symptoms during pregnancy over exclusive breastfeeding at 3 months, as well as the effect of exclusive breastfeeding at 3 months over maternal depression at 12 months postpartum was positively confounded by the maternal level of education (Tables 2 and 3). The lower the maternal schooling, the higher the risk of non-exclusive breastfeeding at 3 months; and the higher the level of maternal schooling, the lower the risk of depression at 12 months postpartum. There was no interaction between maternal schooling and mood symptoms during pregnancy ($p=0.741$) or exclusive breastfeeding at 3 months ($p=0.844$).

Additionally, to evaluate the effect of keeping infants who were partially breastfed (infants who were fed breast milk complemented with other types of milk, such as cow's milk or formula, or with solid or semi-solid foods) [19] or predominantly breastfed (breastfed infants who received fluids such as water, tea, or fruit juices, but were not fed solid or semi-solid foods) [19] in the comparison group (infants non-exclusively breastfed), exploratory analyses comparing "exclusively breastfed at 3 months" to "weaned only infants at 3 months" were run. The crude RR (0.88; 95% CI 0.78) and the RR adjusted for maternal schooling (0.95; 95% CI 0.85; 1.07) were similar to the observed including those children in the comparison group.

Also, there was no association between gestational mood symptoms and any breastfeeding at 3 months in crude (RR 0.97, 95% CI 0.93; 1.02) nor adjusted analysis (RR 1.00; 95% CI 0.96; 1.04). In the same way, any breastfeeding at 3 months was not associated with maternal depression at 12 months postpartum in crude (RR 0.91; 95% CI 0.81; 1.02) nor in adjusted analysis (RR 0.97; 95% CI 0.89; 1.11). No association was observed between continued breastfeeding at 12 months and maternal depression at 12 months postpartum in crude (RR 1.03; 95% CI 0.93; 1.12) nor in adjusted analysis (RR 1.02; 95% CI 0.93; 1.12).

Discussion

After adjusting for potential confounders, we found no association between maternal mood symptoms during pregnancy and exclusive breastfeeding at 3 months as well as

no association between exclusive breastfeeding at 3 months and maternal depression at 12 months postpartum. Maternal level of formal education was the main confounder of these two associations.

Mood symptoms during pregnancy and exclusive breastfeeding at 3 months

Previous studies that evaluated maternal depressive symptoms during the prepartum period and using validated questionnaires reported that mood symptoms during pregnancy were linked to less exclusive breastfeeding [24–28 YSTROM]. However, studies that adjusted for maternal education found no association [29, 30]. Yet, Hahn-Hoolbroke et al. [31] reported reduced breastfeeding duration and reduced any breastfeeding at 3 months in mothers with depressive symptoms during pregnancy, even after controlling for possible confounders, including maternal education.

Lower maternal educational attainment has been strongly associated with maternal mood symptoms during pregnancy [32, 33]. Early education is thought to have a direct pathway linking to mental health through enhancing socio-emotional, cognitive, and motor development and stimulation [34]. In the same way, maternal schooling is one of the most investigated factors as a determinant of breastfeeding outcomes [35]. Education has been related to factors that promote mental health such as increased stimulation, cognitive development, and social maturation, as well as it has been associated with better future opportunities, earning potential, and reduced exposure to environmental toxins [34]. There is evidence that the effect of maternal education on breastfeeding patterns is different in high- and low-middle-income countries (LMIC). In high-income countries, better-educated women breastfeed more often than less educated mothers, while in LMIC, breastfeeding is more frequent among lower socioeconomic groups [1]. This might be due to better-educated women in high-income countries having larger access to information and knowledge on the benefits of breastfeeding especially on the child, as well as higher access to qualified health services and professionals able to guide and counsel them during the process. In low socioeconomic groups from LMIC instead, economic constraints may favor breastfeeding practices. A study with data from the four population-based Pelotas birth cohorts (1982, 1993, 2004, and 2015) showed that the prevalence of exclusive breastfeeding at 3 months increased from 7% in 1993 to 45% in 2015 [36]. Increases in exclusive breastfeeding at 3 months were seen in all socioeconomic groups, but the 2015 rates remain highest (57.2%) among the women in the richest quintile, and lowest among those in the poorest quintile (34.6%) [36].

