International Journal of Public Health
https://doi.org/10.1007/s00038-020-01505-0

ORIGINAL ARTICLE

Trends and inequalities in unplanned pregnancy in three population-based birth cohorts in Pelotas, Brazil

Laísa Rodrigues Moreira[1] · Fernanda Ewerling[1,2] · Iná S. dos Santos[1] · Fernando César Wehrmeister[1,2] · Alicia Matijasevich[1,3] · Aluisio J. D. Barros[1,2] · Ana M. B. Menezes[1] · Helen Gonçalves[1] · Joseph Murray[1] · Marlos R. Domingues[1] · Mariângela Freitas Silveira[1]

Received: 23 March 2020 / Revised: 24 September 2020 / Accepted: 3 October 2020

Abstract

Objectives To assess time trends in unplanned pregnancy, stratified by sociodemographic status, reproductive history, and inequalities in family income and women's skin color, in Pelotas, Brazil.

Methods Data from mothers of participants of the 1993 (N = 5264), 2004 (N = 4243), and 2015 (N = 4268) Pelotas birth cohorts were analyzed. Unplanned pregnancy was investigated in the perinatal period, with tests to assess changes over time among different sociodemographic and reproductive history subgroups and inequalities as a function of family income and skin color.

Results The prevalence of unplanned pregnancy was 62.7% (3299/ 5264), 65.9% (2794/ 4243), and 52.2% (2226/ 4268) in the 1993, 2004, and 2015 cohorts, respectively. Black or brown women and women of lower socioeconomic status had a higher prevalence of unplanned pregnancy in all cohorts. The overall rate of unplanned pregnancy decreased over time in most subgroups. Inequality as a function of family income and skin color increased during the time frame of assessment.

Conclusions The prevalence of unplanned pregnancies decreased in the period analyzed, but it is still unjustifiably high. Efforts aimed at reducing unplanned pregnancy are vital and will require special attention to the most vulnerable groups.

Keywords Unplanned pregnancy · Family planning · Reproductive health · Socioeconomic factors · Health inequalities

Introduction

Becoming a mother leads to many changes for women and their families. An unplanned pregnancy involves a host of implications for which the woman, her family, and her community are not always prepared (Gipson et al. 2008; Le

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00038-020-01505-0) contains supplementary material, which is available to authorized users.

✉ Laísa Rodrigues Moreira
laisa.moreira.psi@gmail.com

Fernanda Ewerling
fewerling@equidade.org

Iná S. dos Santos
inasantos@uol.com.br

Fernando César Wehrmeister
fcwehrmeister@gmail.com

Alicia Matijasevich
amatija@yahoo.com

Aluisio J. D. Barros
abarros@equidade.org

Ana M. B. Menezes
anamene.epi@gmail.com

Helen Gonçalves
hdgs.epi@gmail.com

Joseph Murray
prof.murray@outlook.com

Marlos R. Domingues
marlosufpel@gmail.com

Mariângela Freitas Silveira
mariangelafreitassilveira@gmail.com

Extended author information available on the last page of the article

Published online: 13 October 2020

et al. 2014). At an international level, the Sustainable Development Goals highlight the importance of access to sexual and reproductive health services for all (United Nations 2015). Increasing the availability of, and access to, a wide range of contraceptive methods for women who do not intend to become pregnant (in the short term or ever) is an important means of preventing unplanned pregnancies worldwide and their potential implications, such as the possibility of late and suboptimal antenatal care, impacts on the duration and frequency of breastfeeding, and costs to society and to the health system (Gipson et al. 2008; Le et al. 2014; WHO/RHR and CCP 2018).

Worldwide, little changes have been observed in the percentages of unintended pregnancies in recent years (Singh et al. 2010; Sedgh et al. 2014). In 1995, considering all pregnancies and using data from various sources, the overall rate of unintended pregnancy was 43%; remaining virtually unchanged until 2008 (42%) and decreasing slightly to 40% in 2012, with the highest prevalence found in low- and middle-income countries (Sedgh et al. 2014). In Latin America and the Caribbean, 56% of the 17.8 million pregnancies occurring in 2012 were unintended (Sedgh et al. 2014).

Several factors are associated with unintentional (mistimed or unwanted) or unplanned pregnancies. Such pregnancies occur at a higher rate among women with lower income or lower wealth index (Prietsch et al. 2011; Ali et al. 2016); lower educational attainment (Ali et al. 2016); those not gainfully employed (Theme-Filha et al. 2016); those living in overcrowded households (Prietsch et al. 2011); and those under 19 years of age (Prietsch et al. 2011; Ali et al. 2016; Theme-Filha et al. 2016).

Previous studies have evaluated trends in unintended pregnancy worldwide over time (Singh et al. 2010; Sedgh et al. 2014). However, there is a dearth of research describing temporal trends in unplanned pregnancy among subgroups characterized by factors known to predict this outcome and using standardized methods for measuring and collecting primary data. Within this context, the present study was designed to evaluate trends in unplanned pregnancy over time, considering indicators of sociodemographic status, reproductive history, and inequalities between family income subgroups and women's skin color in the 1993, 2004, and 2015 Pelotas birth cohorts.

Methods

For this analysis, we used primary data from three Pelotas birth cohorts that are observational studies that included standardized procedures in the training of interviewers, data collection, questionnaires construction base, data processing, and other steps, being responsibility of the research group from the Epidemiology Postgraduate Program at the Federal University of Pelotas.

Data were obtained from the perinatal study of the 1993, 2004, and 2015 birth cohorts of Pelotas, a midsized city (population ca. 328,000) in Brazil (IBGE 2017). Specifically, data from the mothers of participants of all three cohorts were analyzed. The perinatal studies were conducted from January 1 through December 31, in 1993, 2004, and 2015, and consisted of daily visits to all maternity hospitals in the city of Pelotas, during which all mothers were interviewed shortly after delivery. The total number of mothers from whom information was obtained during the perinatal assessment (and thus included in the analysis of the present study) was 5,264, 4,243, and 4,268, for the 1993, 2004, and 2015 cohorts, respectively. Losses and refusals were rare: 0.30% (n = 16) in 1993, 0.75% (n = 32) in 2004, and 1.34% (n = 58) in 2015.

