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The perinatal epidemiology of child and adolescent marriage in Brazil, 2011–2018

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A B S T R A C T

Brazil is one of the top contributors of girl child marriages in the world and one of the United Nations' members that committed to end child marriage by 2030 as part of the Sustainable Development Goals. Child marriage is an indicator of gender inequality associated with poor health outcomes. However, the perinatal epidemiology of minor mothers (<18 years) according to marital status has been insufficiently studied. We used 23,163,209 birth registrations (2011–2018) to describe the sociodemographic distribution of births to minor mothers. The association between adverse outcomes and marital status and maternal age was restricted to 7,953,739 births of mothers aged ≤15, 16–17, 18–19, 20–24 years. Multinomial logistic models were used for very (24–31 weeks) and moderately preterm birth (32–36 weeks), and severe (<3rd percentile) and moderately small-for-gestational age (SGA) (3rd to <10th percentile). Logistic models were used for binary outcomes. The proportion of births to minor mothers in the study period was 8.9%, composed of those of single (6.1%), common-law (2.4%) and married girls (0.4%). Births to minor mothers decreased over time (p-value <0.001), were more common in the North Region (13.2%) and among Indigenous (17.4%). Very and moderately preterm birth increased with decreasing age but within each age group, rates were highest among single, followed by common-law and lowest among married mothers. A similar pattern was observed for SGA, low Apgar and late prenatal care initiation. Repeat birth and low age-appropriate education were less common among married compared to single mothers in all age groups, except among ≤15-year-olds [Adjusted Odds Ratio (AOR): 2.56; 95% Confidence Interval (95%CI): 2.40, 2.74 and AOR: 1.30; 95%CI: 1.03, 1.64, respectively]. The association between perinatal indicators and marital status among adolescents is strongly modified by decreasing maternal age. Marital status is relevant for the understanding of early pregnancies.

1. Introduction

The reduction of teenage pregnancies and of marriage before 18 years of age are top priorities to prevent early pregnancy and poor reproductive outcomes among adolescents in developing countries (World Health Organization (WHO), 2011). There is an increasing global recognition that child marriage (CM), defined as any formal marriage or informal union of an individual below age 18, threatens human rights (United Nations, 2021a, 2021b; Wodon et al., 2017), particularly those of girls, with serious consequences for their health, education, well-being, and autonomy (United Nations Children's Fund, 2021 October 2021). Not only girls are more likely to marry before age 18 than boys but also do so at younger ages than for boys in many countries, which reflects entrenched gender inequalities (United Nations Children's Fund, 2021 October 2021; World Policy Analysis Center, 2021). Globally, approximately 12 million girls marry before turning 18 annually (United Nations Children's Fund, 2021 October 2021). Although the marriage of girls is most prevalent in Sub-Saharan Africa and South Asia (Godha et al., 2013; Yaya et al., 2019), it occurs worldwide, including the United States, Canada and Latin America (Fafard St-Germain et al., 2022; Koski & Heymann, 2018; Koski & Clark, 2021; United Nations Children's Fund, 2021 October 2021).

Brazil is the Latin American country with the highest number of child marriages and ranks fourth worldwide. In Brazil in 2006, 26% of women aged 20–24 years married before 18 years and 6% before 15 years (United Nations Children's Fund, 2021 October 2021). Since 2002, the Brazilian Civil Code determined that minority status ceases by the eighteenth birthday, when the person is deemed fully capable of practicing all acts of civil life. However, the minor's incapacity could also cease by marriage. In March 2019, Brazil modified the article 1520 of the Civil Code prohibiting anyone below the age of 16 from marrying under any circumstance (Presidency of the Republic, 2019). Until then,

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≤15-year-old girls were able to marry to help her older partner avoid a criminal sentence for statutory rape or in case of pregnancy (Presidency of the Republic, 2002). Under the new law, however, 16 and 17 years old can still marry with the consent of their parents or legal representatives. While the new law affects legal marriage, common-law couples cohabiting out of wedlock are becoming increasingly common in Brazil, reaching 36% of all couples in 2010 (Covre-Sussai, 2016). An informal union in Brazil only differs from marriage in its formalization but shares its meaning and implications for property and pension rights. The fact that in Brazil the term "casada" (married in Portuguese) is equally applied to both formally married and informally united women reflects the cultural resemblance of the practices (Taylor et al., 2019).

