Journal of Affective Disorders Reports 6 (2021) 100247

Contents lists available at ScienceDirect

Journal of Affective Disorders Reports

journal homepage: www.sciencedirect.com/journal/journal-of-affective-disorders-reports

Research Paper

Social inequalities in maternal depressive symptomatology after childbirth: Comparison across birth cohorts in Brazil

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ARTICLE INFO

Keywords:
Postpartum depression
Health inequalities
Socioeconomic factors
Cohort studies

ABSTRACT

Background: Approximately 40% of women experience their first depressive episode during the postpartum period. In Brazil, several maternal health outcomes are affected by profound social inequalities. Investigating inequalities in maternal depressive symptomatology in two different regions of the country in the first 24 months after childbirth may help clarify these patterns and appropriate support services.
Methods: Data from three birth cohorts from two Brazilian cities (Cruzeiro do Sul, North region, and Pelotas, South region) were analysed. The baseline of each cohort consisted of 4,231 (2004 Pelotas), 4,275 (2015 Pelotas), and 1,246 (MINA-Brazil) live births. Depressive symptomatology was repeatedly measured using the Edinburgh Postnatal Depression Scale (EPDS) at 3, 12, and 24 months postpartum. Socioeconomic status and skin colour inequalities in depressive symptomatology were analysed at each point.
Results: Between the 3rd and 24th months postpartum, maternal depressive symptomatology increased amongst women from the south, but decreased amongst women in the north. Black/brown women and those belonging to the lowest socioeconomic stratum showed the highest frequency of depressive symptomatology. Absolute and relative inequalities remained stable throughout the study period. Depressive symptomatology was most common amongst women with few years of schooling, multiparae, and amongst those who smoked during pregnancy.
Limitations: There was no information regarding any psychological/psychiatric treatment at the time the EPDS was evaluated, and economic status was assessed differently amongst the cohorts.
Conclusions: Marked social inequalities were found in postpartum depressive symptoms. Actions aimed at early detection and reducing social inequalities in maternal postpartum depressive symptomatology are vital.

1. Introduction

Depression is a common health problem during pregnancy and the postpartum period (Committee on Obstetric Practice, 2015). Overall, 21% of women reported depressive symptomatology during pregnancy (Yin et al., 2021). Postpartum depression is the most common complication after delivery, affecting approximately 13% of mothers worldwide (Lubotzky-Gete et al., 2021; Payne and Maguire 2019; Woody et al., 2017). Depressive symptoms may continue or worsen throughout pregnancy and the postpartum period, and can persist for years after delivery (Farías-Antúnez et al., 2020). Maternal depression in the postpartum period has been associated with negative outcomes in the offspring, such as behavioural problems, cognitive difficulties, and depression (Neamah et al., 2018; Stein et al., 2014). For the family, postpartum depression has been associated with financial and housing problems, as well as with disagreements and instability in marital and

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https://doi.org/10.1016/j.jadr.2021.100247
Received 6 August 2021; Received in revised form 23 September 2021; Accepted 1 October 2021
Available online 5 October 2021

intra-family relationships (Çankaya, 2020; Kingsbury et al., 2018).

In Brazil, maternal and child health outcomes are affected by profound social inequalities, including maternal, neonatal, and infant mortality, premature births, low birth weight, malnutrition (undernutrition and excess weight; Canella et al., 2020; Farias et al., 2019; Menezes et al., 2019; Moreira et al., 2020; Silveira et al., 2019a), and postpartum depressive symptomatology (Matijasevich et al., 2009). Regarding postnatal depression, it has been reported that in the first year after birth, maternal depression was more than two times higher amongst the economically weaker women than amongst those who were better off (Matijasevich et al., 2009). Social inequalities affect women's health status before, during, and after pregnancy by limiting their access to and their use of health services (Boccolini et al., 2017; Maina et al., 2018) and other possible mechanisms such as high exposure to financial stress, violence, racism, and less social support (Leal et al., 2005; Pascoe and Richman, 2009). Reducing these inequalities is urgent, not only because of their effects on individuals, but also because higher frequencies of comorbidities amongst low-income groups, who are more dependant on public health services, may be costly and burdensome to the entire healthcare system of a country (Zhang and Rodriguez, 2012).

As Brazil is a country of continental dimensions with marked socioeconomic differences, the frequency of maternal postpartum depressive symptomatology may vary according to different geographic regions. Studies that evaluated these symptoms using the Edinburgh Postnatal Depression Scale (EPDS) reported frequencies varying between 6.7% and 23.8% in the south and southeast of the country (Matijasevich et al., 2009; Poles et al., 2018; Silveira et al., 2019b; Strapasson et al., 2018), and in the northeast region these frequencies varied from 6.9% to 32.5% (Angelo et al., 2014; Brito et al., 2015; Lima et al., 2017). Although the overall rates of postpartum depression across the south, southeast, and northeast of Brazil are available, data are lacking on the frequency of the symptoms in the north of the country, and detailed comparisons of social inequalities in depression are needed. It is also important to highlight the absence of longitudinal data related to maternal depression in the north region.

Therefore, investigating the social inequalities in maternal depressive symptomatology in the first 24 months after childbirth in two distinct geographical and socioeconomic regions from the same country may help to clarify the extent of social inequalities across different wealth and skin colour groups, allowing the development of specific strategies to reduce postpartum depression in each context. Our study aimed to: (1) compare the frequency of maternal depressive symptomatology after childbirth between population-based birth cohort studies carried out in Cruzeiro do Sul (Acre, north of Brazil) and Pelotas (Rio Grande do Sul, south of Brazil), cities marked by important socioeconomic differences; (2) investigate the socioeconomic status and skin-colour-related inequalities in maternal depression in the first and second year postpartum in these cohorts; and (3) examine other possible maternal determinants of postpartum depression in addition to socioeconomic inequality.

2. Methods

2.1. Study population

Data from three birth cohorts from two cities of Brazil were analysed in the present study, Cruzeiro do Sul (Acre) and Pelotas (Rio Grande do Sul), which have an estimated population of approximately 90,000 and 343,000, respectively (IBGE, 2019). According to the Brazilian Institute of Applied Economic Research (IPEA, 2019), amongst the 26 states and the Federal District of Brazil, Rio Grande do Sul occupied the 6th position in the Human Development Index (HDI) in 2017 (mean HDI of 0.783), while Acre occupied the 21st position (mean HDI of 0.709). In 2017, the population of Cruzeiro do Sul had a Gross Domestic Product (GDP) per capita of R$ 15,585.70 (IBGE, 2017), and 44.2% of the population had a monthly income per capita of up to half the minimum wage (IBGE, 2010). The GDP per capita of Pelotas was R$ 24,894.68 (IBGE, 2017) and 31.9% of the residents had an income per capita of up to half the minimum wage (IBGE, 2010).

All women who delivered in the years 2004 and 2015 in one of the five maternity hospitals of Pelotas, where more than 99% of all deliveries take place, and were residents of an urban area of the city were invited to participate in the study. A similar methodology was employed for the 2004 and 2015 Pelotas birth cohorts (Hallal et al., 2018; Santos et al., 2011), including consistent variable definitions and comparable questions. The city's maternity wards were visited daily, and mothers were interviewed at the hospital soon after delivery. Children and their mothers were visited at their homes at 3, 12, and 24 months after birth. On each occasion, mothers were interviewed by trained fieldworkers using a standardised questionnaire to collect information about the mothers' and children's health.

In the MINA-Brazil (Maternal and Child Health and Nutrition in Acre, Brazil) birth cohort study, women were eligible to participate if they intended to give birth at the Women's and Children's Hospital of Juruá Valley, where 96% of all deliveries of Cruzeiro do Sul take place. The research team visited mothers within the first 12 h after delivery before hospital discharge to explain the study protocol and invited them to participate, collecting baseline data from July 2015 to June 2016. During the follow-up, phone interviews on morbidities and feeding practices were conducted 3 months after delivery. At 12 months and 24 months postpartum, follow-up visits were carried out at the health centre of the city. A structured questionnaire was administered to mothers or guardians regarding the family's socioeconomic position, lifestyle factors, and maternal and child health conditions. More details are provided by Cardoso et al. (2020).

2.2. Data on outcome

In the three cohort studies, repeated data on maternal depressive symptomatology were obtained using the Edinburgh Postnatal Depression Scale (EPDS) at 3, 12, and 24 months postpartum. The EPDS was originally devised for the identification of postpartum depression disorders for use in clinical and research settings (Cox et al., 1987). The EPDS is a self-administered, 10-item scale. Each item has four possible responses from 0 to 3, with a minimum score of 0 and a maximum of 30. The scale expresses the intensity of depressive symptoms over the preceding seven days. In Brazil, the EPDS was validated amongst a sample of mothers from the 2004 Pelotas birth cohort study (Santos et al., 2007). In the present study, EPDS was dichotomized as < 13 and ≥ 13 (sensitivity of 95% and specificity of 93%) to produce a 'non--depressed/depressed' classification (Santos et al., 2007).

In contrast to the original self-administered format, questions were posed to mothers by a trained interviewer as a single block, and in the same order as in the original instrument, within the cohort's regular interviews. The decision to verbally pose the questions to mothers was related to the fact that the women were unfamiliar with self-administered data collection instruments, and a significant proportion of them had little schooling. The administration of EPDS as an interview is accepted by the authors of the instrument (Cox et al., 1987), and was used previously by Da Silva et al. (1998).