The number of participants analyzed in this study differs from that of other publications using data from the Pelotas birth cohorts (Additional File 1). Namely, in the current study, data from both mothers of liveborn infants (the usual focus of birth cohort research) and stillbirths were included, as the present study focused on pregnancy itself rather than on child outcomes. Data from mothers of twins or triplets were counted only once (only the firstborn child was considered), so that there was no duplication of data on intentionality of pregnancy. As the three cohorts are similar prospective studies in terms of standardization, the methods and measurement instruments employed, comparison between studies is allowed (Barros et al. 2008). The *Cohort Profiles* and previous publications present more detailed information (Victora et al. 1996; Barros et al. 2008; Victora et al. 2007; Santos et al. 2010; Hallal et al. 2017).

Measures

The outcome of interest—unplanned pregnancy—was assessed by the following question: "Did you plan on having this child or did you get pregnant by accident?" Responses were presented in the multiple-choice format, as planned; by accident; more or less. For analysis, this variable was dichotomized into the following categories: (0) = planned; (1) = by accident/more or less. The "more or less" category was grouped into the "by accident" category because it denotes uncertainty regarding pregnancy planning, i.e., mothers who selected this option were also considered to have had unplanned pregnancies. In other words, the outcome measures of 1993, 2004, and 2015 Pelotas birth cohorts refer to the pregnancy that gave birth to the Perinatal Cohort study participants. Planning of previous pregnancies was not assessed in this study.

The sociodemographic independent variables of interest were: monthly family income, as a function of minimum

wage (in Brazilian Real, the Brazilian currency), in the month before childbirth (≤ 1; 1.1–3.0; 3.1–6.0; 6.1–10.0; or > 10.0 times the minimum wage); maternal schooling (0–4; 5–8; or ≥ 9 full years of schooling); gainful employment during pregnancy (no/yes); maternal skin color (white/brown/black); living with a partner (no/yes); and maternal age (≤ 19; 20–24; 25–29; 30–34; or ≥ 35 years)—minimum age was 13 years in the 1993 and 2015 cohorts and 12 years in the 2004 cohort, while maximum age was 47 years in the 1993 and 2015 cohorts and 46 years in the 2004 cohort. The reproductive independent variables assessed were parity (primiparous, 1, or ≥ 2); history of miscarriage (defined as fetal loss up to 20 weeks of pregnancy; no/yes); and history of stillbirth (defined as a stillborn infant delivered after gestational age 20 weeks and/or weighing > 500 g; no/yes).

The sociodemographic indicator family income as a function of minimum wage was collected in Brazilian reais (R$). "Minimum wage" was defined as the minimum pay a worker must receive per month in accordance with Brazilian legislation (Bertoldi et al. 2019). Maternal skin color was assigned by the interviewer and collected in three categories (white, black, or other) in the 1993 cohort, while in the 2004 and 2015 cohorts, it was self-reported and collected in five categories (2004 cohort: white, black, brown, yellow or Asian, indigenous; 2015 cohort: white, black, yellow, brown, indigenous). In the present study, the maternal skin color variable was stratified into three categories: white, brown, and black. This required some adaptation. The "other" category of the 1993 cohort was categorized as "brown" for analysis, since the percentages of Asian and indigenous mothers in the 2004 and 2015 cohorts were similar and exceedingly low, and a similar scenario can thus be inferred for the 1993 cohort. In the 2004 cohort, only 0.3% (n = 13) of the mothers included in the analyses were Asian and 0.7% (n = 30) were indigenous. In the 2015 cohort, only 0.4% (n = 15) were classified as having yellow skin color and 0.2% (n = 10) as indigenous. For the same reason, in the 2004 and 2015 cohorts, the three categories of interest were kept and the other categories (yellow/Asian and indigenous) were omitted for analysis of the maternal skin color variable (i.e., they were considered missing values). This was done to the assumption that the small sample size of these categories would result in unreliable estimates for these subgroups. However, the decision was made to allow these women to remain in the study, considering that this would not influence the other results and given the interest of providing an overview of unplanned pregnancy in all three Pelotas cohorts.

Data analysis

The statistical analyses of this study were at the individual level. In other words, mothers of 1993, 2004, and 2015 Pelotas birth cohort participants were the focus to construct this analytical framework. The base to guide these statistical analyses was the previous scientific knowledge regarding the outcomes investigated and inequalities. First, a general description of possible predictors of unplanned pregnancy was conducted. Absolute and relative frequencies with respective 95% confidence intervals were obtained to describe the participants according to the sociodemographic and reproductive history indicators. Then, Chi-square test for a linear trend was used to investigate changes (i.e., increases or decreases) in the occurrence of unplanned pregnancy over time, considering the studied indicators.

Absolute and relative inequality measures were calculated for income and skin color. Income as a function of minimum wage was used to calculate these measures. For income-related inequalities, the Slope Index of Inequality (SII) and Concentration Index (CIX) were calculated. The SII, a measure of absolute inequality, was used to calculate the differences between the highest quintile of family income (the wealthiest 20%) with the lowest income (the poorest 20%), considering the predicted values of the distribution of outcome prevalence for specific family income quintiles (Silva et al. 2018). The SII ranges from − 100 to 100 percentage points, with zero indicating no inequality, negative values indicating inequality in favor of the poor (i.e., the outcome of interest is more prevalent among the poor), and positive values denoting inequality in favor of the rich (i.e., the outcome of interest is more prevalent among the rich). The CIX is a measure of relative inequality that also takes into account all quintiles by means of a predictive model, much like the Gini index (Silva et al. 2018). Its scale ranges from − 100 to + 100 and is interpreted similarly as that of the SII, except that the CIX is, as noted above, a measure of relative inequality (Silva et al. 2018).