As socially constructed, the meaning, drivers and consequences of marriage are context-dependent, as well as the concept of a "child" or "adult" (Efevbera & Bhabha, 2020). Most research pointing at the harmful effects of child marriage have been conducted in high prevalence Asian and African countries, where patriarchal traditions confer women subordinate roles and marriages often involve dowries, arranged or forced marriages (Inter-Parliamentary Union (IPU) & World Health Organization (WHO), 2016; United Nations Children's Fund, 2015) In these regions, secondary data analyses of Demographic and Health Surveys have linked CM with a range of poor reproductive outcomes, including unintended pregnancies (Marphatia et al., 2017; Raj et al., 2009; Godha et al., 2013; Nasrullah et al., 2014), composites measures of stillbirths, induced or spontaneous abortions (Marphatia et al., 2017; Raj et al., 2009; Godha et al., 2013; Nasrullah et al., 2014; Kamal & Hassan, 2015; Yaya et al., 2019), rapid repeat childbirth (Godha et al., 2013; Nasrullah et al., 2014; Raj et al., 2009), preterm birth (Miller et al., 2021; Rahman et al., 2018), and low prenatal care use (Paul & Chouhan, 2019; Uddin et al., 2019). Less research has been produced in Western countries, where CM is less prevalent (Fafard St-Germain et al., 2022), believed to be consensual, most often involving cohabiting informal unions, although influenced by structural determinants such as intergenerational poverty (Taylor et al., 2019; Wodon et al., 2017; United Nations Children's Fund, 2021 October 2021).

To better understand the perinatal epidemiology of child marriage we used nationwide Brazilian birth records, including 1.57 million births to minor mothers. This study provides a baseline to measure the impact of the 2019 law change and progress towards the Sustainable Development Goals that aims at ending CM by 2030 (United Nations, 2021a, 2021b). The study has two objectives. Firstly, to quantify the proportion and distribution of births to minor mothers according to marital status and other sociodemographic characteristics. Secondly, to assess the risk of adverse birth outcomes associated with marital arrangements among minors and adolescents of different ages.

2. Methods

2.1. Study design and population

This cross-sectional study uses secondary data of all birth registrations occurred in all the states of Brazil from 2011 to 2018. The "Declaration of Live Birth" is a mandatory form that is distributed to all health care providers, who are responsible for its completion. Birth attendants (e.g., physician, nurse, midwife) directly enter information generated during the birth episode (e.g., birthweight, Apgar score) and elicit obstetric history and sociodemographic information from the mother, right after giving birth (Ministério da Saúde, 2011). These public use data were downloaded from the Live Births' Information System (SINASC) of the Ministry of Health.

To quantify the proportion of births to minor mothers by marital status all live births to mothers of all ages were considered. Birth records with missing maternal age and missing or unknown marital status were excluded.

For the second objective of assessing the associations between early marriage and birth outcomes, to contextualize minors within the full range of adolescents we restricted the study population to mothers aged less than 25 years (Hardin et al., 2017; Sawyer et al., 2018). Exclusion criteria further included multiple births, unknown infant sex, missing gestational age, gestational age <24 weeks or >42 weeks, missing birthweight and implausible combinations of birthweight and gestational age, based on four standard deviations below or above the median sex- and gestational age-specific birthweight of international newborn standards (Villar et al., 2014).

2.2. Variable definitions

2.2.1. Exposures

Maternal age, as well as other sociodemographic characteristics, was measured at the time of the birth of the child. Maternal age groups include all adolescents up to 24 years, categorized into 20–24 years, 18–19 years and minor or underage mothers. Minority of age was defined as a maternal age <18 years at the time of the birth, subdivided into mothers aged 16–17 years and ≤15 years.

Marital status was categorized as legally married, divorced/separated/widowed, common-law union, and single never married, based on the preestablished categories present in the birth registration form. For the first objective, divorced/separated/widowed mothers were grouped with the legally married because it indicates that these mothers have been married at some point before completing 18 years of age, irrespective of the marital status at the time of the birth. For the second objective, however, the small group composed of divorced, separated and widowed mothers was excluded to reduce heterogeneity of exposure and not reporting unstable estimates based on small numbers.

2.2.2. Outcomes

Preterm birth (PTB) was subdivided into very preterm (24–31 gestation weeks) and moderately preterm (32–36 weeks) and compared against term births (37–42 weeks). Small for gestational age (SGA) was subdivided into extreme SGA (<3rd percentile) and moderately SGA (3rd to <10th percentile). SGA percentile cutoffs were obtained from an international standard (Villar et al., 2014) to enable international comparisons. Repeat birth was defined as the birth of a mother who had at least a previous live birth or stillbirth. Low Apgar was defined as an Apgar score less than seven at 5 min (Casey et al., 2001). Late prenatal care initiation was defined as having started after the first trimester. Low age-appropriate education was defined as an educational attainment below that expected for a given age group (OECD, 2021).

2.2.3. Covariates

In descriptive analyses we used Race (skin color) (Black, Brown, Indigenous, White, Yellow and unknown), Region (North, North-East, Central-West, South-East and South) and Period of birth (2011–2012, 2013–2014, 2015–2016 and 2017–2018) as stratification variables. Region reflects broad geographic socioeconomic differences and was based on the states of residence of the mother. For multivariable analysis we further use Father's age (<18 years, 18–24, 25+ and unknown), Late prenatal care initiation as occurring past the first trimester and Maternal age-appropriate low education, defined as a maternal educational achievement below the level expected by the Brazilian common national curriculum at a given age (OECD, 2021). Missing values for covariates were recoded as unknown to prevent sample size loss.