2.3. Data on determinants

The following factors were considered to be potential determinants of maternal depression after childbirth: maternal age at delivery (< 20, 20–34, and ≥ 35), maternal schooling (< 10, 10–12, and > 12 years), marital status (with partner or single mothers), parity (defined as the number of previous deliveries including stillbirths, and categorised as 0, 1, and ≥ 2), multiple births (no/yes), previous abortion/s (no/yes), smoking during pregnancy (smoking at least one cigarette per day on an everyday basis in any trimester of pregnancy: no/yes), alcohol intake during pregnancy (any amount of alcohol intake during any trimester of

pregnancy: no/yes), self-reported high blood pressure during pregnancy (no/yes), and self-reported diabetes during pregnancy (no/yes). Pre-pregnancy body mass index (BMI) was calculated in kg/m^2. For pregnant women aged $\geq$ 19 years, pre-pregnancy BMI was classified according to the WHO recommendations (WHO, 1995): low weight ($<$ 18.5 kg/m^2), adequate (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) and obesity ($\geq$ 30 kg/m^2). For pregnant women aged $<$ 19 years, the pre-pregnancy BMI for age was calculated into Z score units and classified as follows: low weight (Z score ≤ -2), eutrophic (Z score > -2 to Z score $+1$), overweight (Z score $\geq +1$ to Z score $+2$) and obesity (Z score $\geq +2$) (Onis et al., 2007).

Family income in the month prior to delivery was used as a measure of socioeconomic status, and was collected in Brazilian Real as a continuous variable and categorised as quintiles for both Pelotas cohort studies. In the MINA-Brazil cohort, information on household assets was used to calculate a wealth index as a proxy for socioeconomic status, and quintiles were calculated. We refer to the first quintile (Q1) as the weakest quintile (weakest 20%) and the fifth quintile (Q5) as the wealthiest quintile (wealthiest 20%). Self-reported skin colour was collected in the perinatal interview, and categorised as white, brown, yellow, indigenous, and black according to the classification adopted by the Brazilian Census Bureau (IBGE, 2010d). As the frequency of yellow and indigenous women in the three cohorts was very low, we named this group brown only; however, the category continued to include yellow and indigenous mothers.

2.4. Statistical analysis

We used chi-square (χ^2) tests to compare the distribution of maternal characteristics between the MINA-Brazil and Pelotas birth cohort studies, and to study the association between these characteristics and maternal depressive symptomatology after childbirth in each cohort at three time points (3, 12, and 24 months postpartum). Additionally, we used the chi-square test for trend to compare the distribution of maternal depressive symptomatology frequencies over time in each cohort study. This test was also used to analyse trends in maternal depressive symptomatology within each quintile of socioeconomic status and each category of skin colour over time.

Socioeconomic and skin colour inequalities in maternal postpartum depressive symptomatology were studied. In this article, we refer to inequalities as any measurable aspect of health that varies across individuals or groups, differentiating this term from inequities, which are systematic differences that are unfair and unjust (Kawachi et al., 2002). Two indicators of economic-related inequality were estimated: (i) an indicator of absolute inequality, the slope index of inequality, and (ii) an indicator of relative inequality, the concentration index (Harper and Lynch, 2005).

The slope index of inequality is derived by regressing the mean health outcome within a particular social group on the mean relative rank of social groups (Shaw et al., 2007; Wagstaff et al., 1991). In the case of quintiles of family income/wealth index, each quintile included approximately 20% of the cohort, and the midpoints of the quintile categories were calculated. The slope index of inequality was then obtained by regressing the outcomes studied on the midpoint score for each quintile. The slope of the regression line represents the absolute difference between the highest (score 1) and lowest (score 0) values of the socioeconomic position indicator. In addition, absolute socioeconomic and skin colour inequalities in maternal postpartum depressive symptomatology were described using the 'equiplot' graph (www.equidade.org/equiplot). This graph is a simple and easy way to interpret and visually display inequalities. It presents outcome frequencies by groups (e.g., wealth quintiles), making it possible to 'visualise' both the frequencies in each group and the distance or gap between groups, which represents absolute inequality.

The concentration index was calculated in its relative formulation with no corrections (Barros and Victora, 2013). The concentration index uses an analogous approach to the Gini index by ranking individuals according to their socioeconomic position on the *x*-axis and their cumulative health condition on the *y*-axis. This index is expressed on a scale ranging from -100 to 100, where a value of 0 represents perfect equality. If the outcome is more concentrated towards richer groups, the concentration index assumes a positive value, as the curve is below the diagonal. When poorer groups are more affected than richer groups, the concentration index is negative (Barros and Victora, 2013; Barros et al., 2012).

Skin colour inequalities were studied using absolute (i.e., the arithmetical difference between [black/brown] and white) and relative comparisons (that is, the ratio of [black/brown] vs. white). Due to the low frequency of some skin colour groups (i.e. 3.4% of black women in the MINA-Brazil cohort), the black and brown skin colour categories were pooled. However, the analyses are also presented separately by these three skin colour groups (white, black, and brown) in Supplementary Table 1.

In each cohort at three time points (3, 12, and 24 months postpartum) adjusted analysis were performed using logistic regression based on a hierarchical model composed of three levels (Victora et al., 1997). Level one was composed of family income, maternal skin colour, schooling, and marital status. Level two included maternal age, parity, multiple births, and previous abortions. Level three included maternal smoking, alcohol intake, high blood pressure, diabetes, and pre-pregnancy BMI. This hierarchical analysis considered the effect of each variable in relation to the outcome, and was controlled for confounding variables of the same and higher levels. Variables that presented a p-value < 0.20, in each level, were maintained in the adjusted analysis. All analyses were performed using Stata v.15.

2.5. Details of ethics approval

The 2004 Pelotas study was approved by the Ethics Committee of the School of Medicine (4.06.01.113), and the 2015 Pelotas cohort by the School of Physical Education (CAAE: 26,746,414.5.0000.5313), Federal University of Pelotas. The MINA-Brazil study was approved by the Ethical Committee of the School of Public Health, University of São Paulo, Brazil (872.613/2014 and 2.358.129/2017). Each participant provided written informed consent for all three studies.

3. Results

The baseline of each study consisted of 4231, 4275, and 1246 live births for the 2004 Pelotas, 2015 Pelotas, and MINA-Brazil cohorts, respectively. The nonresponse rate at recruitment in both the Pelotas studies was below 1%, and in the MINA-Brazil was 11.5%. For the 2004 Pelotas cohort at 3, 12, and 24 months postpartum, the response rates were 95.7%, 94.3%, and 93.5%, respectively. In the 2015 Pelotas study, the response rates were 97.2%, 95.4%, and 95.4% at 3, 12, and 24 months, respectively. For the MINA-Brazil cohort, the response rates at 3, 12, and 24 months after delivery were 63.2%, 63.1%, and 69.9%, respectively. The EPDS questionnaire was applied to the whole cohort for all the three studies, except for 2004 Pelotas at the three-month follow-up, when a sub-sample of 965 mothers was chosen to respond to the questionnaire.

Marked differences in maternal characteristics were observed amongst the three cohort studies (Table 1). The 2004 and 2015 Pelotas birth cohort studies had higher frequencies of white women, while the MINA-Brazil cohort had more brown/yellow/indigenous women. Higher frequencies of young ($<$ 20-year-old) and single women were observed in the MINA-Brazil study, and higher proportions of mothers with more than 12 years of schooling were observed in the 2015 Pelotas cohort study. The 2015 Pelotas cohort presented the lowest frequency amongst women with multiple children. Women from MINA-Brazil presented higher frequencies of alcohol intake and lower proportions of smoking, high blood pressure, and diabetes during pregnancy than

Table 1
Comparison of maternal characteristics between 2004 Pelotas ($n = 4231$), 2015 Pelotas ($n = 4275$) and MINA-Brazil ($n = 1246$) birth cohorts.

Variable	2004 Pelotas n (%)	2015 Pelotas n (%)	MINA-Brazil n (%)	p^*
Skin colour				
White	3088 (73.0)	3024 (70.8)	149 (12.3)	<0.001
Brown/yellow/ indigenous	295 (7.0)	577 (13.5)	1017 (84.3)	
Black	846 (20.0)	667 (15.6)	41 (3.4)	
Schooling (years)				
< 10	2603 (62.2)	1743 (40.8)	430 (35.7)	<0.001
10–12	1238 (29.6)	1314 (30.7)	568 (47.1)	
> 12	345 (8.2)	1217 (28.5)	208 (17.2)	
Marital status				
With partner	3536 (83.6)	3667 (85.8)	936 (77.5)	<0.001
Single	693 (16.4)	607 (14.2)	271 (22.5)	
Maternal age (years)				
< 20	799 (18.9)	623 (14.6)	304 (24.4)	<0.001
20–34	2865 (67.7)	3018 (70.6)	822 (66.0)	
≥ 35	565 (13.4)	633 (14.8)	120 (9.6)	
Parity				
0	1975 (46.7)	2136 (50.0)	592 (47.5)	<0.001
1	1214 (28.7)	1320 (30.9)	345 (27.7)	
≥ 2	1040 (24.6)	817 (19.1)	309 (24.8)	
Multiple birth				
No	4145 (98.0)	4164 (97.4)	1224 (98.2)	0.081
Yes	84 (2.0)	111 (2.6)	22 (1.8)	
Previous abortion[#]				
No	1848 (72.1)	1732 (73.0)	488 (69.0)	0.119
Yes	715 (27.9)	641 (27.0)	219 (31.0)	
Smoking[§]				
No	3067 (75.5)	3567 (83.5)	1150 (95.1)	<0.001
Yes	1162 (27.5)	705 (16.5)	59 (4.9)	
Alcohol intake[§]				
No	4089 (96.7)	3954 (92.6)	990 (82.0)	<0.001
Yes	140 (3.3)	315 (7.4)	217 (18.0)	
High blood pressure[§]				
No	3220 (76.3)	3183 (74.5)	1029 (82.6)	<0.001
Yes	1001 (23.7)	1089 (25.5)	217 (17.4)	
Diabetes[§]				
No	4100 (97.0)	3906 (91.4)	1230 (98.7)	<0.001
Yes	126 (3.0)	366 (8.6)	16 (1.3)	
Prepregnancy BMI (kg/ m^2)				
< 18.5	215 (7.4)	154 (3.7)	80 (7.2)	<0.001
18.5–24.9	1828 (63.3)	2039 (49.3)	644 (58.0)	
25.0–29.9	587 (20.3)	1169 (28.2)	285 (25.7)	
≥ 30	259 (9.0)	779 (18.8)	101 (9.1)	

[*] Chi-square.
[#] Women without previous pregnancies were not included.
[§] Variables related to the gestational period (e.g. smoking during pregnancy).
MINA-Brazil baseline data collection was carried out from July 2015 to June 2016.

did women from the two Pelotas studies. Even though the proportion of pre-pregnancy BMI categories was similar in the 2004 Pelotas and MINA-Brazil cohorts, pre-pregnancy obesity (BMI > 30 kg/m^2) was two times higher in the 2015 Pelotas than in the other cohorts. No differences were observed amongst the three studies regarding multiple births and previous abortions.