In addition, to ascertain whether inequalities existed according to maternal skin color, absolute (brown–white) and (black–white) and relative (brown/white) and (black/white) inequality was calculated. In a simple way, the absolute inequality was calculated as the difference between the groups ($X_1 - X_0$), and relative inequality was based on the ratio (X_1/X_0), where X_0 was the reference group selected and X_1 was the group against which this reference group was compared. Double stratification was used to check for intersectionalities between skin color and family income in the three cohorts. This analysis would allow us, for instance, to highlight the prevalence of

unplanned pregnancy among white, black, or brown women in each family income category (≤ 1, 1.1–3.0, 3.1–6.0, 6.1–10.0, > 10.0 × minimum wage), by cohort. For this purpose, the black and brown skin color categories were pooled, because very similar patterns of the outcome and distribution by family income were found in these groups (Additional File 2). The number of women in each of the investigated strata allows a better visualization of equivalent patterns when pooling brown and black women together than when considering the white, brown, and black categories separately, as there were certain strata with very few or no participants, e.g., brown women with family income > 10.0 × the minimum wage (Additional File 2). All analyses were carried out in STATA version 13.1 (StataCorp 2013).

Ethical aspects

All procedures performed in this study were in accordance with the legislation in force at the time of assessment. The confidentiality of data was ensured throughout. In cases in which the participants were younger than 18 years old, informed consent from their parents or legally authorized representative was required. In Brazil, Ethics Committee submission and approval only became mandatory in 1996; thus, the 1993 cohort was not subject to such requirements. The 2004 and 2015 Pelotas birth cohorts were approved by the Universidade Federal de Pelotas Research Ethics Committees. The 2004 cohort was accepted by the Ethics Committee of the School of Medicine, and the 2015 cohort, by the Ethics Committee of the School of Physical Education.

Results

In the 1993 and 2004 cohorts, almost two-thirds of mothers reported unplanned pregnancies, while in 2015 this percentage declined to 52.2%. Most families received up to three times the minimum wage across all cohorts, and in the 2015 cohort there was a reduction in the proportion of families receiving one minimum wage or less (Table 1). Both maternal school attainment and the proportion of working mothers increased substantially over time. About half of mothers were aged 20–29 in all cohorts, but there was a slight increase in the proportion of mothers aged 30 and older and a reduction in teenage mothers (≤ 19 years) over time. All cohorts were predominantly white, and more than 80% of mothers were cohabitating with a partner or spouse. Regarding reproductive history, the percentage of primiparous women and women who had one child increased over time, while the proportion of women with two or more children decreased. The proportion of miscarriage remained stable at around 28%, while that of stillbirth was higher in the 2004 cohort (4.1%) (Table 1).

The outcome prevalence was higher among poorer families across all cohorts (Table 2). The rate of unplanned pregnancy followed a downward trend over time in all family income categories, except among mothers who lived at or below the minimum wage, who had both the highest prevalence and greatest stability of the outcome of interest. The prevalence of unplanned pregnancy was higher among those with lower educational attainment. Reductions were observed among all groups of education, but mothers with ≥ 9 years of schooling made the most progress, reducing their prevalence of unplanned pregnancy by about 10 percentage points from 1993 to 2015. Mothers who worked during pregnancy experienced a much greater reduction in this outcome over time than mothers who did not work. There was also a reduction in these rates over time among women who lived with a partner. Stratifying by age showed that teenage mothers and those aged 35 or older were more likely to report unplanned pregnancies in the 1993 and 2004 cohorts. Among teenage mothers (age ≤ 19 years) and young mothers (age 20–24), no changes were observed over the 22 years of study. On the other hand, there was a substantial reduction in unplanned pregnancies among older women: by 2015, these mothers had a prevalence similar to that of the 25–34 age-group (45%, 95% CI 41.2–49.0). Black and brown mothers had a higher prevalence of unplanned pregnancy, but all skin color groups showed a similar reduction over time. Stratification by reproductive history showed that mothers with two or more children had the highest prevalence of unplanned pregnancy (about 75%), and no significant changes were identified over time in this group (Table 2).

Table 3 shows that both absolute and relative inequalities in relation to family income increased over time, and similar patterns were identified to maternal schooling and maternal age (Additional file 3). In 1993, the SII was − 14.96, i.e., the prevalence of the outcome was − 14.96 percentage points higher among the poorest mothers than among the richest mothers. That same year, the CIX (a measure of relative inequality) was -1.16. In 2015, the SII was up to − 31.87 and the CIX to − 3.20, revealing an increase in income inequalities over time. Absolute and relative inequalities as a function of maternal skin color also increased over time, but the differences were much less pronounced than those observed for other variables (Table 4). The prevalence of unplanned pregnancy identified was higher among black and brown women than among white women. In the 1993, 2004, and 2015 cohorts, absolute inequalities were higher when comparing black and white women than when comparing brown and white women. In 2015, for instance, the absolute inequality between brown and white women was 10.20 percentage

Table 1 Sociodemographic characteristics of the mothers from the three Pelotas birth cohorts (Pelotas, Brazil, 1993, 2004, 2015)