2.3. Data analysis

Multinomial logistic models were used to obtain crude and adjusted odds ratios with 95% confidence intervals for the association between marital status and maternal age with very preterm and moderately preterm, with term births as the reference group. Likewise, severe SGA (<3rd percentile) and moderately SGA (3rd to <10th percentile) were compared to non-SGA births. For the remaining dependent variables, a binary logistic model was used. All models included a product term

maternal age group*marital status to test for interaction. Effect estimates were first reported as joint associations with births to single mothers aged 20–24 years as the sole reference group and secondly within strata of age group with births to single mothers in each stratum as the reference group. All analyses were conducted with SAS 9.4® (SAS Institute, Cary, NC).

3. Results

3.1. Distribution of births to minor mothers by marital status

There were 23,446,170 births in the dataset. After excluding 544 records with missing or invalid maternal age, 2795 with maternal age >49 years, and 279,905 with missing or invalid marital status, 23,163,209 records (98.8%) were used to estimate the proportion of births to minor mothers.

Overall, births to minor mothers in the study period accounted for 8.9% of all births, composed of those of single (6.1%), in-union (2.4%) and married girls (0.4%) (Fig. 1). Births to minor mothers decreased over time from 0.59% in 2011–2012 to 0.27% in 2017–2018 (p-value for trend <0.001), were more common in the least urbanized and poorer regions of the country, such as the North (13.2%) and Northeast (10.9%), and more common among Indigenous (17.4%) and brown (mixed-race) mothers (10.7%). Black minor mothers were the least likely to have ever been legally married (0.3%) and Indigenous the most likely (1.8%).

3.2. Adverse birth outcomes

To assess how the interplay of maternal age and marital status was associated with perinatal indicators in the broad context of adolescence we restricted the analytic sample to 10,045,548 births to mothers aged ≤24 years. We excluded 713,967 (7.11%) with unknown parity, 5732 (0.06%) with missing birthweight, 912,080 (9.08%) with missing gestational age, 16,056 (0.16%) with gestational age less than 24 and more than 42 weeks, 141,570 (1.41%) multiple births, 1816 (0.02%) with invalid infant sex and 96,740 (1.08%) records with implausible combinations of birthweight for gestational age, 326,358 records with missing race information (3.25%), and 151,144 (1.50%) with missing maternal education. We also excluded mothers with divorced, separated or widowed marital status (38,947; 0.39%) due to low numbers for minor age subgroups. Some records qualified for more than one exclusion criteria. The final dataset included 7,953,739 records (79.2% of all births to mothers aged ≤24 years).

Minor mothers (<18 years) accounted for 19.7% of births to mothers aged ≤24 years (5.5% to ≤15- and 14.2% to 16-17-year-old mothers) and for 48.5% of teenage births (13.5% to ≤15- and 35.0% to 16-17-year-old mothers) (Table 1). Births within legal marriages were rare among minors (1.2% and 6.0% among ≤15- and 16-17-year-old mothers, respectively) but increased with maternal age. Common-law unions accounted for about 1 in 4 births in all age groups, including ≤15-year-old mothers. Births to White mothers were increasingly more common with advanced age, while an opposite pattern occurred among brown and Indigenous mothers. The North and North-East region were home of higher proportions of births to ≤15- and 16-17-year-old