The variations in frequencies of maternal depressive symptomatology after childbirth across the three birth cohort studies and across time periods are shown in Fig. 1. The frequency of depressive symptomatology was higher in MINA-Brazil than in the 2004 and 2015 Pelotas cohorts at 3 months postpartum. However, at the 12- and 24-month follow-ups, the frequencies observed in the 2004 and 2015 Pelotas birth cohort studies were consistently higher than those in the MINA-Brazil study. In the MINA-Brazil cohort, the frequency of depressive symptomatology decreased over time (χ^2 trend $p = 0.003$), while in the 2004 and 2015 Pelotas cohort studies, the frequencies increased over the study period (χ^2 trends $p = 0.003$ and $p < 0.001$, respectively).

Socioeconomic status inequalities in maternal depressive symptomatology are shown in Table 2 and Fig. 2. In all cohorts at the three assessments, depressive symptomatology was negatively associated with socioeconomic status, and absolute and relative inequalities remained fairly stable over the study period. In the 2004 Pelotas study, the economically weaker women had frequencies of depressive symptomatology 2.6 times higher than the richest women at both the 3- and 24-month follow-ups. Women in the 3rd quintile of socioeconomic status presented a significant increase in depressive symptomatology (from 8.2% to 16.1%, $p = 0.027$) during the study. In the 2015 Pelotas cohort, the economically weakest women presented frequencies of depressive symptomatology 4.1 and 3.7 times higher than the richest group at the 3- and 24-month follow-ups, respectively. Except for the richest quintile, the frequency of depressive symptomatology increased significantly over time for all the other quintiles. Finally, in the MINA-Brazil study, the economically weaker women had depressive symptomatology frequencies 3.0 and 3.3 times higher than the richest quintile at the 3- and 24-month follow-ups, respectively. No increase or decrease was observed over time in any socioeconomic quintile. The largest gap (absolute inequality) in the frequencies of depressive symptomatology was found in the 2015 Pelotas cohort at 12 and 24 months postpartum (Fig. 2).

Skin colour inequalities in maternal depressive symptomatology are shown in Table 3 and Fig. 3. In the 2004 Pelotas study, black/brown women had higher frequencies of depressive symptomatology than white women at 12 and 24 months postpartum. In the 2015 Pelotas cohort, black/brown women presented the highest frequencies at the three assessments. The frequency of depressive symptomatology increased amongst white and black/brown women between 3 and 24 months postpartum in both Pelotas studies. In the 2004 and 2015 Pelotas cohorts, absolute and relative skin colour inequalities remained relatively stable. In the MINA-Brazil cohort, black/brown women started with the highest frequency of maternal depressive symptomatology; however, this changed over time: at 12- and 24-month follow-up visits, white women showed the highest frequencies of depressive symptomatology. Thus, there was a change in the direction of the absolute and relative inequalities between the skin colour groups over time. In Fig. 3, the largest gap (absolute inequality) in the frequency of depressive symptomatology between white and black/brown was found in the 2015 Pelotas cohort at 3 and 24 months postpartum, and in the MINA-Brazil study at 12- and 24-month follow-ups.

The distribution and adjusted odds ratios of maternal depressive symptomatology across potential determinants are shown in Supplementary Tables 2 and 3. At the three-time assessments, and in practically all the studies, frequencies of maternal depressive symptomatology were highest amongst women with fewer years of schooling, multiparae, and women who smoked.

4. Discussion

Between 3 and 24 months postpartum, maternal depressive symptomatology increased amongst women from the south of Brazil, but reduced amongst mothers from the north. Marked socioeconomic and skin colour inequalities were observed in depressive symptomatology. In nearly all analyses of the three cohorts, black/brown women and those belonging to the weakest socioeconomic strata had the highest frequencies of postpartum depressive symptomatology. Absolute and relative socioeconomic inequalities remained stable over the study period in all cohorts. Skin colour inequalities remained relatively stable in both the 2004 and 2015 Pelotas cohorts. In the MINA-Brazil cohort, black/brown women showed the highest frequencies of depressive symptomatology at 3 months postpartum, while white women showed the highest frequencies at the 12- and 24-month follow-ups. For the

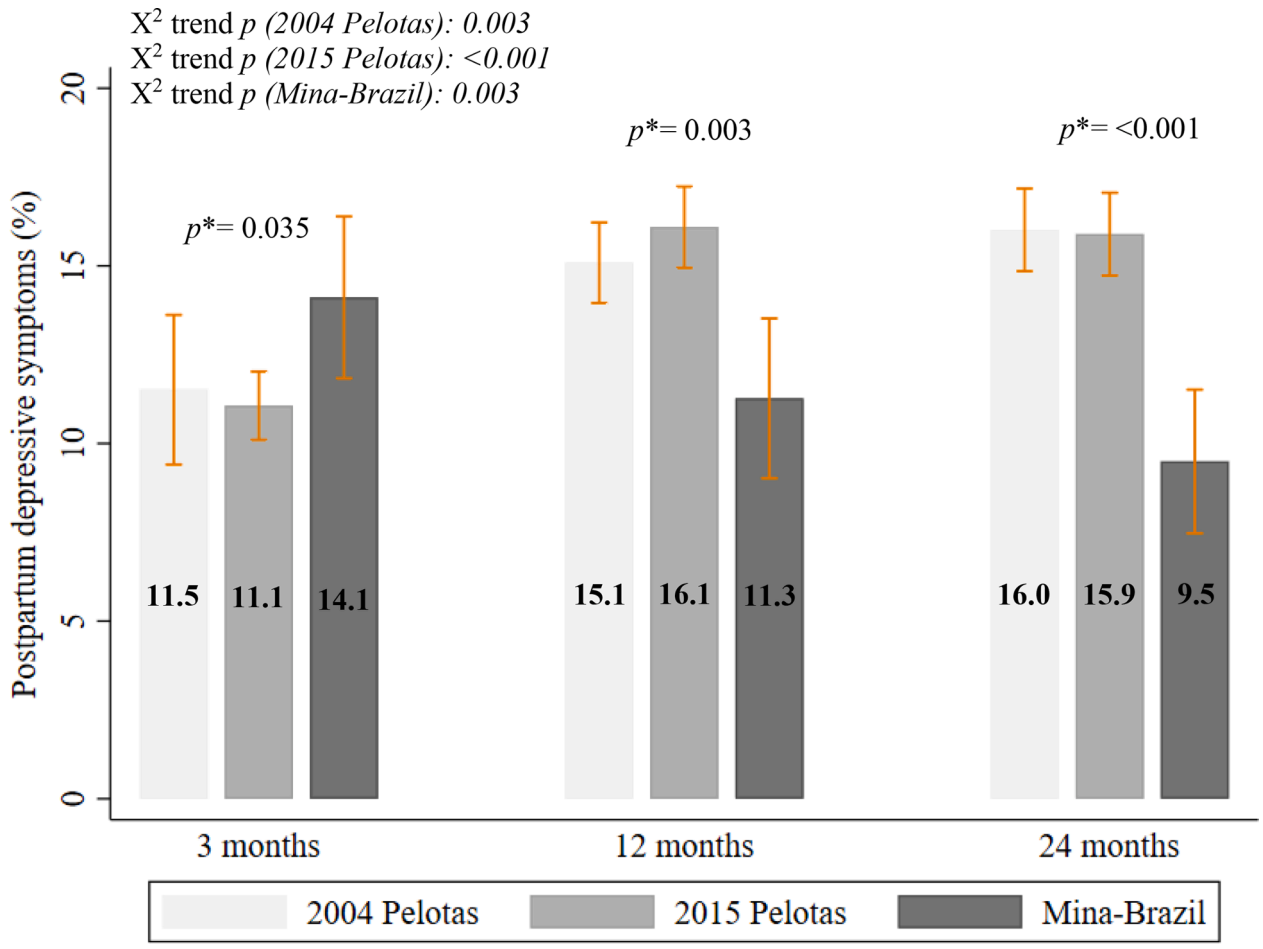

Fig. 1. Frequency of maternal postpartum depressive symptoms and 95% confidence intervals amongst 2004, 2015 Pelotas and MINA-Brazil birth cohorts in the three-time period studied. *x^2 test for difference between the 2004, the 2015 Pelotas and Mina-Brazil birth cohort study in each time assessment. MINA-Brazil baseline data collection was carried out from July 2015 to June 2016.