	1993 cohort (*N* = 5264) % (95% CI)	2004 cohort (*N* = 4243) % (95% CI)	2015 cohort (*N* = 4268) % (95% CI)
Sociodemographic indicators			
Family income (minimum wages)	5152	4230	4267
< = 1	19.0 (18.0—20.0)	24.1 (22.8—25.4)	12.8 (11.8—13.9)
1.1–3.0	41.7 (40.4—43.1)	43.2 (41.7—44.7)	47.2 (45.7—48.7)
3.1–6.0	23.5 (22.3—24.7)	22.2 (21.0—23.5)	26.4 (25.1—27.7)
6.1–10.0	8.4 (7.6—9.2)	5.7 (5.1—6.5)	7.4 (6.7—8.2)
> 10.0	7.4 (6.7—8.2)	4.8 (4.2—5.5)	6.2 (5.5—6.9)
Maternal schooling (years)	5258	4201	4268
0–4	28.1 (26.9—29.3)	15.7 (14.6—16.8)	9.2 (8.4—10.1)
5–8	46.3 (44.9—47.6)	41.4 (39.9—42.9)	25.7 (24.4—27.1)
9 +	25.6 (24.4—26.8)	42.9 (41.4—44.4)	65.0 (63.6—66.5)
Maternal occupation during pregnancy	5262	4242	4268
No	62.9 (61.6—64.2)	59.9 (58.5—61.4)	44.5 (43.1—46.0)
Yes	37.1 (35.8—38.4)	40.1 (38.6—41.5)	55.5 (54.0—56.9)
Maternal age (years)	5263	4241	4267
≤ 19	17.5 (16.5—18.6)	19.0 (17.9—20.2)	14.8 (13.7—15.9)
20–24	27.6 (26.4—28.9)	27.2 (25.9—28.5)	23.8 (22.5—25.1)
25–29	25.6 (24.5—26.8)	22.5 (21.3—23.8)	23.6 (22.3—24.9)
30–34	18.1 (17.1—19.2)	17.8 (16.7—19.0)	23.2 (22.0—24.5)
35 +	11.1 (10.3—12.0)	13.5 (12.5—14.5)	14.7 (13.6—15.8)
Maternal skin color	5262	4149	4237
White	77.2 (76.1—78.3)	62.2 (60.7—63.7)	70.9 (69.5—72.2)
Brown	4.5 (4.0—5.1)	21.0 (19.8—22.2)	13.1 (12.1—14.1)
Black	18.3 (17.3—19.3)	16.8 (15.7—18.0)	16.0 (15.0—17.2)
Living with a partner	5264	4243	4268
No	12.3 (11.5—13.3)	16.5 (15.5—17.7)	14.5 (13.5—15.6)
Yes	87.7 (86.7—88.5)	83.5 (82.3—84.5)	85.5 (84.4—86.5)
Reproductive history			
Parity	5264	4242	4267
0 (primiparae)	35.2 (33.9—36.5)	39.4 (38.0—40.9)	49.5 (48.0—51.0)
1	27.7 (26.5—28.9)	26.0 (24.7—27.4)	30.8 (29.4—32.2)
2 +	37.1 (35.8—38.4)	34.5 (33.1—36.0)	19.7 (18.5—20.9)
History of miscarriage[a]	3412	2569	2367
No	71.8 (70.3—73.3)	71.8 (70.0—73.5)	73.2 (71.4—75.0)
Yes	28.2 (26.7—29.7)	28.2 (26.5—30.0)	26.8 (25.0—28.6)
History of stillbirth[a]	3412	2569	2367
No	97.3 (96.7—97.8)	95.9 (95.0—96.6)	96.9 (96.1—97.5)
Yes	2.7 (2.2—3.3)	4.1 (3.4—5.0)	3.1 (2.5—3.9)

95% CI = 95% Confidence interval

[a]Considering women with at least one previous pregnancy (1993 cohort: *n* = 3412, 2004 cohort: *n* = 2569, and 2015 cohort: *n* = 2367)

points, while the inequality between black and white women was 13.05 percentage points, i.e., the prevalence of unplanned pregnancy among brown and black women was 10.20 and 13.05 percentage points higher than among white women, respectively. Also, in 2015, the relative inequality ratio (black/white) was 1.27, i.e., unplanned pregnancies were 1.27 times more likely to occur among black women than among white women (Table 4).

In all cohorts, black or brown women with a lower family income generally had a higher prevalence of

Table 2 Prevalence of unplanned pregnancy according to mother's sociodemographic characteristics and reproductive history in the three 1993, 2004 and 2015 Pelotas birth cohorts (Pelotas, Brazil, 1993, 2004, 2015)

	Unplanned pregnancy according to birth cohort			p (χ^2 linear trend)[b]
	1993 (N = 5264) % (95% CI)	2004 (N = 4243) % (95% CI)	2015 (N = 4268) % (95% CI)	
Total unplanned pregnancy	(3299) 62.7 (61.4—64.0)	(2794) 65.9 (64.4—67.3)	(2226) 52.2 (50.7—53.7)	< 0.001
Sociodemographic indicators				
Family income— minimum wages				
< = 1	69.9 (66.9—72.7)	74.2 (71.4—76.8)	65.5 (61.4—69.3)	0.230
1.1—3.0	62.4 (60.4—64.5)	68.1 (65.9—70.2)	55.9 (53.8—58.1)	< 0.001
3.1—6.0	61.6 (58.8—64.3)	59.6 (56.5—62.7)	49.0 (56.5—62.7)	< 0.001
6.1—10.0	58.9 (54.2—63.5)	57.0 (50.7—63.1)	37.7 (32.5—43.1)	< 0.001
> 10.0	50.7 (45.6—55.7)	44.1 (37.4—51.0)	26.2 (21.3—31.9)	< 0.001
Maternal schooling (years)				
0–4	65.2 (62.7—67.5)	69.6 (66.0—73.0)	59.1 (54.2—63.9)	0.232
5–8	64.1 (62.1—65.9)	70.3 (68.1—72.4)	62.5 (59.6—65.3)	0.828
9 +	57.4 (54.8—60.0)	60.5 (58.2—62.7)	47.1 (45.2—48.9)	< 0.001
Maternal occupation during pregnancy				
No	62.3 (60.6—63.9)	68.5 (66.7—70.3)	56.8 (54.6—59.0)	< 0.006
Yes	63.4 (61.2—65.5)	61.8 (59.5—64.1)	48.4 (46.4—50.4)	< 0.001
Maternal age (years)				
≤ 19	69.4 (66.3—72.3)	76.8 (73.8—79.6)	68.7 (65.0—72.2)	0.873
20–24	61.1 (58.6—63.6)	67.9 (65.2—70.5)	60.8 (57.7—63.7)	0.819
25–29	58.0 (55.3—60.6)	58.3 (55.1—61.4)	45.8 (42.7—48.9)	< 0.001
30–34	58.0 (54.8—61.1)	59.5 (55.9—62.9)	43.8 (40.7—46.9)	< 0.001
35 +	74.3 (70.6—77.7)	67.3 (63.3—71.0)	45.0 (41.2—49.0)	< 0.001
Maternal skin color				
White	60.3 (58.8—61.8)	61.9 (60.0—63.8)	48.6 (46.8—50.4)	< 0.001
Brown	69.2 (63.0—74.8)	68.6 (65.5—71.6)	58.8 (54.6—62.8)	< 0.001
Black	70.9 (67.9—73.7)	76.2 (72.9—79.2)	61.6 (57.9—65.2)	< 0.001
Living with a partner				
No	84.2 (81.1—86.8)	88.3 (85.7—90.5)	84.0 (80.9—86.7)	0.961
Yes	59.6 (58.2—61.1)	61.4 (59.8—63.0)	46.8 (45.2—48.4)	< 0.001
Reproductive history				
Parity				
0 (primiparae)	56.3 (54.0—58.6)	60.2 (57.8—62.5)	45.8 (43.7—47.9)	< 0.001
1	54.7 (52.1—57.2)	59.8 (56.9—62.6)	49.0 (46.3—51.7)	0.004
2 +	74.7 (72.7—76.5)	76.9 (74.6—79.0)	73.1 (70.0—76.0)	0.692
History of miscarriage[a]				
No	68.5 (66.6—70.3)	71.5 (69.4—73.6)	58.9 (56.6—61.2)	< 0.001
Yes	60.1 (56.9—63.1)	64.4 (60.8—67.8)	47.6 (43.8—51.5)	< 0.001
History of stillbirth[a]				
No	66.2 (64.6—67.8)	69.9 (68.0—71.7)	56.3 (54.3—58.3)	< 0.001
Yes	62.4 (52.0—71.7)	61.3 (51.7—70.2)	43.2 (32.4—54.8)	0.017