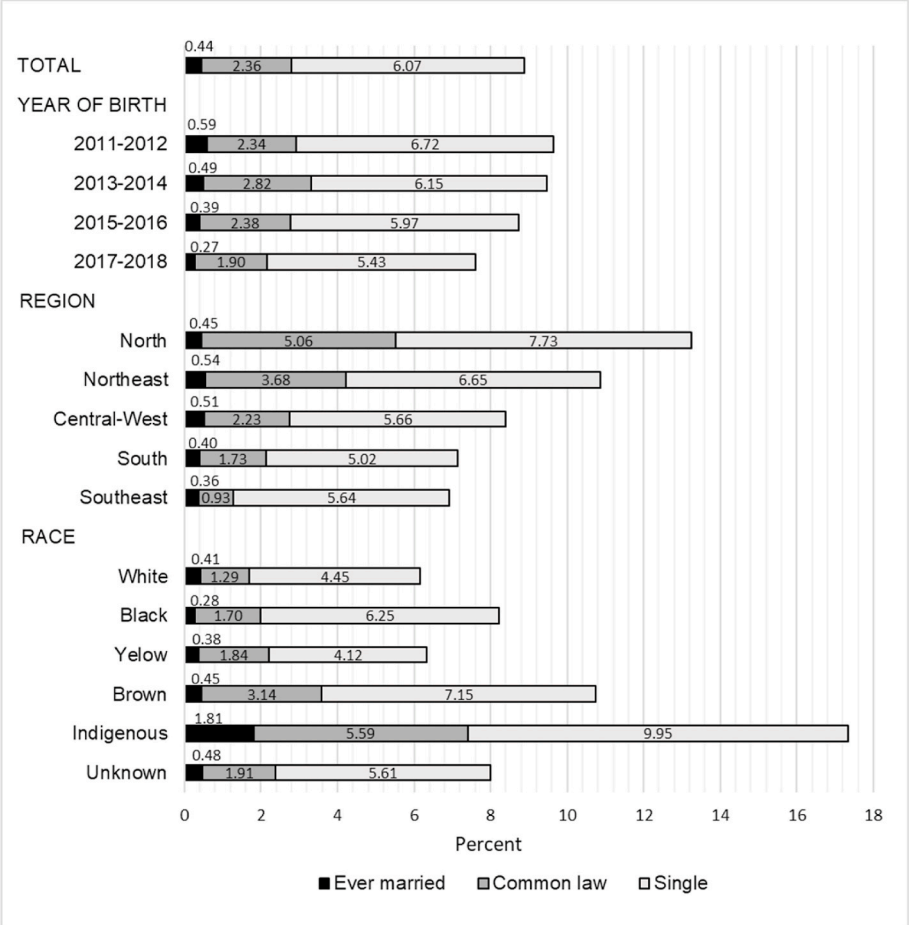

Fig. 1. Percentage of births to minor mothers according to marital status*, by period, region and race/skin colour, Brazil 2011–2018 (N = 23,163,209)
* Ever married includes divorced, separated and widowed.

Table 1
Characteristics of births to adolescent mothers according to maternal age, Brazil, 2011–2018

	Number of births					Percent[a]				
	≤15 y	16-17 y	18-19 y	20-24 y	Total	≤15 y	16-17 y	18-19 y	20-24 y	Total
N, row percent	436,839	1,133,341	1,669,923	4,713,636	7,953,739	5.5	14.2	21.0	59.3	100.0
Marital status										
Legally Married	5303	67,650	205,312	1,092,735	1,371,000	1.2	6.0	12.3	23.2	17.2
Common-law union	106,047	324,463	483,652	1,288,532	2,202,694	24.3	28.6	29.0	27.3	27.7
Single	325,489	741,228	980,959	2,332,369	4,380,045	74.5	65.4	58.7	49.5	55.1
Race/skin colour										
White	106,885	308,553	490,757	1,538,082	2,444,277	24.4	27.2	29.4	32.6	30.7
Yellow	1179	3385	5135	16,089	25,788	0.3	0.3	0.3	0.4	0.3
Brown	296,606	747,200	1,064,405	2,850,599	4,958,810	67.9	65.9	63.7	60.5	62.3
Black	22,657	59,894	92,645	269,653	444,849	5.2	5.3	5.6	5.7	5.6
Indigenous	9512	14,309	16,981	39,213	80,015	2.2	1.3	1.0	0.8	1.0
Region										
North	68,867	159,008	219,393	560,963	1,008,231	15.8	14	13.1	11.9	12.7
North-East	152,109	365,354	504,285	1,340,009	2,361,757	34.8	32.2	30.2	28.4	29.7
Central-West	34,362	88,948	135,134	390,921	649,365	7.9	7.9	8.1	8.3	8.2
South-East	132,888	381,536	594,724	1,785,356	2,894,504	30.4	33.7	35.6	37.9	36.4
South	48,613	138,495	216,387	636,387	1,039,882	11.1	12.2	13	13.5	13.0
Year of birth										
2011–2012	93,831	241,236	339,817	952,582	1,627,466	21.5	21.3	20.4	20.2	20.5
2013–2014	122,663	314,783	458,010	1,232,364	2,127,820	28.1	27.8	27.4	26.1	26.7
2015–2016	116,595	301,183	446,219	1,252,905	2,116,902	26.7	26.6	26.7	26.6	26.6
2017–2018	103,750	276,139	425,877	1,275,785	2,081,551	23.7	24.3	25.5	27.1	26.2
Paternal age, years										
<18	25,331	36,179	19,434	13,191	94,135	5.8	3.2	1.2	0.3	1.2
18-24	98,729	289,208	411,598	766,432	1,565,967	22.6	25.5	24.7	16.3	19.7
25 and more	24,974	100,287	228,841	1,259,886	1,613,988	5.7	8.9	13.7	26.7	20.3
Unknown	287,805	707,667	1,010,050	2,674,127	4,679,649	65.9	62.4	60.5	56.7	58.8

[a] Column percents unless otherwise specified.

mothers, while the opposite was observed in the remainder of the country. In at least 28% of births to ≤15-year-old mothers the father was 18 years-old or older. The true frequency is unknown due to a large proportion of missing data for this variable, particularly among births to younger mothers.

Very and moderately preterm birth were jointly modified by maternal age group and marital status (p-value for interaction <0.001) (Fig. 2a and b). They both increased with decreasing maternal age but the association was stronger for very preterm birth, with odds ratios around 2. Within age groups rates were lowest among married (although it did not reach statistical significance among ≤15-year-old mothers due to small numbers), intermediate among common-law and highest among single mothers. Despite a protective association within age groups, married and common-law ≤15 and 16-17-year-old mothers exhibited higher odds of preterm birth than their single 20-24-year-old counterparts.