Maternal schooling is strongly correlated with socioeconomic conditions of the family and in studies evaluating

health outcomes is commonly used as a proxy of other socioeconomic characteristics (such as income and occupation) [37]. In our study, the prevalence of exclusive breastfeeding at 3 months increased with the increase of family income (from 18.4% among mothers of the poorest quintile to 34.9% among the wealthiest mothers; p for linear trend < 0.001). Several studies have found association between socioeconomic conditions and depression, with the poorest being more affected by this disorder than the wealthiest [32, 33, 38]. In Brazil, a nation-wide study using the Edinburgh Postnatal Depression Scale 6–18 months after birth found a prevalence of 26.3% of probable depression and identified 70% increase in the risk of depression among mothers from the lower economic class [39]. The combination of higher socioeconomic status and higher education with lower prevalence of mood symptoms in pregnancy and postpartum depression as well as with higher prevalence of exclusive breastfeeding at 3 months in the cohort may have contributed to the finding of no association between depression and exclusive breastfeeding and vice-versa.

Exclusive breastfeeding at 3 months and postpartum depression at 12 months

Studies that reported a protective effect of any breastfeeding [40] and exclusive breastfeeding [24, 25] over maternal postpartum depression applied no or minimal adjustment to possible confounders, not including maternal education into their analyses [24, 25, 40]. Studies that controlled for potential socioeconomic confounders [41] in particular maternal education [31] found no association between exclusive or any breastfeeding and maternal depression in the postpartum period.

In our study, the exploratory analysis with the restricted sample comparing exclusively breastfed with only weaned babies reinforced the lack of association between exclusive breastfeeding at 3 months and prevention of maternal depression at 12 months, thus increasing the plausibility of our finding.

Strengths and limitations

The study was based on longitudinal data from a large, population-based sample. The follow-up rate of this cohort at all points ($< 6\%$ loss rate) is noteworthy. Follow-up rates were lowest among families in the upper and lower extremes of income that also represent the upper and lower extremes of the chosen outcomes. On the assessment of the effect of exclusive breastfeeding at 3 months on maternal postpartum depression, a restriction on women who screened positive for mood symptoms in pregnancy was applied. This aimed to assure that a positive screening for depressive symptoms

after childbirth was not the persistence of gestational mood symptoms.

The use of the EPDS to assess postpartum maternal depression could be considered a limitation because the EPDS is a screening (not a diagnostic) tool being only able to identify women at increased risk of depression. Additionally, the use of recall questionnaires to determine the infant's feeding practices (weaning and solid food introduction dates) may be subjected to information bias. Moreover, maternal mood in pregnancy was assessed by means of a single question rather than with a standardized instrument. However, in previous analysis with the same population with the aim of identify longitudinal patterns of maternal depression between three months and 6 years postpartum, women with chronic depression showed the highest rates of positive answers to this question [18]. Also, because mood symptoms tend to lower in the second and third trimesters of pregnancy [10], maternal gestational mood symptom prevalence might have been underestimated due to the question being included in the perinatal interview. Nevertheless, our results were consistent among studies that evaluated gestational symptoms during pregnancy [24–28].

Conclusion

In our study, maternal mood symptoms during pregnancy did not lead to reduced prevalence of exclusive breastfeeding at 3 months; and lack of exclusive breastfeeding at 3 months was not a risk factor for maternal depression 12 months postpartum. Crude associations were due to the confounding effect of maternal schooling. Thus, social investments in women education can bring the double benefit of preventing maternal depression and of promoting exclusive breastfeeding in early infancy.

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Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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