95% CI = 95% confidence interval

[a]Considering women with at least one previous pregnancy (1993 cohort: n = 3412, 2004 cohort: n= 2569, and 2015 cohort: n = 2367)

[b]p Value of the Chi-square test for the linear trend comparing 1993, 2004, and 2015 birth cohorts

Table 3 Income-related absolute (Slope Index of Inequality, SII) and relative (Concentration Index, CIX) inequality for the occurrence of unplanned pregnancy in each Pelotas birth cohort (Pelotas, Brazil, 1993, 2004, 2015)

Family income—minimum wages	Unplanned Pregnancy	
	Slope Index of Inequality—SII (% points)	Concentration Index—CIX (× 100)
Cohort		
1993	− 14.96	− 1.16
2004	− 25.28	− 2.30
2015	− 31.87	− 3.20

unplanned pregnancy (Fig. 1). Among white-skinned women, the lowest-income women had the highest prevalence of these pregnancies, with more pronounced inequalities in the 2015 cohort (a difference of approximately 40 percentage points between the highest-income and lowest-income white women). For black and brown women, although there was little income inequality in rates of unplanned pregnancy in the 1993 cohort, in the 2004 and 2015 cohorts a pattern similar to that for white women was found, i.e., a higher rate of unplanned pregnancies among women with lower family income. When the cohorts were considered individually, the prevalence of unplanned pregnancies was higher for black or brown women compared to white women regardless of family income. In 2015, there was a difference of approximately 20 percentage points in unplanned pregnancy occurrence between white and black/brown women even at the highest income stratum (above 10 times the minimum wage). Additional information concern analysis with skin color (white, brown, and black, separately) and family income, by cohort, is provided in Additional File 2.

Discussion

The prevalence of unplanned pregnancies in the 1993, 2004, and 2015 Pelotas birth cohorts was 62.7%, 65.9%, and 52.2% respectively; it was strongly affected by sociodemographic factors. Brazil is a country with many

Table 4 Inequalities in rates of unplanned pregnancy according to maternal skin color for each Pelotas birth cohort (Pelotas, Brazil, 1993, 2004, 2015)

Maternal skin color	Unplanned pregnancy			
	Absolute inequality		Relative inequality	
	Brown—white	Black—white	Brown–white	Black–white
Cohort				
1993	8.88	10.57	1.15	1.18
2004	6.71	14.31	1.11	1.23
2015	10.20	13.05	1.21	1.27

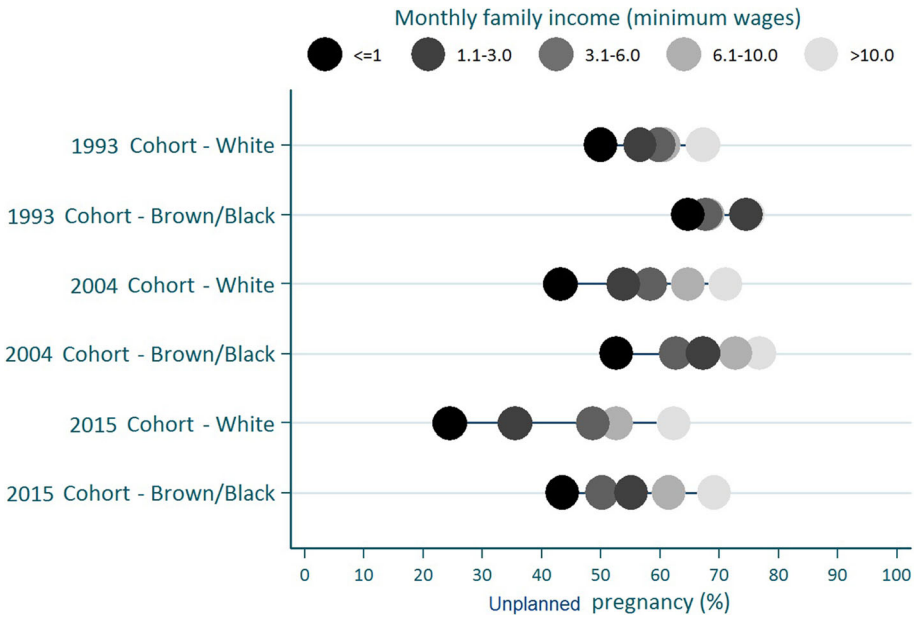

Fig. 1 Prevalence of unplanned pregnancy according to monthly family income (in minimum wages) and maternal skin color in three Pelotas Birth Cohorts (Pelotas, Brazil, 1993, 2004, 2015)