Small-for-gestational age followed an age-graded pattern similar to that of preterm birth, although less pronounced. Married women had lower odds of extreme SGA than their single counterparts within age groups, except among ≤15-year-old mothers (Fig. 2, c), and lower odds of moderately SGA in all age groups (Fig. 2, d) (p-value for interaction <0.001). There were no SGA differences between births to common-law and single women.

Low Apgar score also increased with decreasing age (Fig. 3, a) but there was not strong evidence of a significant interaction (p-value = 0.11) with marital status. Compared to births of single women, those of married women had lower odds of low Apgar within all maternal age groups. Common-law women had a borderline reduced odds than single women, but did not reach statistical significance in all age groups.

Late prenatal care initiation exhibited a strong graded pattern according to decreasing maternal age (Fig. 3, b, left) and another strong risk gradient from married to common-law to single women within all age groups (Fig. 3, b, right) (p-value for interaction <0.001). Compared to single women aged 20–24 years, married women were at lower or similar odds, except among ≤15-year-old mothers, who were at higher odds, while common-law women were at higher odds in all teenager groups (Fig. 3, b, left).

Repeat birth was more common as maternal age increased and the age gradient was strongly modified by marital status (p-value for interaction <0.001) (Fig. 3, c, left). Compared to single mothers, married mothers had lower odds of repeat birth across age groups, with the only exception of ≤15-year-old mothers who had the highest odds in this age group [Adjusted Odds Ratio (AOR): 2.56; 95% Confidence Interval (95%CI): 2.40, 2.74] (Fig. 3, c, right). Common-law mothers had higher repeat birth rates than single women in all age groups.

Low age-appropriate education showed a pattern similar to that of repeat birth (p-value for interaction <0.001) with increasing proportions associated with increasing age (Fig. 3, d, left). Compared to single women, married women were less likely to have low education across age groups, with the exception of ≤15-year-old mothers who had higher odds [AOR: 1.30; 95%CI: 1.03, 1.64] (Fig. 3, d, right). Common-law women had slightly higher odds than single women across age groups.

4. Discussion

4.1. Main findings

This nationwide population-based study indicates that overall, in the last decade one out of 11 Brazilian births were to women below 18 years of age. Births to minor mothers were unevenly distributed, with higher proportions in the poorest Northern regions and among Indigenous and mixed-race women. While the majority of these births were to single mothers, one third were to common-law or married mothers, although births to legally married girl mothers were less common and decreased by half in the study period.

Our main finding is that, among adolescents, maternal age modifies the association between marital status and most perinatal indicators in an outcome-specific way. First, married women had consistently better outcomes than single women, with common-law women generally having outcomes intermediate or similar to those of single women, particularly among those aged 18 years and older, but the marriage