Table 2
Frequency (%) of maternal postpartum depressive symptoms per cohort in each follow-up period and family income/wealth index quintile.

Cohort study	Frequency and 95% CI, per family income/wealth index quintile					Slope index of inequality (95% CI)	Concentration index (95% CI)
	Weakest	2nd	3rd	4th	Richest		
2004 Pelotas							
3 months	15.9 (11.0; 22.5)	17.2 (12.5; 23.2)	8.2 (4.7; 13.8)	10.1 (6.6; 15.2)	6.2 (3.5; 10.6)	−13.6 (−21.2; −6.0)	−19.5 (−29.6; −9.4)
12 months	22.1 (19.2; 25.2)	20.0 (17.3; 23.0)	14.5 (12.2; 17.2)	11.0 (9.0; 13.4)	8.1 (6.3; 10.2)	−18.6 (−22.6; −14.5)	−19.1 (−23.2; −15.0)
24 months	22.8 (19.9; 25.9)	19.7 (17.0; 22.7)	16.1 (13.7; 18.9)	12.7 (10.5; 15.2)	8.9 (7.1; 11.2)	−17.4 (−21.5; −13.3)	−17.7 (−21.7; −13.7)
x^2 test for linear trend	$p = 0.129$	$p = 0.610$	$p = 0.027$	$p = 0.221$	$p = 0.233$		
2015 Pelotas							
3 months	19.5 (16.9; 22.4)	12.7 (10.6; 15.2)	10.7 (8.7; 13.0)	7.8 (6.2; 9.8)	4.8 (3.5; 6.5)	−17.5 (−21.1; −13.9)	−24.8 (−29.4; −20.1)
12 months	27.6 (24.6; 30.9)	18.5 (16.0; 21.4)	14.3 (12.1; 16.9)	12.6 (10.5; 15.1)	7.7 (6.1; 9.8)	−22.8 (−26.9; −18.7)	−22.5 (−26.4; −18.6)
24 months	25.9 (22.9; 29.2)	18.9 (16.2; 21.7)	14.6 (12.2; 17.3)	13.3 (11.1; 15.9)	6.9 (5.3; 9.0)	−21.8 (−26.0; −17.7)	−22.2 (−26.2; −18.3)
x^2 test for linear trend	$p = 0.003$	$p = 0.001$	$p = 0.021$	$p< 0.001$	$p = 0.077$		
MINA-Brazil							
3 months	22.6 (16.8; 29.8)	13.9 (9.4; 19.9)	11.6 (7.7; 17.2)	15.9 (11.3; 22.0)	7.6 (4.6; 12.5)	−13.5 (−21.8; −5.2)	−11.0 (−20.6; −1.3)
12 months	17.5 (11.7; 25.4)	15.7 (10.5; 22.7)	9.2 (5.6; 14.7)	11.1 (7.0; 17.2)	5.9 (3.2; 10.6)	−13.7 (−22.1; −5.4)	−19.1 (−30.2; −7.9)
24 months	16.4 (10.9; 23.9)	8.4 (4.8; 14.3)	10.0 (6.3; 15.6)	9.1 (5.6; 14.6)	4.9 (2.5; 9.1)	−10.8 (−18.3; −3.3)	−15.1 (−27.6; −2.7)
x^2 test for linear trend	$p = 0.173$	$p = 0.173$	$p = 0.628$	$p = 0.053$	$p = 0.272$		

p-value = x^2 test for linear trend for maternal postpartum depressive symptoms within each category of family income/wealth index over time. MINA-Brazil baseline data collection was carried out from July 2015 to June 2016.

three cohorts, frequencies of maternal depressive symptomatology were highest amongst women with fewer years of schooling, multiparae, and amongst those who smoked during pregnancy.

Brazil is a country with many social inequalities and cultural differences, and Pelotas and Cruzeiro do Sul are two cities with pronounced socioeconomic and racial differences (IBGE, 2017, 2010b, 2010c). Concerning skin colour distribution, individuals who identified themselves as white made up the majority of Pelotas' population (80%), while those who identified themselves as brown were the more prominent group in Cruzeiro do Sul (67%). Other studies have shown that lower socioeconomic levels (Gebregziabher et al., 2020; Goyal et al., 2010) and black/brown skin colour (Araújo et al., 2019; Cannon and Nasrallah, 2019; Filha et al., 2016) are associated with higher frequencies of maternal postpartum depressive symptomatology.

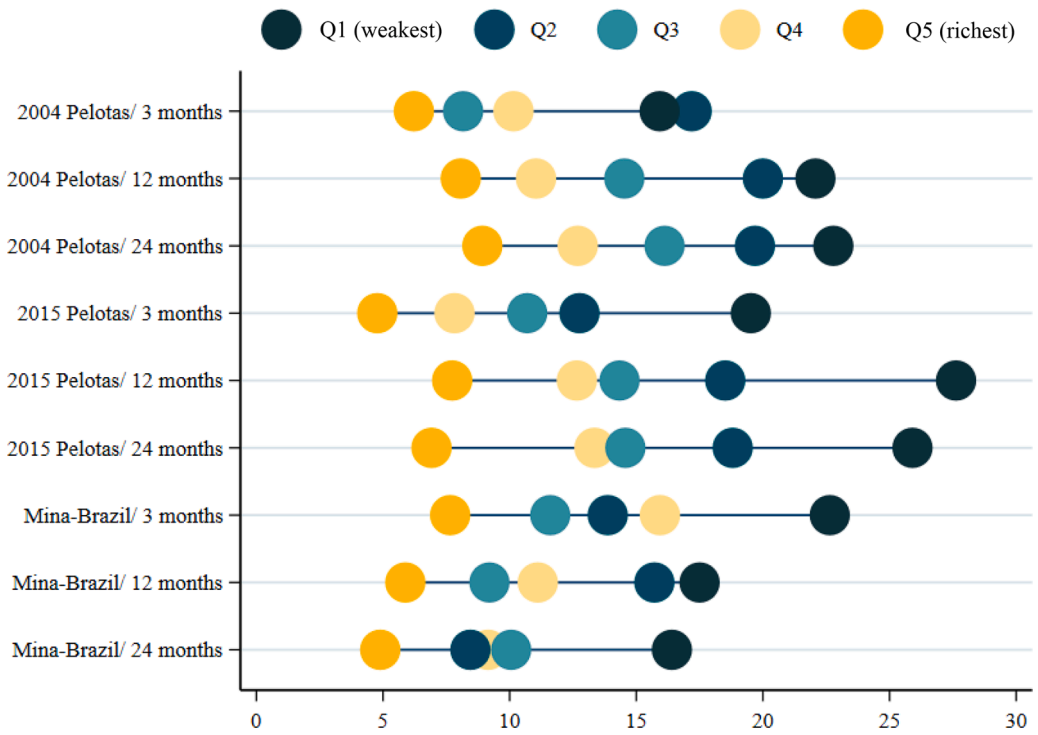

Fig. 2. Frequency (%) of maternal postpartum depressive symptoms by family income/wealth index quintiles amongst 2004, 2015 Pelotas and MINA-Brazil birth cohorts in the three-time period studied. MINA-Brazil baseline data collection was carried out from July 2015 to June 2016.

Therefore, it was expected that maternal depression would be more prevalent in Cruzeiro do Sul than in Pelotas. Although this hypothesis was confirmed at 3 months postpartum, at the 12- and 24-month follow-ups, these frequencies were higher in both studies conducted in Pelotas. These results are intriguing, and further studies are needed, especially in the north of Brazil, where research on postpartum depression is still scarce.

The onset of postpartum depression occurs early, between the first week and the first month after delivery. The majority of cases of postnatal depression are self-limiting and resolve within three to six months of the onset (Cooper and Murray, 1998). However, there is evidence suggesting that for many women, the first episode can trigger recurrent or chronic episodes of depressive disorders (Watson et al., 1984). There are mixed findings regarding the course of maternal depressive symptomatology in the postpartum period. While some studies show stability (Matijasevich et al., 2009), others find an increase (Rubertsson et al., 2006; Matijasevich et al., 2009) or decrease (Tokomitsu et al., 2020) of depressive symptoms in the first two years postpartum. In the present study, the evolution of depressive symptomatology after childbirth was different in the three cohorts analysed, with an increase amongst the southern mothers and a reduction amongst the northern mothers. Additionally, the frequency of depression in the first two years postpartum was higher than that in other national (Melo et al., 2012; Poles et al., 2018) and international (Fan et al., 2020; Song et al., 2019) studies. Therefore, our results point to the need for health professionals to give specific attention to the care of maternal mental health in the postpartum period. The lack or inadequate treatment of maternal depression after childbirth can explain its persistence throughout childbearing years with detrimental effects on mothers, their offspring, and the whole family (Matijasevich et al., 2009).