socioeconomic inequalities and cultural differences. Although it is not possible to affirm that Pelotas city represents the entire country, social inequalities such as income-related, for example, are also present in this city, being identified increasing in the population size over time and predominance of urban population (Bertoldi et al. 2019). As identified, unplanned pregnancy levels were similar to those found elsewhere in Southern Brazil (65%) (Prietsch et al. 2011). However, these figures were higher than the worldwide rate of unintended pregnancy, which is close to 40% (Sedgh et al. 2014). The Pelotas cohorts revealed a reduction in unplanned pregnancy occurrence in most social subgroups from 1993 to 2015, except for women aged 24 years or younger, women with low educational attainment, women with a family income of one minimum wage or less, those who did not live with a partner, and those with two or more children. Rates of unplanned pregnancies differed according to family income and maternal skin color.

When pregnancy is unplanned, there are various additional costs, especially regarding the different possible outcomes of the pregnancy and health care needs, for example (Le et al. 2014). Maternal consequences of unintended pregnancy can include major depression and generalized anxiety disorders (Currao and Mezuk 2019), as well as reduced use of certain health services (Khan et al. 2019). Socioeconomic difficulties may also be faced by women whose pregnancy was unplanned, particularly those with lower family income. Less-favorable living conditions are associated with increased difficulty in accessing contraceptive methods, and empowerment and financial autonomy may not always be realized satisfactorily.

Furthermore, elucidating the consequences for different skin color groups can contribute to making improvements for mothers and children. A survey of data from Latin American and Caribbean countries found very similar coverage rates of certain health actions for women of African ethnicity and those of the reference group; however, in Brazil, differences in wealth and education were observed between white women and those of African descent (black or brown) (Mesenburg et al. 2018). In Brazil, these differences may be explained at least partly by the legacy of slavery, which continues to be observed in the socioeconomic and health indicators of the black and brown population (Chor et al. 2005; Santos 2005; Porto 2006), as demonstrated by our findings regarding unplanned pregnancy.

A comparison of the three cohorts revealed an increase in maternal schooling over time. A previous study comparing the 1982, 1993, 2004, and 2015 Pelotas birth cohorts identified a decrease in absolute inequalities regarding family income and educational attainment, as well as other relevant indicators of trends in sociodemographic parameters over time (Bertoldi et al. 2019). The proportion of women who worked during pregnancy also increased over time, and the prevalence of unplanned pregnancy declined in this group, which allow us to infer that women in this city have taken on new roles over time such as their greater insertion in the labor market.

Regarding age, consistent with other studies (Prietsch et al. 2011; Theme-Filha et al. 2016), we generally observed the highest prevalence of unplanned pregnancy among adolescents and young women. The World Health Organization defines adolescents as those between the ages of 10 and 19, while the United Nations defines young people as those aged 15 to 24 (WHO 1986). It is essential that health services be prepared to meet the demands of adolescents and young adults (WHO 2012), including those related to pregnancy planning. A study using Demographic and Health Surveys data from 15 low- and middle-income countries in Africa, Asia, Eastern Europe, and Latin America found that adolescents and young adults had the highest contraceptive failure rates with methods such as withdrawal, condoms, and the combined oral contraceptive pill, among others which may themselves result in unplanned pregnancy (Bradley et al. 2019).

Investigating the intentionality of subsequent pregnancies and providing information on contraceptive options for multiparous women in need of contraception may be an interesting strategy to help reduce the prevalence of unplanned pregnancy. In this regard, several studies suggest that long-acting reversible contraceptives (LARCs) are effective in reducing unintended pregnancy and have lower failure rates compared to other contraceptive methods (Modi et al. 2013; Bradley et al. 2019). Regarding unplanned pregnancies, receiving support from partner and other family members and having a large, welcoming support network can help overcome barriers that may arise at different times during gestation and at life course (Kavanaugh et al. 2017).

The Sustainable Development Goals highlight the need for increasing equity, with goal number 10 reaffirming the commitment to reduce inequalities within and among countries (United Nations 2015). However, inequalities of maternal skin color, family income, and intersectional inequalities between the two were detected in the present study. These inequalities changed over time, with rates of unplanned pregnancy declining most rapidly among the wealthiest—possibly due to factors such as higher educational attainment, financial autonomy, and a desire to postpone childbearing. In addition, we can infer that being a low-income black or brown woman will be associated with several other social determinants which may influence health outcomes or even unplanned pregnancy.

Strengths and limitations

For analysis of intersectionalities between skin color and family income in the three cohorts, the skin color categories "brown" and "black" were pooled. However, in Brazil, the issue of skin color is best represented on a gradient. Thus, we chose to provide in our Supplementary Material further analyses stratified independently by each individual maternal skin color. In the 1993 cohort, family income was collected as a function of minimum wage; thus, in subsequent analyses, we chose to categorize this variable as presented in the *Cohort Profile* of the 1993 cohort (Victora et al. 2007) and follow the same pattern for subsequent cohorts, so as to ensure comparability.

This study did not capture data on abortion, which may have underestimated the prevalence of unplanned pregnancy if one considers that we set out to acquire information about unplanned pregnancies in general. Definitions of unplanned pregnancy and measures thereof differ between studies found in the literature (Santelli et al. 2003; Prietsch et al. 2011; Le et al. 2014; Sedgh et al. 2014; Borges et al. 2016; Theme-Filha et al. 2016; Hall et al. 2017). However, the current study used data from the 1993, 2004, and 2015 Pelotas birth cohorts, in which unplanned pregnancy was measured consistently and data collection procedures were standardized and precautions such as not using the term "unwanted pregnancy" in the questionnaire and paying close attention to the ethical aspects involved in conducting interviews were followed throughout. This is particularly relevant for epidemiological studies, as it ensures comparability and minimizes the risk of information bias (Gordis 2014). Large-scale surveys such as the Pelotas birth cohorts are important to monitor the occurrence and trends of sexual and reproductive health outcomes over time.