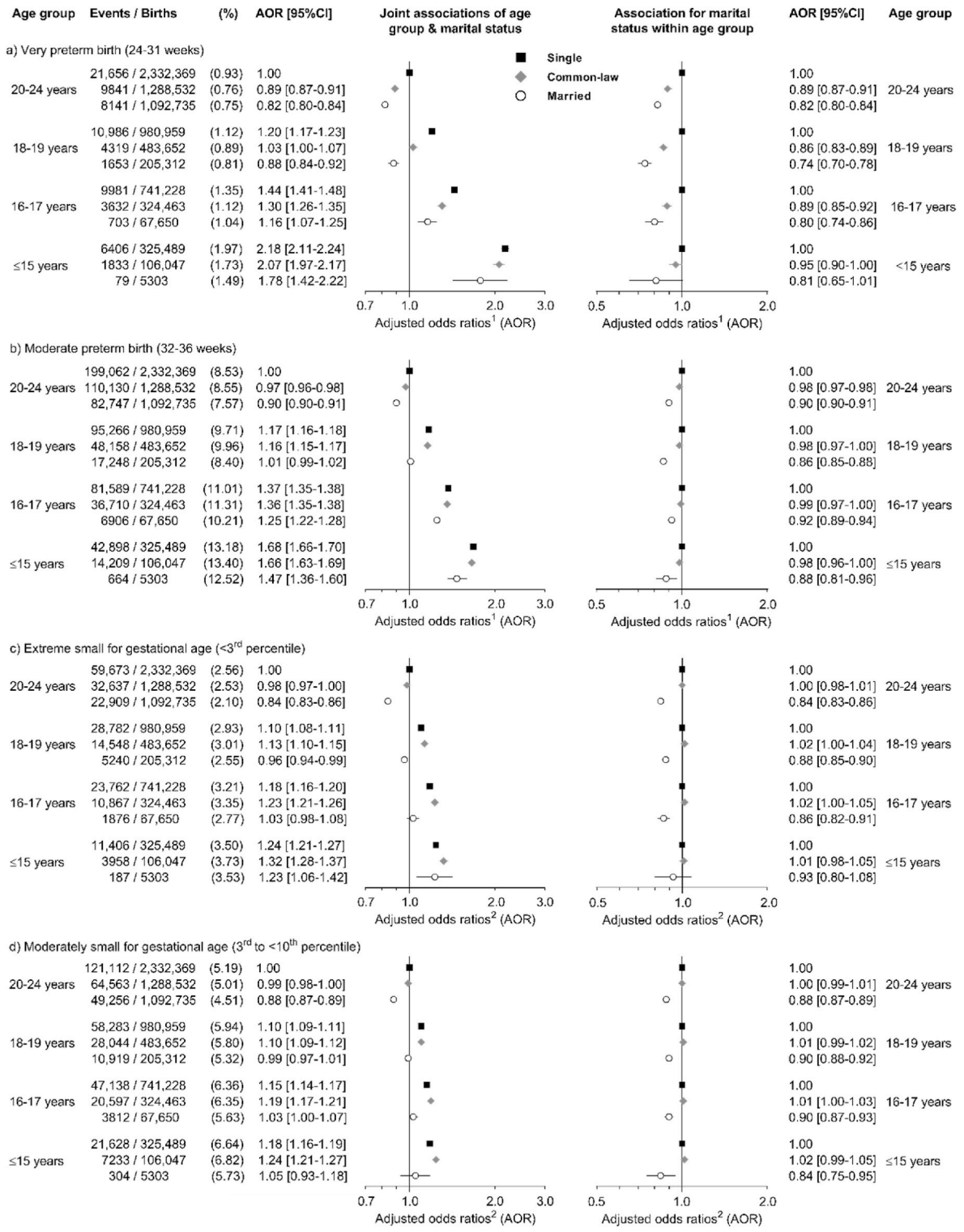

Fig. 2. Preterm birth (a, b) and small for gestational age groups* (c, d) by maternal age group and marital status, Brazil, 2011-2018

[1] Adjusted for infant sex, parity, father's age, maternal race, low maternal education, region, year of birth

[2] Adjusted for parity, father's age, maternal race, low maternal education, region, year of birth*

Based on a multinomial model for gestational age groups: 24–
31 weeks, 32–
36 weeks, and 37–
42 weeks (reference), and for small-for-gestational age groups: <3rd percentile, 3 to <10th percentile, and 10th
+
percentile (reference).