The Sustainable Development Goals highlight the need for increasing equity, with goal number 10 reaffirming the commitment to reduce inequalities within and between countries (United Nations, 2015). However, in Brazil, social inequalities still affect many important health-related outcomes, including maternal, neonatal, and infant mortality, prematurity, low birth weight, malnutrition and antenatal care quality (Canella et al., 2020; Farias et al., 2019; Menezes et al., 2019; Moreira et al., 2020; Silveira et al., 2019a; Victora et al., 2010). In the present study, we detected substantial socioeconomic and skin colour inequalities in maternal postpartum depressive symptomatology. These absolute and relative inequalities remained stable between 3 and 24 months after childbirth, except for skin colour inequalities in the MINA-Brazil cohort. Here black/brown women showed the highest frequency of depressive symptomatology at the 3-month follow-up, while white mothers showed the highest frequency at 12 and 24 months postpartum. The association between socioeconomic status and postpartum depressive symptomatology was previously reported by international (Gebregziabher et al., 2020; Goyal et al., 2010; Wassif et al., 2019) and national studies (Araújo et al., 2019; Filha et al., 2016; Melo et al., 2012), with economically weaker women being more affected by postpartum depression than the economically better-off mothers. However, our study addresses a gap in the literature by studying absolute and relative social inequalities in maternal depressive symptomatology over the first two years after pregnancy. Barros and Victora (2013) highlight the need for inequality measures that consider the entire socioeconomic distribution, such as the slope index of inequality (absolute measure) and the relative concentration index (relative measure). Furthermore, few authors have investigated both socioeconomic and racial inequalities in maternal depression during the postpartum period (Matijasevich et al., 2009).

Socioeconomic inequalities in postpartum depressive symptomatology may be explained by a lack of resources available to poorer women, including access to medical care, transportation, and support from a partner or spouse, which makes proper treatment difficult (Goyal et al., 2010). Landy et al. (2008) argue that women from the economically weaker social strata often experience inequities in health and health care. In their daily lives, they face chronic stressors that go beyond poverty, such as lack of social support, isolation, racism, violence, language barriers, and low levels of education. In our study, socioeconomic inequalities in postpartum depressive symptomatology were similar in two regions of Brazil with different social and geographic characteristics, suggesting that economically weaker mothers are more

Table 3
Frequency (%) of maternal postpartum depressive symptoms per cohort in each follow-up period and maternal skin colour.

Cohort study	Frequency and 95% CI, per maternal skin colour			Absolute inequality	Relative inequality
	White	Black/ Brown[#]	p[*]		
2004 Pelotas					
3 months	10.8 (8.6; 13.5)	13.3 (9.6; 18.1)	0.297	2.5	1.2
12 months	14.3 (13.1; 15.6)	17.2 (15.0; 19.7)	0.025	2.9	1.2
24 months	14.9 (13.6; 16.2)	19.1 (16.8; 21.6)	0.002	4.2	1.3
x^2 test for linear trend	$p = 0.025$	$p = 0.034$			
2015 Pelotas					
3 months	9.0 (8.0; 10.1)	16.0 (14.0; 18.2)	<0.001	7.0	1.8
12 months	14.6 (13.3; 15.9)	19.9 (17.7; 22.3)	<0.001	5.4	1.4
24 months	14.2 (12.9; 15.5)	20.2 (17.9; 22.6)	<0.001	6.0	1.4
x^2 test for linear trend	$p < 0.001$	$p = 0.010$			
MINA-Brazil					
3 months	11.3 (6.4; 19.4)	14.5 (12.2; 17.1)	0.404	3.2	1.3
12 months	16.5 (10.1; 25.6)	10.6 (8.5; 13.2)	0.097	−5.9	0.6
24 months	14.4 (8.7; 23.0)	8.9 (7.0; 11.3)	0.084	−5.5	0.6
x^2 test for linear trend	$p = 0.536$	$p = 0.001$			

[#] Brown, yellow and indigenous.
[*] Chi-square test. Absolute inequality = (brown + black) - white. Relative inequality = (brown + black) / white. MINA-Brazil baseline data collection was carried out from July 2015 to June 2016.

affected by postpartum depressive symptomatology than wealthier women, regardless of the region of the country where they reside.

International studies conducted earlier have reported skin colour inequalities in maternal postpartum depressive symptomatology (Chan et al., 2020; Ko et al., 2017; Liu and Tronick, 2013) with black/brown women being more affected by postpartum depression than white mothers. Due to ethnic inequalities in access to community mental health services (Alegria et al., 2008; Maina et al., 2018), the likelihood that women receive mental health care for postpartum depression may vary by race and ethnicity. Pascoe and Richman (2009) highlighted that skin colour inequalities are potentially related to discrimination or structural racism, whereby obstetric or community mental health providers dismiss or misplace depressive symptoms in women from minority communities. (Kozhimannil et al., 2011) studied mothers from the USA and observed that the relationship between ethnicity, depression, and mental health care is complex and highlighted several related factors such as cultural expectations and perceptions of both motherhood and mental health, differences in risk factors, perceived need for care, socioeconomic status, provider factors, patient-provider communication, and access/type of health insurance.

The highest frequencies of postpartum depressive symptomatology amongst non-white women have been reported in other Brazilian studies (Araújo et al., 2019; Filha et al., 2016). Filha et al. (2016), who studied 23,894 postpartum women from Brazil's five macro-regions, noted that mothers with brown skin presented a higher frequency of depressive symptomatology than those with white skin. Besides postpartum depression, other health inequalities related to skin colour are frequent in Brazil. The highest frequencies of negative health outcomes such as unplanned pregnancies, short birth intervals, previous preterm births, and previous low birth weights have been reported amongst black/-brown women (Matijasevich et al., 2019; Moreira et al., 2020). Leal et al. (2005) analysed inequalities in access to and utilisation of healthcare services according to skin colour, and reported less access to adequate prenatal as well as greater difficulties in admission to maternity hospitals amongst women with black/brown skin colour. The authors affirm that the disadvantages experienced by black and brown women in the country extended beyond socioeconomic indicators to maternal and foetal care, with several indicators related to prenatal, delivery, and new-born care deteriorating as skin colour darkened. Victora et al. (2010) evaluated maternal skin colour inequalities in antenatal care quality, and reported that black/brown women had lower frequencies of 12 procedures, including screening for cervical cancer, blood and urine analyses, prescription of vitamins, and ultrasound performed during antenatal care than did white mothers.

Many researchers have investigated risk factors for maternal depression in the postpartum period, and our findings are similar to most of these studies. Lesser education was associated with a higher risk of postpartum depressive symptomatology in several studies (Ghaedrahmati et al., 2017; Goyal et al., 2010; Jansen et al., 2010; Lobato et al., 2011; (Matsumura et al.,2019). In a cross-sectional survey of 811 mothers from southeastern Brazil, Lobato et al. (2011) noted that postpartum depression was consistently higher amongst women with low schooling. Findings on the association between parity and postpartum depressive symptomatology were mixed. Brazilian studies with 2687 (Hartmann et al., 2017), 555 (Melo et al., 2012), and 23,894 mothers (Filha et al., 2016) observed that multiparity was associated with an increased risk of postpartum depression. However, Satoh et al. (2009) and Iwata et al. (2016) investigated 169 and 3769 Japanese mothers, respectively, and noted that primiparae showed a higher frequency of postpartum depressive symptomatology than multiparae. Additionally, Tokomitsu et al. (2020) in a recent meta-analysis including 123 studies also observed higher frequencies of postpartum depression amongst primiparae than multiparae.

Regarding smoking during pregnancy, a recent meta-analysis (Chen et al., 2019), including 13 studies with 1476,922 women, indicated that prenatal smoking was consistently associated with postpartum depression. Jansen et al. (2010), studying Brazilian mothers, observed that smoking during the prenatal period increased the incidence of postpartum depression by 1.7 times. Gurber et al. (2017) argued that physiological changes during pregnancy may be experienced as stressful events by some mothers, leading to the onset of depression symptoms and beginning smoking. The association between smoking and postpartum depression is well established in the literature, and even passive smoking has been associated with this outcome (Song et al., 2019).

Our study has some limitations. For the analysis of self-reported skin colour inequalities, the skin colour categories 'brown' and 'black' were pooled. However, in Brazil, skin colour is best represented by a gradient (Moreira et al., 2020). Thus, we chose to provide in our supplementary material further analyses stratified independently by white, brown, and black women. We also have no information about the use of antidepressants or any psychological/psychiatric treatment at the time the EPDS was administered, and some mistakes in classifications cannot be ruled out for the three cohorts. In addition, socioeconomic positions have been assessed in different ways in Pelotas studies and in the MINA-Brazil cohort. In Pelotas, family income was used, while in

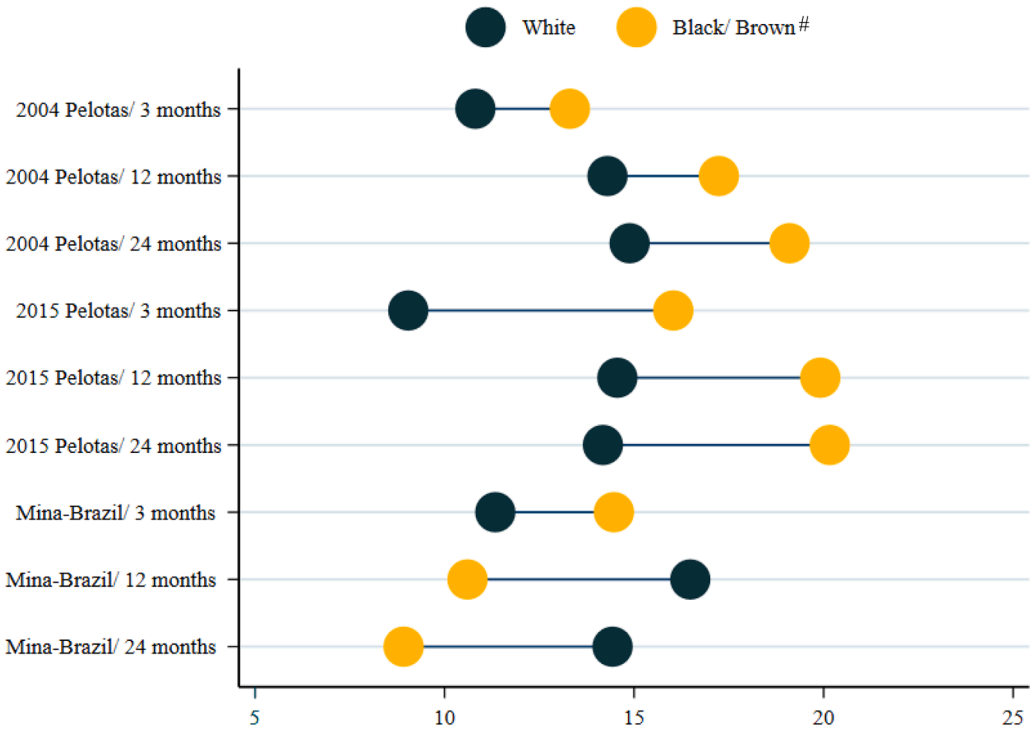

Fig. 3. Frequency (%) of maternal postpartum depressive symptoms by skin colour amongst 2004, 2015 Pelotas and MINA-Brazil birth cohorts in the three-time period studied. #Brown, yellow and indigenous. MINA-Brazil baseline data collection was carried out from July 2015 to June 2016.