Conclusions and public health implications

Actions aimed at reducing inequalities and improving key determinants of unplanned pregnancy are vital. Based on the findings of this study and on the existing literature, in addition to the characteristic biological issues of pregnancy, several other externalities that may contribute to the occurrence of unplanned pregnancy must be considered—including sociodemographic determinants as well as psychosocial, relational, and contextual factors—in order to ensure that the sexual and reproductive health needs of the entire population are addressed. Policy makers, researchers, and clinicians may try to approximate the theoretical and the practical work and so achieve better results. Additional research is required to identify which type of barriers women whose pregnancy were unplanned face and looking for ways to preventing new unplanned pregnancies.

In the Pelotas sample, we observed a reduction in unplanned pregnancies over time, but the prevalence remained high. Most pregnancies in this city are still unplanned, and key subgroups have been identified in which no significant improvement occurred. There was also an increase in inequality in rates of unplanned pregnancy as a function of family income and maternal skin color over time. Within this context, it is essential that various sectors, including but not limited to health, provide the necessary support for women and children to experience healthy development regardless of whether pregnancy was intentional.

Funding We are grateful for financial support received from several sources. In part, this study was financed by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Finance Code 001. This article is based on data from the 1993, 2004 and 2015 Pelotas birth cohort studies, conducted at the Postgraduate Program in Epidemiology at the Universidade Federal de Pelotas, with the collaboration of the Brazilian Public Health Association (ABRASCO). The European Union, National Support Program for Centers of Excellence (PRONEX), the Brazilian National Research Council (CNPq), and the Brazilian Ministry of Health supported previous phases of the 1993 Pelotas birth cohort. The World Health Organization, National Support Program for Centers of Excellence (PRONEX), Brazilian National Research Council (CNPq), Brazilian Ministry of Health, and Children's Pastorate supported previous phases of the 2004 Pelotas birth cohort. The first phases of the 2015 Pelotas (Brazil) birth cohort were funded by the Wellcome Trust (095582).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval and informed consent to participate All procedures performed in this study were in accordance with the legislation in force at the time of assessment and with the 1964 Declaration of Helsinki and its later amendments. Informed consent was obtained from all individual participants included in the study, and confidentiality of data was ensured throughout process. In cases in which the participants were younger than 18 years old, informed consent from their parents or legally authorized representative was required. In Brazil, Ethics Committee submission and approval only became mandatory in 1996; thus, the 1993 cohort was not subject to such requirements. The 2004 and 2015 Pelotas birth cohorts were approved by the Universidade Federal de Pelotas Research Ethics Committees. The 2004 cohort was accepted by the Ethics Committee of the School of Medicine, and the 2015 cohort, by the Ethics Committee of the School of Physical Education.

References

Ali SA, Tikmani SS, Qidwai W (2016) Prevalence and determinants of unintended pregnancy: systematic review. World Fam Med J/Middle East J Fam Med 14:37–46. https://doi.org/10.5742/mewfm.2016.92806

Barros AJD, Santos IS, Matijasevich A et al (2008) Methods used in the 1982, 1993, and 2004 birth cohort studies from Pelotas, Rio Grande do sul State, Brazil, and a description of the socioeconomic conditions of participants' families. Cad Saude Publica 24:S371–S380. https://doi.org/10.1590/S0102-311X2008001500002

Bertoldi AD, Barros FC, Hallal PRC et al (2019) Trends and inequalities in maternal and child health in a Brazilian city: methodology and sociodemographic description of four population-based birth cohort studies, 1982–2015. Int J Epidemiol 48:i4–i15. https://doi.org/10.1093/ije/dyy170

Borges ALV, Barrett G, dos Santos OA et al (2016) Evaluation of the psychometric properties of the London measure of unplanned pregnancy in Brazilian Portuguese. BMC Pregnancy Childbirth 16:244. https://doi.org/10.1186/s12884-016-1037-2

Bradley SEK, Polis CB, Bankole A, Croft T (2019) Global contraceptive failure rates: who is most at risk? Stud Fam Plann 50:3–24. https://doi.org/10.1111/sifp.12085

Chor D, Limade CRA (2005) Aspectos epidemiológicos das desigualdades raciais em saúde no Brasil. Cad Saude Publica 21:1586–1594. https://doi.org/10.1590/S0102-311X2005000500033

Currao A, Mezuk B (2019) Association between unintended pregnancy and internalizing disorders among Latina and Asian American mothers. J Affect Disord 258:117–124. https://doi.org/10.1016/j.jad.2019.07.068

Gipson JD, Koenig MA, Hindin MJ (2008) The effects of unintended pregnancy on infant, child, and parental health: a review of the literature. Stud Fam Plann 39:18–38. https://doi.org/10.1111/j.1728-4465.2008.00148.x

Gordis L (2014) Epidemiology. Elsevier Saunders, Philadelphia

Hall JA, Barrett G, Copas A, Stephenson J (2017) London measure of unplanned pregnancy: guidance for its use as an outcome measure. Patient Relat Outcome Meas 8:43–56. https://doi.org/10.2147/PROM.S122420

Hallal PC, Bertoldi AD, Domingues MR et al (1048h) Cohort profile: the 2015 Pelotas (Brazil) birth cohort study. Int J Epidemiol 47:1048–1048h. https://doi.org/10.1093/ije/dyx219

IBGE (2017) Pelotas - População no último censo [2010]. In: Inst. Bras. Geogr. e Estatística. https://cidades.ibge.gov.br/brasil/rs/pelotas. Accessed 13 May 2019