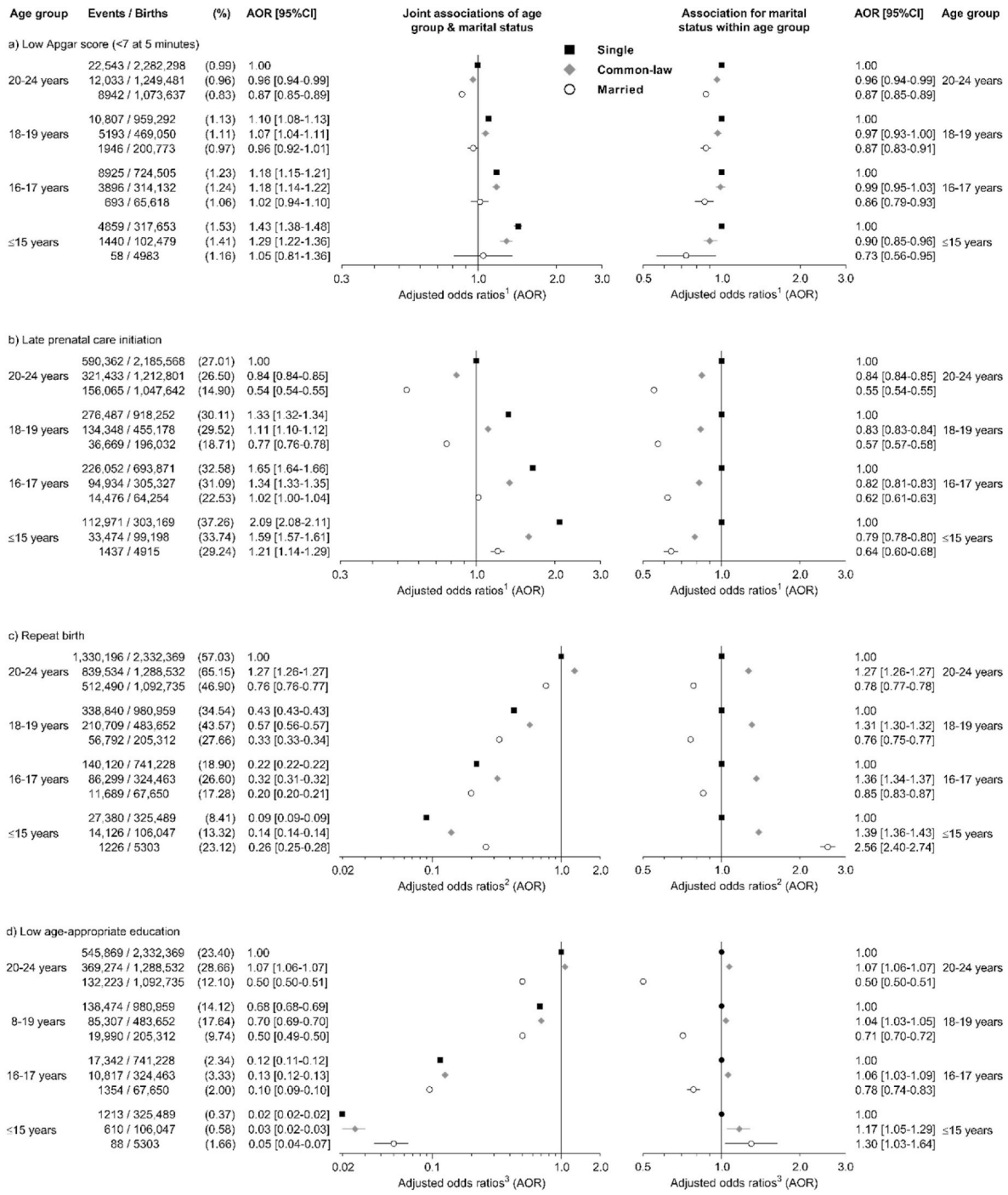

Fig. 3. Low Apgar[†] (a), late prenatal care initiation[‡] (b), repeat birth (c), and low age-appropriate education (d) by maternal age group and marital status, Brazil, 2011–2018

[†]189,838 (2.4%) observations were excluded due to missing data on Apgar scores.

[‡]467,532 (5.9%) observations were excluded due to missing data on prenatal care initiation.

(1) Adjusted for infant sex, parity, father's age, maternal race, low maternal education, region, year of birth

(2) Adjusted for father's age, maternal race, low maternal education, region, year of birth

(3) Adjusted for parity, father's age, maternal race, region, year of birth.

advantage tended to weaken or disappear with decreasing age. Second, despite a marriage advantage within age groups, this advantage in PTB, SGA and prenatal care was not sufficient to offset the higher risk associated with early age across age groups experienced by all minor mothers, particularly ≤15-year-old mothers, who were at the highest risk of most indicators, compared to 20-24-year-old single mothers. The marriage advantage was also observed for repeat birth and low education within age groups, except among ≤15-year-old mothers, for whom the association reversed exhibiting higher odds for married girls compared to single girls. Together, these findings suggest that the protection associated with marriage among adult mothers cannot be easily generalized to minor mothers.

4.2. Interpretation

Despite decreasing trends in teen pregnancy, Brazilian teenage pregnancy rates are still above the global and Latin American averages (Lancet, 2020). Our study found that among births to teen mothers, half of them were to <18-year-old and 13% to ≤15-year-old girls. Child marriage, including formal and informal unions, accounted for one third of births to underage mothers, and was unevenly distributed within the country. These births occurred more often in poor regions and racialized groups that may also face challenges to access health services regularly (Lancet, 2020), as evidenced in the late initiation of prenatal care observed in our study.

We found an inverse age gradient in PTB, LBW, Apgar and late prenatal care initiation among adolescents that is consistent with previous studies (Ganchimeg et al., 2014; Osterman & Martin, 2018), some of which also observed a similar gradient for a wide array of pregnancy complications and neonatal adverse outcomes (Ganchimeg et al., 2014). This highlights the increased perinatal risk associated with early childbearing age, particularly among ≤15-year-old girls (Ganchimeg et al., 2014; Salihu et al., 2006).

We also found a marriage advantage across all outcomes among 20-24-year-old mothers that is consistent with a substantial literature highlighting the beneficial associations of marriage with perinatal outcomes among adult women (Holt et al., 1997; Luo et al., 2004; Raatikainen, Heiskanen, & Heinonen, 2005). However, there is a knowledge gap regarding the generalizability of the marriage advantage below age 20 that our study contributes to fill. Despite a formal marriage advantage across age groups, perinatal health indicators of 16–17- and ≤15-year-old girls still fared worse than those of 20–24-year-old single mothers, implying that the marriage advantage within age groups was not strong enough to counterweight the higher absolute perinatal risk that gradually increases with younger maternal age. This suggests that preventing early pregnancies may result in health gains, beyond differences associated with marital arrangements. While the age gradient in perinatal risk may reflect biological and social immaturity for childbearing (Ganchimeg et al., 2014) marital status differences within age groups reflect the influence of complex social contexts that confer marital and cohabitation arrangements meanings that guide social interactions and behaviors that in turn influence pregnancy outcomes.