MINA-Brazil information on household assets was assessed to calculate a wealth index as a proxy of socioeconomic status. However, as we use quintiles of these two measures of socioeconomic position, we believe that our approach still allows us to verify disparities amongst the wealthiest and economically weakest women in each cohort study. Additionally, there is no data on maternal depressive symptomatology on the course of the pregnancy. This was unfortunate as early maternal depression could be important not only for the later child outcomes, but also as a determinant of the trajectory of maternal mood.The last limitation is the potentially different qualities of mental health care available for women in the city of Pelotas and Cruzeiro do Sul, which may partially explain the reduction in postpartum depressive symptomatology amongst mothers from the north of the country. In the MINA-Brazil cohort (Cruzeiro do Sul, Acre), we hypothesised that the 'strong bond' created between the team of professionals/researchers and the study participants could have stimulated greater reference of women experiencing depressive symptoms to mental health services available in the city. However, we have no data to certify better access to health services for participants of the MINA-Brazil study, as we do not know whether women who were referred to mental health services actually consulted more or were treated more than mothers from the Pelotas cohort.

A major strength of the present study was its mode of data collection (prospective information was obtained from amongst large unselected populations over time), combined with the use of a standardised and validated screening instrument for maternal postnatal depressive symptomatology in the three cohort studies. Large-scale surveys such as the Pelotas and MINA-Brazil birth cohorts are important for monitoring the occurrence and trends of health outcomes amongst women and their children over time. Additionally, the equal timings of maternal depressive symptomatology assessments (at 3, 12, and 24 months) in the three studies may prevent bias in the results. Moreover, to the best of our knowledge, this is the first longitudinal study to investigate social inequalities in postpartum depressive symptomatology in mothers living in the Brazilian Amazon region (MINA-Brazil cohort).

It is important to highlight the clinical and public health implications of our findings. Maternal depression has profound short- and long-term effects on the physical and mental health of the offspring (Brockington, 2017; Culpepper, 2015; Leivas et al., 2018). Actions aimed at early detection, prevention of modifiable risk factors, adequate treatment of depressive episodes, and reducing social inequalities in maternal postpartum depressive symptomatology are vital. Strategies that facilitate the reduction of health inequalities must be multidisciplinary and include all sectors of the health system. Identifying and improving inequalities in access to and utilisation of mental health care for postpartum women should be a maternal health priority.

5. Credit author statement

Danilo Dias Santana: Writing - Original Draft Preparation, Data analysis. **Marly Augusto Cardoso:** Conceptualization, Methodology, Data collection, Writing- Reviewing and Editing, Funding acquisition. **Iná S. Santos:** Conceptualization, Methodology, Data collection, Writing- Reviewing and Editing, Funding acquisition. **Maira Barreto Malta:** Methodology, Data collection, Writing- Reviewing and Editing. **Bárbara Hatzlhoffer Lourenço:** Methodology, Data collection, Writing- Reviewing and Editing. **Marcia C. Castro:** Conceptualization, Methodology, Data collection, Writing- Reviewing and Editing, Funding acquisition. **Mariângela Freitas da Silveira:** Conceptualization, Methodology, Data collection, Writing- Reviewing and Editing, Funding acquisition. **Marlos Domingues:** Conceptualization, Methodology, Data collection, Writing- Reviewing and Editing, Funding acquisition. **Joseph Murray:** Conceptualization, Methodology, Data collection, Writing-Reviewing and Editing, Fnunding acquisition. **Alicia Matijasevich:** Conceptualization, Methodology, Writing- Reviewing and Editing, Funding acquisition.

6. Author contributions

Conceptualization: MAC, ISS, MCC, MFS, MD, JM and AM; Methodology: MAC, ISS, MBM, BHL, MCC, MFS, MD, JM and AM; Data collection: MAC, ISS, MBM, MFS, MD, and JM; Data analysis: DDS;

Writing - Original Draft Preparation: DDS; Writing - Review and Editing: all authors; Funding Acquisition: MAC, ISS, MCC, MFS, MD, JM and AM. All authors have read and agreed whit this version of the manuscript.

Declaration of Competing Interest

The authors declare no conflicts of interest. The funders were not involved in the design or interpretation of the findings.

Availability of data and materials

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

Funding

The MINA-Brazil study was supported by the Brazilian National Council for Scientific and Technological Development (CNPq) (grant number 407255/2013–3), the Maria Cecília Souto Vidigal Foundation, and the São Paulo Research Foundation (FAPESP) (grant number 2016/00270–6). The 2004 Pelotas study was supported by the Wellcome Trust, The World Health Organization, National Support Program for Centers of Excellence (PRONEX), CNPq, Brazilian Ministry of Health, and Children's Pastorate. The 2015 Pelotas Birth Cohort was supported by the Wellcome Trust (grant numbers 095582 and 10735_Z_18_Z), CNPq, Fundação de Amparo a Pesquisa do Estado do Rio Grande do Sul (FAPERGS), Children's Pastorate, and the Bernard van Leer Foundation (grant number BRA-2018–178). DDS is supported by FAPESP (grant number 2020/04259–2). MAC, ISS, MFS, MD, JM and AM are supported by CNPq.

Acknowledgements

The authors thank all the women and children who participated in the MINA-Brazil Study. The establishment of this cohort involved a large number of professional health workers, research team members, and different institutions, with special acknowledgments to the Maternity Hospital and Primary Health Care Units of Cruzeiro do Sul, Acre, Brazil. This article is based on data from the studies 'Pelotas Birth Cohort, 2004, 2015′ conducted by the Postgraduate Program in Epidemiology at Universidade Federal de Pelotas, in collaboration with the Brazilian Public Health Association (ABRASCO).

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jadr.2021.100247.

References

Angelo, R., Sabino, L., Schwingel, P., Lima, A., Zambaldi, A., Cantilino, A., et al., 2014. Pain and associated factors in depressed and non depressed puerperal women. Rev. Dor. 15, 100–106. https://doi.org/10.5935/1806-0013.20140022.

Araújo, I.S., Aquino, K.S., Fagundes, L.K.A., Santos, V.C., 2019. Postpartum depression: epidemiological clinical profile of patients attended in a reference public maternity in Salvador-BA. Rev. Bras. Ginecol. Obstet. 41, 155–163. https://doi.org/10.1055/s-0038-1676861.

Barros, A.J., Ronsmans, C., Axelson, H., Loaiza, E., Bertoldi, A.D., França, G.V., et al., 2012. Equity in maternal, newborn, and child health interventions in Countdown to 2015: a retrospective review of survey data from 54 countries. Lancet 379, 1225–1233. https://doi.org/10.1016/S0140-6736(12)60113-5.

Barros, A.K., Victora, C.G., 2013. Measuring coverage in MNCH: determining and interpreting inequalities in coverage of maternal, newborn, and child health interventions. PLoS Med 10, e1001390. https://doi.org/10.1371/journal.pmed.1001390.

Boccolini, C.S., Boccolini, P.M.M., Monteiro, F.R., Venancio, S.I., Giugliani, E.R.J., 2017. Breastfeeding indicators trends in Brazil for three decades. Rev. Saude Publica. 51 https://doi.org/10.11606/s1518-8787.2017051000029. Epub November 17.

Brito, C., Alves, S., Ludermir, A., Araújo, T., 2015. Depressão pós-parto entre mulheres com gravidez não pretendida. Rev. Saude Publica. 49, 1–9. https://doi.org/10.1590/S0034-8910.2015049005257.

Brockington, I., 2017. Suicide and filicide in postpartum psychosis. Arch. Womens Ment. Health. 20, 63–69. https://doi.org/10.1007/s00737-016-0675-8.

Canella, D.S., Duran, A.C., Claro, R.M., 2020. Malnutrition in all its forms and social inequalities in Brazil. Public Health Nutr 23 (S1), s29–s38. https://doi.org/10.1017/S136898001900274X.

Çankaya, S., 2020. The effect of psychosocial risk factors on postpartum depression in antenatal period: a prospective study. Arch. Psychiatr. Nurs. 34, 176–183. https://doi.org/10.1016/j.apnu.2020.04.007.

Cannon, C., Nasrallah, H.A., 2019. A focus on postpartum depression among African American women: a literature review. Ann. Clin. Psychiatry. 31, 138–143.

Cardoso, M.A., Matijasevich, A., Malta, M.B., Lourenco, B.H., Gimeno, S., Ferreira, M.U., Castro, M.C., Group, MINA-Brazil Study, 2020. Cohort profile: the Maternal and Child Health and Nutrition in Acre, Brazil, birth cohort study (MINA-Brazil). BMJ Open 10, e034513. https://doi.org/10.1136/bmjopen-2019-034513.