Kavanaugh ML, Kost K, Frohwirth L et al (2017) Parents' experience of unintended childbearing: a qualitative study of factors that mitigate or exacerbate effects. Soc Sci Med 174:133–141. https://doi.org/10.1016/j.socscimed.2016.12.024

Khan MN, Harris ML, Shifti DM et al (2019) Effects of unintended pregnancy on maternal healthcare services utilization in low-and lower-middle-income countries: systematic review and meta-analysis. Int J Public Health 64:743–754. https://doi.org/10.1007/s00038-019-01238-9

Le HH, Connolly MP, Bahamondes L et al (2014) The burden of unintended pregnancies in Brazil: a social and public health system cost analysis. Int J Womens Health 6:663–670. https://doi.org/10.2147/IJWH.S61543

Mesenburg MA, Restrepo-Mendez MC, Amigo H et al (2018) Ethnic group inequalities in coverage with reproductive, maternal and child health interventions: cross-sectional analyses of national surveys in 16 Latin American and Caribbean countries. Lancet Glob Heal 6:e902–e913. https://doi.org/10.1016/S2214-109X(18)30300-0

Modi MN, Heitmann RJ, Armstrong AY (2013) Unintended pregnancy and the role of long-acting reversible contraception. Expert Rev Obstet Gynecol 8:549–558. https://doi.org/10.1586/17474108.2013.848596

Porto A (2006) O sistema de saúde do escravo no Brasil do século XIX: doenças, instituições e práticas terapêuticas. História, Ciências, Saúde-Manguinhos 13:1019–1027. https://doi.org/10.1590/S0104-59702006000400013

Prietsch SOM, González-Chica DA, Cesar JA, Mendoza-Sassi RA (2011) Gravidez não planejada no extremo Sul do Brasil: prevalência e fatores associados. Cad Saude Publica 27:1906–1916. https://doi.org/10.1590/S0102-311X2011001000004

Santelli J, Rochat R, Hatfield-Timajchy K, et al (2003) The measurement and meaning of unintended pregnancy. Perspect Sex Reprod Health 35:94–101 https://onlinelibrary.wiley.com/doi/abs/https://doi.org/10.1363/3509403?sid=nlm%3Apubmed

Santos SA dos (2005) Ações afirmativas e combate ao racismo nas Américas.Brasília: Ministério da Educação: UNESCO 5:1–394 https://etnicoracial.mec.gov.br/images/pdf/publicacoes/acoes_afirm_combate_racismo_americas.pdf

Santos IS, Barros AJD, Matijasevich A et al (2010) Cohort profile: the 2004 Pelotas (Brazil) birth cohort study. Int J Epidemiol 40:1461–1468. https://doi.org/10.1093/ije/dyq130

Sedgh G, Singh S, Hussain R (2014) Intended and unintended pregnancies worldwide in 2012 and recent trends. Stud Fam Plann 45:301–314. https://doi.org/10.1111/j.1728-4465.2014.00393.x

da Silva ICM, Restrepo-Mendez MC, Costa JC et al (2018) Mensuração de desigualdades sociais em saúde: conceitos e abordagens metodológicas no contexto brasileiro. Epidemiol e Serviços Saúde 27:e000100017. https://doi.org/10.5123/S1679-49742018000100017

Singh S, Sedgh G, Hussain R (2010) Unintended pregnancy: worldwide levels, trends, and outcomes. Stud Fam Plann 41:241–250. https://doi.org/10.1111/j.1728-4465.2010.00250.x

StataCorp LP (2013) Stata Statistical Software: Release 13.1. College Station, Texas 77845 USA

Theme-Filha MM, Baldisserotto ML, Fraga ACSA et al (2016) Factors associated with unintended pregnancy in Brazil: cross-sectional results from the Birth in Brazil National Survey, 2011/2012. Reprod Health 13:235–243. https://doi.org/10.1186/s12978-016-0227-8

United Nations (2015) Transforming our world: The 2030 agenda for sustainable development. Gen Assem 70 Sess

Victora CG, Hallal PC, Araújo CLP et al (2007) Cohort profile: the 1993 Pelotas (Brazil) birth cohort study. Int J Epidemiol 37:704–709. https://doi.org/10.1093/ije/dym177

World Health Organization (WHO) (1986) Young people's health-a challenge for society: report of a WHO Study Group on Young People and" Health for All by the Year 2000"[meeting held in Geneva from 4 to 8 June 1984]. World Health Organization

World Health Organization (WHO) (2012) Making health services adolescent friendly: Developing national quality standards for adolescent friendly health services. https://apps.who.int/iris/bitstream/handle/10665/75217/9789241503594_eng.pdf;jsessionid=0E1C32943A1A85F7F9930393B39E0ADB?sequence=1

World Health Organization Department of Reproductive Health and Research (WHO/RHR) and Johns Hopkins Bloomberg School of Public Health/Center for Communication Programs (CCP) (2018) Family Planning: A Global Handbook for Providers (2018 update).Baltimore and Geneva: CCP and WHO https://

apps.who.int/iris/bitstream/handle/10665/260156/9780999203705-eng.pdf?sequence=1

Affiliations

Laísa Rodrigues Moreira[1] · Fernanda Ewerling[1,2] · Iná S. dos Santos[1] · Fernando César Wehrmeister[1,2] · Alicia Matijasevich[1,3] · Aluisio J. D. Barros[1,2] · Ana M. B. Menezes[1] · Helen Gonçalves[1] · Joseph Murray[1] · Marlos R. Domingues[1] · Mariângela Freitas Silveira[1]

[1] Postgraduate Program in Epidemiology, Federal University of Pelotas, 1160 - 3rd floor. Centro, Marechal Deodoro, Pelotas, RS 96020-220, Brazil

[2] International Center for Equity in Health, Federal University of Pelotas, Pelotas, Brazil

[3] Department of Preventive Medicine, Faculty of Medicine FMUSP, University of São Paulo, São Paulo, Brazil