Being married was associated with lower repeat birth and low education across age groups, with the exception of ≤15-year-old married girls, who were at higher odds relative to their single counterparts. The reversal of the direction of these associations among ≤15-year-old married girls may signal lack of autonomy and dependence on their older partners, which could manifest as limited ability to negotiate contraceptive use and sexual intercourse frequency, resulting in high early fertility, and renunciation of educational and career goals to exclusively embrace household roles (Wodon et al., 2017; Darroch, Landry, & Oslak, 1999). Giving birth to multiple children at such an early age may exacerbate the challenges in advancing educational and career goals among childbearing girls (United Nations Children's Fund, 2021 October 2021; Wodon et al., 2017). Higher rates of repeat birth among married minors may reflect that family formation is a desirable life trajectory, leading to intended early pregnancies. In contrast, lower repeat birth rates among 16-17-, 18-19- and 20-24-year-old married mothers compared to single mothers may reflect selection of women of higher socioeconomic status into legal marriages in which the planning of small families or longer birth spacing may be strategies to meet maternal career aspirations without delaying family formation. Overall fertility trends have reached below replacement levels in Brazil, particularly among the well-off but remain higher among women residing in poor regions, of low education and of non-white skin color (Tejada et al., 2017). Some ≤15-year-old girls may perceive legal marriage or an informal union as a trade-off to overcome a negative life situation, such as poverty or a detrimental family environment (Bhan et al., 2019; Taylor et al., 2019).

4.3. Strengths and limitations

Strengths of this study include the large nationwide population-based sample, which made it possible to conduct a detailed examination of the interplay between marital status and age groups, notably ≤15-year-old girls, who are usually collapsed with other teenagers in many studies due to sample size constraints. A second strength is the categorization of marital status into legally married, common-law and single women, unlike USA birth certificates that only distinguish legally married from unmarried women (Fafard St. Germain et al., 2022; Martin et al., 2019). There are several limitations. First, maternal age and marital status were self-reported and may be affected by misclassification. It is possible that some informal unions are misclassified as legal marriages, given the shared meaning and widespread acceptability of the practice. Marital status among Indigenous women must be interpreted with caution, given the diversity of Indigenous groups which marital practices cannot be reduced to a common statistical typology. Second, due to the cross-sectional nature of the data it was not possible to discriminate whether marriage or informal unions preceded conception or occurred during pregnancy. Third, some mothers may have contributed more than one birth in the study period but birth registrations lack a maternal identifier relating different births of a same mother. Fourth, since birth registrations occur at or after the birth of the child, many births to 16- and 18-year-old mothers may have been conceived at 15 or 17 years of age, respectively, and contributed to an underestimation of early pregnancies. Finally, residual confounding cannot be discarded due to measurement error and limited availability of covariates.

4.4. Implications

Despite these limitations, our study provides new insights on the perinatal epidemiology of child marriage by using birth records, less affected by self-reported biases than demographic surveys. Since our results cover the most recent period prior to the 2019 legislation forbidding underage marriage, they provide a baseline to monitor progress towards the reduction of adolescent pregnancy and child marriage in Brazil. The modification of the associations between perinatal outcomes and marital status according to adolescent age groups highlights the importance of not collapsing minors (<18 years) with other teenagers (18–19 years) to better understand how the health impacts of marital arrangements change with the legal majority of age. We propose to routinely report the proportion of births to <18-year-old girls among all births to teenage mothers as a relevant indicator to monitor progress towards the reduction of early pregnancy, since the 18th birthday signals the passage to adulthood in most countries, with the consequent uptake of civil rights and responsibilities, which may in turn influence health outcomes. Likewise, birth registrations may be strengthened by improving data completeness and quality, and reducing geographic inequalities in data collection. Improvements in the completeness of paternal age may help in determining boy child marriages and parental age differences, which reflect gender inequalities. Inclusion of other paternal characteristics, such as education, in birth registrations may help understand paternal influences on perinatal outcomes. Although the focus of this study was on girl child marriages and unions, births to adolescent single mothers were found to be more common and faced generally higher risk of adverse outcomes than those occurred in wedlock, which reinforces the need to prevent teenage pregnancies, irrespective of marital status. However, strategies for prevention and care of adolescent pregnancies would benefit from considering marital situation, as a key dimension of the social environment. For example, although the 2019 Brazilian legislation is expected to deter legal marriages it may not prevent girls entering into informal unions, which are far more common than legal marriages. Decreasing secular trends in legal marriage and legislation seem insufficient to meet the Sustainable Development Goal of eliminating all forms of child marriage

by 2030, unless effective interventions are put in place to accelerate progress (Lancet, 2020) by addressing informal unions and subnational inequalities. Longitudinal and qualitative studies are needed to disentangle the specific causes and health and social consequences of the different marital arrangements among adolescent age subgroups.

Author statement

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Ethical statement

Since only anonymized secondary public use data were used, the study did not require ethics review by Brazilian Research Ethics Boards, according to the Brazilian National Health Council's Resolution no. 510/2016.

National Health Council of Brazil. 2016. *Resolution no 510, April 7, 2016.* Norms applicable to Research in Social Sciences and Humanities. Official Journal of the Union, May 2016. http://conselho.saude.gov.br/resolucoes/2016/Reso510.pdf.

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Declaration of competing interest

The authors have no conflicts of interest to disclose.

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