Chan, A.L., Guo, N., Popat, R., Robakis, T., Blumenfeld, Y.Y., et al., 2020. Racial and Ethnic Disparities in Hospital-Based Care Associated with Postpartum Depression. J. Racial Ethn. Health Disparities. Advance online publication. https://doi.org/10.1007/s40615-020-00774-y.

Chen, H.L., Cai, J.Y., Zha, M.L., Shen, W.Q., 2019. Prenatal smoking and postpartum depression: a meta-analysis. J. Psychosom. Obstet. Gynaecol. 40, 97–105. https://doi.org/10.1080/0167482X.2017.1415881.

Committee on Obstetric Practice, 2015. The American College of Obstetricians and Gynecologists Committee Opinion no. 630. Screening for perinatal depression. Obstet. Gynecol. 125, 1268–1271. https://doi.org/10.1097/01.AOG.0000465192.34779.dc.

Cooper, P.J., Murray, L., 1998. Postnatal depression. BMJ 316, 1884–1886.

Cox, J.L., Holden, J.M., Sagovsky, R., 1987. Detection of postnatal depression: development of the 10 item Edinburgh Postnatal Depression Scale. Br. J. Psychiatry. 150, 782–786.

Culpepper, L., 2015. Impact of untreated major depressive disorder on cognition and daily function. J. Clin. Psychiatry. 76, e901. https://doi.org/10.4088/JCP.13086tx4c.

Fan, Q., Long, Q., De Silva, V., Gunarathna, N., Jayathilaka, U., et al., 2020. Prevalence and risk factors for postpartum depression in Sri Lanka: a population-based study. Asian J. Psychiatr. 47, 101855 https://doi.org/10.1016/j.ajp.2019.101855.

Farias, Y.N., Leite, I.D.C., Siqueira, M.A.M.T., Cardoso, A.M., 2019. [Ethnic and racial inequalities in hospital admissions due to avoidable causes in under-five Brazilian children, 2009-2014]. Cad. Saude Publica. 19 (S3), e00001019 https://doi.org/10.1590/0102-311x00001019.

Farías-Antúnez, S., Matijasevich, A., Barros, A.J.D., 2020. Maternal depression trajectories from 3 months to 11 years postpartum and offspring body composition in early adolescence Public Health Nutr. Santos, I.D.S.D., 23, 2327–2335. https://doi.org/10.1017/S1368980019005196.

Filha, M., Ayers, S., Gama, S., Leal, M., 2016. Factors associated with postpartum depressive symptomatology in Brazil: the Birth in Brazil National Research Study, 2011/2012. J. Affect. Disord. 194 https://doi.org/10.1016/j.jad.2016.01.020.

Gebregziabher, N.K., Netsereab, T.B., Fessaha, Y.G., Alaza, F.A., Ghebrehiwet, N.K., Sium, A.H., 2020. Prevalence and associated factors of postpartum depression among postpartum mothers in central region, Eritrea: a health facility based survey. BMC Public Health 1614. https://doi.org/10.1186/s12889-020-09676-4.

Ghaedrahmati, M., Kazemi, A., Kheirabadi, G., Ebrahimi, A., Bahrami, M., 2017. Postpartum depression risk factors: a narrative review. J. Educ. Health. Promot. 6, 60. https://doi.org/10.4103/jehp.jehp_9_16.

Goyal, D., Gay, C., Lee, K.A., 2010. How much does low socioeconomic status increase the risk of prenatal and postpartum depressive symptoms in first-time mothers? Womens Health Issues 20, 96–104. https://doi.org/10.1016/j.whi.2009.11.003.

Gurber, S., Baumeler, L., Grob, A., Surbek, D., Stadlmayr, W., 2017. Antenatal depressive symptoms and subjective birth experience in association with postpartum depressive symptoms and acute stress reaction in mothers and fathers: a longitudinal path analysis. Eur. J. Obstet. Gynecol. Reprod. Biol. 215, 68–74. https://doi.org/10.1016/j.ejogrb.2017.05.021.

Hallal, P.C., Bertoldi, A.D., Domingues, M.R., da Silveira, M.F., Demarco, F.F., da Silva, I., et al., 2018. Cohort Profile: the 2015 Pelotas (Brazil) Birth Cohort Study. Int. J. Epidemiol. 47 https://doi.org/10.1093/ije/dyx219, 1048–1048 h.

Harper, S., Lynch, J., 2005. Methods For Measuring Cancer Disparities: Using Data Relevant to Healthy People 2010 Cancer-Related Objectives, in: NCI Cancer Surveillance Monograph Series. National Cancer Institute, Maryland.

Hartmann, J.M., Mendoza-Sassi, R.A., Cesar, J.A., 2017. [Postpartum depression: prevalence and associated factors]. Cad Saude Publica 33, e00094016. https://doi.org/10.1590/0102-311x00094016.

IBGE, Instituto Brasileiro de Geografia e Estatística, 2010a. Percentual da população com rendimento nominal mensal per capita de até 1/2 salário mínimo: IBGE, Censo Demográfico. https://www.ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?=&t=conceitos-e-metodos (accessed 2 July 2020).

IBGE, Instituto Brasileiro de Geografia e Estatística, 2010b. Índice de Desenvolvimento Humano. https://cidades.ibge.gov.br/brasil/(accessed 5 November 2020).

IBGE, Instituto Brasileiro de Geografia e Estatística, 2010c. População residente por cor ou raça e religião. https://sidra.ibge.gov.br/Tabela/3175#resultado (accessed 25 November 2020).

IBGE, Instituto Brasileiro de Geografia e Estatística, 2010d Atlas do Censo Demográfico de 2010. https://biblioteca.ibge.gov.br/visualizacao/livros/liv64529_cap9.pdf (accessed 16 March 2021).

IBGE, Instituto Brasileiro de Geografia e Estatística, 2017. PIB Per capita: IBGE, Em Parceria Com Os Órgãos Estaduais De Estatística. Secretarias Estaduais de Governo e Superintendência da Zona Franca de Manaus – SUFRAMA https://www.ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?=&t=conceitos-e-metodos (accessed 13 July 2020).

IBGE, Instituto Brasileiro de Geografia e Estatística, 2019. Estimativas da População. https://www.ibge.gov.br/estatisticas/sociais/populacao/9103-estimativas-de-populacao.html?=&t=conceitos-e-metodos (accessed 13 June 2020).

IPEA, Instituto de Pesquisa Econômica Aplicada, 2019. Radar IDHM: evolução do IDHM e de seus índices componentes no período de 2012 a 2017. https://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/190416_rada_IDHM.pdf (accessed 21 November 2020).

Iwata, H., Mori, E., Sakajo, A., Aoki, K., Maehara, K., Tamakoshi, K., 2016. Prevalence of postpartum depressive symptoms during the first 6 months postpartum: association with maternal age and parity. J. Affect. Disord. 203, 227–232. https://doi.org/10.1016/j.jad.2016.06.002.

Jansen, K., Curra, A.R., Souza, L.D., Pinheiro, R.T., Moraes, I.G., Cunha, M.S., et al., 2010. Tobacco smoking and depression during pregnancy. Rev. Psiquiatr. Rio Gd. Sul. 32, 44–47. https://doi.org/10.1590/S0101-81082010000200004.

Kawachi, I., Subramanian, S.V., Almeida-Filho, N., 2002. A glossary for health inequalities. J. Epidemiol. Community. Health. 56, 647–652. https://doi.org/10.1136/jech.56.9.647.

Kingsbury, A.M., Plotnikova, M., Clavarino, A., Mamun, A., Najman, J.M., 2018. Social adversity in pregnancy and trajectories of women's depressive symptoms: a longitudinal study. Women Birth 31, 52–58. https://doi.org/10.1016/j.wombi.2017.06.016.

Ko, J.Y., Rockhill, K.M., Tong, V.T., Morrow, B., Farr, S.L., 2017. Trends in postpartum depressive symptoms - 27 states, 2004 2008, and 2012. MMWR Morb. Mortal. Wkly. Rep 66, 153–158. https://doi.org/10.15585/mmwr.mm6606a1.

Kozhimannil, K.B., Trinacty, C.M., Busch, A.B., Huskamp, H.A., Adams, A.S., 2011. Racial and ethnic disparities in postpartum depression care among low-income women. Psychiatr Serv 62, 619–625. https://doi.org/10.1176/appi.ps.62.6.619.

Leal, M.C., Gama, S.G.N., Cunha, C.B., 2005. Racial, sociodemographic, and prenatal and childbirth care inequalities in Brazil, 1999-2001. Rev. Saude Publica. 39, 100–107. https://doi.org/10.1590/s0034-89102005000100013.

Leivas, P., Tejada, C., Bertoldi, A., Santos, A., Jacinto, P., 2018. Associação da posição socioeconômica e da depressão materna com a saúde das crianças: avaliação da PNAD 2008. Brasil. Ciênc. saúde coletiva. 23, 1635–1645. https://doi.org/10.1590/1413-81232018235.23162015.

Lima, T., Maciel, W., Alencar, M., Cruz, J., Carvalho, C., Silva, A., 2017. Association between maternal depressive symptoms with child malnutrition or child excess weight. Rev. Bras. Saude Mater. Infant. 17, 591–601. https://doi.org/10.1590/1806-93042017000300010.

Liu, C.H., Tronick, E., 2013. Rates and predictors of postpartum depression by race and ethnicity: results from the 2004 to 2007 New York City PRAMS survey (Pregnancy Risk Assessment Monitoring System). Matern. Child Health J 17, 1599–1610. https://doi.org/10.1007/s10995-012-1171-z.

Lobato, G., Moraes, C.L., Dias, A.S., Reichenheim, M.E., 2011. Postpartum depression according to time frames and sub-groups: a survey in primary health care settings in Rio de Janeiro. Brazil. Arch. Womens Ment. Health. 14, 187–193. https://doi.org/10.1007/s00737-011-0206-6.

Lubotzky-Gete, S., Ornoy, A., Grotto, I., Calderon-Margalit, R., 2021. Postpartum depression and infant development up to 24 months: a nationwide population-based study. J. Affect. Disord. 285, 136–143. https://doi.org/10.1016/j.jad.2021.02.042.

Maina, I.W., Belton, T.D., Ginzberg, S., Singh, A., Johnson, T.J., 2018. A decade of studying implicit racial/ethnic bias in healthcare providers using the implicit association test. Soc. Sci. Med. 199, 219–229. https://doi.org/10.1016/j.socscimed.2017.05.009.

Matijasevich, A., Golding, J., Smith, G.D., Santos, I.S., Barros, A.J., Victora, C.G., 2009. Differentials and income-related inequalities in maternal depression during the first two years after childbirth: birth cohort studies from Brazil and the UK. Clin. Pract. Epidemiol. Ment. Health. 5, 12. https://doi.org/10.1186/1745-0179-5-12.

Matijasevich, A., Victora, C.G., Silveira, M.F., Wehrmeister, F.C., Horta, B.L., Barros, F.C., et al., 2019. Maternal reproductive history: trends and inequalities in four population-based birth cohorts in Pelotas, Brazil, 1982-2015. Int. J. Epidemiol. 48 (S1), i16–i25. https://doi.org/10.1093/ije/dyy169.

Matsumura, K., Hamazaki, K., Tsuchida, A., Kasamatsu, H., Inadera, H., IBGE, Instituto Brasileiro de Geografia e Estatística, 2019. Education level and risk of postpartum depression: results from the Japan Environment and Children's Study (JECS). BMC Psychiatry 19, 419. https://doi.org/10.1186/s12888-019-2401-3.

Melo, E.F., Cecatti, J.G., Pacagnella, R.C., Leite, D.F., Vulcani, D.E., Makuch, M.Y., 2012. The prevalence of perinatal depression and its associated factors in two different settings in Brazil. J. Affect. Disord. 136, 1204–1208. https://doi.org/10.1016/j.jad.2011.11.023.

Menezes, A.M.B., Barros, F.C., Horta, B.L., Matijasevich, A., Bertoldi, A.D., Oliveira, P.D., et al., 2019. Stillbirth, newborn and infant mortality: trends and inequalities in four population-based birth cohorts in Pelotas, Brazil, 1982-2015. Int. J. Epidemiol. 48 (S1), i54–i62. https://doi.org/10.1093/ije/dyy129.

Moreira, L.R., Ewerling, F., dos Santos, I.S., Wehrmeister, F.C., Matijasevich, A., Barros, A.J.D., et al., 2020. Trends and inequalities in unplanned pregnancy in three population-based birth cohorts in Pelotas. Brazil. Int. J. Public Health. 65, 1635–1645. https://doi.org/10.1007/s00038-020-01505-0.

Neamah, H.H., Sudfeld, C., McCoy, D.C., Fink, G., Fawzi, W., Masanja, H., et al., 2018. Intimate Partner Violence, Depression, and Child Growth and Development. Pediatrics 142, e20173457. https://doi.org/10.1542/peds.2017-3457.

Onis, M., Onyango, A.W., Borghi, E., Siyam, A., Nishida, C., Siekmann, J., 2007. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ 85, 660–667. https://doi.org/10.2471/BLT.07.043497.

Pascoe, E.A., Richman, L.S., 2009. Perceived discrimination and health: a meta-analytic review. Psychol. Bull. 135, 531–554. https://doi.org/10.1037/a0016059.

Payne, J., Maguire, J., 2019. Pathophysiological mechanisms implicated in postpartum depression. Front. Neuroendocrinol. 52, 165–180. https://doi.org/10.1016/j.yfrne.2018.12.001.

Poles, M., Carvalheira, A., Carvalhaes, M., Parada, C., 2018. Sintomas depressivos maternos no puerpério imediato: fatores associados. Acta Paul. Enferm. 31, 351–358. https://doi.org/10.1590/1982-0194201800050.

Rubertsson, C., Wickberg, B., Gustavsson, P., Radestad, I., 2006. Depressive symptoms in early pregnancy, two months and one year postpartum-prevalence and psychosocial risk factors in a national Swedish sample. Arch. Womens Ment. Health. 8, 97–104. https://doi.org/10.1007/s00737-005-0078-8.

Santos, I.S., Barros, A.J., Matijasevich, A., Domingues, M.R., Barros, F.C., Victora, C.G., 2011. Cohort Profile: the 2004 Pelotas (Brazil) birth cohort study. Int J Epidemiol 40, 1461–1468. https://doi.org/10.1093/ije/dyq130.

Santos, I.S., Matijasevich, A., Tavares, B.F., Barros, A.J., Botelho, I.P., Lapolli, C., et al., 2007. Validation of the Edinburg Postnatal Depression Scale (EPDS) in a sample of mothers from the 2004 Pelotas Birth Cohort Study. Cad Saude Publica 23, 2577–2588. https://doi.org/10.1590/S0102-311x2007001100005.

Satoh, A., Kitamiya, C., Kudoh, H., Watanabe, M., Menzawa, K., Sasaki, H., 2009. Factors associated with late post-partum depression in Japan. Jpn. J. Nurs. Sci. 6, 27–36. https://doi.org/10.1111/j.1742-7924.2009.00121.x.

Shaw, M., Galobardes, B., Lawlor, D., Lynch, J., Wheeler, B., Davey Smith, G., 2007. The Handbook of Inequality and Socioeconomic Position: Concepts and Measures. Policy Press, Bristol.

Silveira, M.F., Victora, C.G., Horta, B.L., Silva, B.G., Matijasevich, A., Barros, F.C., et al., 2019a. Low birthweight and preterm birth: trends and inequalities in four population-based birth cohorts in Pelotas, Brazil, 1982-2015. Int. J. Epidemiol. 48 (S1), i46–i53. https://doi.org/10.1093/ije/dyy106.

Silveira, M.F., Mesenburg, M.A., Bertoldi, A.D., De Mola, C.L., Bassani, D.G., Domingues, M.R., et al., 2019b. The association between disrespect and abuse of women during childbirth and postpartum depression: findings from the 2015 Pelotas birth cohort study. J. Affect. Disord. 256, 441–447. https://doi.org/10.1016/j.jad.2019.06.016.

Stein, A., Pearson, R.M., Goodman, S.H., Rapa, E., Rahman, A., McCallum, M., et al., 2014. Effects of perinatal mental disorders on the fetus and child. Lancet 384, 1800–1819. https://doi.org/10.1016/S0140-6736(14)61277-0.

Strapasson, M.R., Ferreira, C.F., Ramos, J.G.L., 2018. Associations between postpartum depression and hypertensive disorders of pregnancy. Int. J. Gynaecol. Obstet. 143, 367–373. https://doi.org/10.1002/ijgo.12665.

United Nations, 2015. Transforming our world: the 2030 agenda for sustainable development. https://sustainabledevelopment.un.org/post2015/transformingourworld (accessed 17 December 2020).

Victora, C.G., Matijasevich, A., Silveira, M., Santos, I., Barros, A.J., Barros, F.C., 2010. Socio-economic and ethnic group inequities in antenatal care quality in the public and private sector in Brazil. Health Policy Plan 25, 253–261. https://doi.org/10.1093/heapol/czp065.

Victora, C.G., Huttly, S.R., Fuchs, S.C., Olinto, M.T., 1997. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. Int. J. Epidemiol. 26, 224–227. https://doi.org/10.1093/ije/26.1.224.

Wagstaff, A., Paci, P., van Doorslaer, E., 1991. On the measurement of inequalities in health. Soc. Sci. Med. 33, 545–557.

Wassif, O.M., Abdo, A.S., Elawady, M.A., Abd Elmaksoud, A.E., Eldesouky, R.S., 2019. Assessment of Postpartum Depression and Anxiety among Females Attending Primary Health Care Facilities in Qaliubeya Governorate. Egypt. J. Environ. Public Health. 2019, 3691752. https://doi.org/10.1155/2019/3691752.

Watson, J.P., Elliott, S.A., Rugg, A.J., Brough, D.I., 1984. Psychiatric disorder in pregnancy and the first postnatal year. Br. J. Psychiatry 144, 453–462.

WHO, World Health Organization, 1995. Physical status: the use and interpretation of anthropometry. https://www. who. int/childgrowth/ publications/ physical_ status/ en/ (accessed 23 December 2020).

Woody, C.A., Ferrari, A.J., Siskind, D.J., Whiteford, H.A., Harris, M.G., 2017. A systematic review and meta-regression of the prevalence and incidence of perinatal depression. J. Affect. Disord. 219, 86–92. https://doi.org/10.1016/j.jad.2017.05.003.

Yin, X., Sun, N., Jiang, N., Xu, X., Gan, Y., Zhang, J., et al., 2021. Prevalence and associated factors of antenatal depression: systematic reviews and meta-analyses. Clin. Psychol. Rev. 83, 101932 https://doi.org/10.1016/j.cpr.2020.101932.

Zhang, H., Rodriguez-Monguio, R., 2012. Racial disparities in the risk of developing obesity-related diseases: a cross-sectional study. Ethn Dis 22, 308–316.