Perinatal factors and their association with early-adulthood suicidal behaviour in a Brazilian birth cohort

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Abstract

Background: To investigate the relationship between perinatal risk factors and suicidal ideation and attempts in young adults in Pelotas, Brazil.

Methods: The data were collected from the 1993 Pelotas Birth Cohort study. Every pregnant woman who gave birth in one of the hospitals in Pelotas Brazil in 1993 was invited to participate in the study. The current study uses perinatal data collected in 1993, and follow-ups at ages 18 and 22. The primary outcome was lifetime suicide attempts with past month suicide ideation a secondary outcome. The association between perinatal predictors and suicidal ideation or lifetime suicide attempts was investigated using hierarchical logistic regression.

Findings: There was an analytic sample size of 3493. The perinatal factors association with lifetime suicide attempts were sex (OR= 2.25 CI: 1.76-2.89), paternal education at birth (OR=0.60, 95%CI: 0.36-0.99), maternal education (9-11 years OR= 2.81, 95%CI: 1.41-5.59, & 0-8 years OR= 2.21, 95%CI: 1.07-4.58), support from friends or neighbours at birth (OR= 0.36 95%CI: 0.17-0.77), and maternal smoking during pregnancy (OR=1.41, 95%CI: 1.10-1.79). Patterns of associations were broadly similar with suicidal ideation. Interactions between sex and the perinatal factors paternal education, maternal education, smoking and support from friends were assessed and found to be not significant.

Conclusion: Several factors during the perinatal period are associated with risk of lifetime suicide attempts and ideation in young adults in Brazil. Early-life factors associated with suicide related concerns in early adulthood were similar to those observed in studies from high-income settings.

Highlights

1. Associated factors determined using data from upper-middle income setting.
2. Maternal education, and maternal smoking are associated with risk of lifetime suicide attempts.
3. Associations were similar with suicidal ideation including sex, maternal education, and maternal smoking.

Key words
Suicide attempts, suicide ideation, perinatal, cohort study

Introduction

Death by suicide is one of the leading causes of death worldwide for youth and young adults (1). Suicide is common in high income countries, but the vast majority of suicides happen in low- and middle-income countries (1). In 2019, 77% of suicides happened in low- and middle-income countries(1) and the rate of suicides is likely to be underestimated due to cause of death misclassification and inaccuracy of death registries(2). Suicidal ideation and attempt are associated with death by suicide (3). A systematic review of adolescents and young adults in 149 regions reported a high prevalence of suicidal ideation and lifetime suicide attempts (16.4% and 6.2%, respectively) (4). A study of adolescents in low- and middle-income countries found that the prevalence of suicide planning, ideation and attempts was approximately 17% each (5).

The perinatal period, which refers to the weeks immediately before and after the birth, can affect health across the lifespan. This idea is explained by the theory of fetal programming, where development of the fetus during pregnancy can be affected by maternal stressors and change that development(6). Physical illnesses such as cardiovascular disease (7) and asthma (8) as well as mental illnesses(9) later in life are associated with various perinatal factors. Stressful events, smoking, drinking and low education during pregnancy was found to increase scores on the Child Behaviour Checklist in an Australian cohort study(10). Several studies have found that baby measurements at birth can lead to mental illnesses including depression(11–13).

There has also been evidence that the perinatal period is associated with suicidal behaviours. A systematic review completed in 2019 investigated the association between perinatal and perinatal factors with suicide, suicide attempt, and suicidal ideation (14). This review found that lower maternal age, single motherhood, low socioeconomic status, low birth weight, and earlier gestational age at birth were risk factors for suicide attempt. Of the 42 studies included all but one were from high-income countries, and while most studies had suicide as an outcome, fewer looked specifically at suicidal ideation and attempt. A notable exception to the preponderance of evidence from high-income settings was a 2022 study from South Africa that found that low birth weight (Odds Ratio (OR)= 1.2), and high birth order (OR= 1.15) were significantly associated with suicidal ideation in adulthood for females, while socioeconomic adversity (OR= 1.13) was significantly associated with suicidal ideation in adulthood for males (15). Identifying perinatal risk factors is important in low- and middle-income countries due to the higher prevalence of risk factors such as low age at pregnancy and low birth weight(16) that have been linked to later suicidal outcomes in higher income settings(14).

There is a large gap in the literature on how perinatal risk factors for suicidality affect those in low- and middle-income countries. The objective of this study is to investigate the relationships between various perinatal risk factors and suicidal ideation and attempts using a large birth cohort study in Pelotas, Brazil. Both past month suicide ideation and lifetime suicide attempts are important to investigate as they have been demonstrated to have differing etiology and risk factors(17). We hypothesized that many of the risk factors would be associated with both past month suicide ideation and lifetime suicide attempts.

Methods

Study sample

Data for this study were from the 1993 Pelotas Birth Cohort Study, a prospective birth cohort study in southern Brazil. Pelotas had a population of approximately 270,000 (in 1993) with a human development index of 0.739. The GDP per capita was just over R$ 21,000, broadly similar to the rest of Brazil. All women who gave birth in the city's five hospitals that year were approached to participate in the study. Children whose parents had consented at birth were followed up at 11, 15, 18, and 22 years of age. For this study, the birth sample and the follow-up at 18 and 22 years were utilized because they included information on lifetime suicide attempts and past month suicide ideation. Full details on the 1993 birth cohort(18) and the 18(19) and 22(20) year follow-ups can be found elsewhere.

Measures

Outcomes

The primary outcome analysed in this study was lifetime suicide attempt, with suicidal ideation being a secondary outcome. These were assessed at age 18 and 22 using the Mini International Neuropsychiatric Interview (MINI), version 5.0 by a trained psychologist. Selecting 'yes' to the question, "Have you ever tried to kill yourself" indicated a positive outcome for lifetime suicide attempt. The questions used to assess suicidal ideation included 1) "In the past month have you thought about killing yourself" (suicide thought), and 2) "In the past month have you thought of a way to kill yourself" (suicide plan). Indication of "yes" with either question was used to assess past month suicide ideation. We combined responses from age 18 and 22 into one variable for both suicidal ideation and lifetime suicide attempt. If they indicated yes at either age, they were considered to have lifetime suicide attempts and/or past month suicide ideation.

Exposures

All exposures were assessed soon after birth of the infant; exposures were self-reported by the mother of the child during an in-person interview with trained study personnel using a standard questionnaire. Child measurements and weights were also taken at this time by study personnel and nursing staff. The exposure variables were categorized using previous literature about perinatal factors.

Low birth weight was defined as weight less than 2500 grams at birth, as defined by the World Health Organization(21). Infants with heads measuring less than 33 cm, were classified as having *small head circumference*. Babies were considered to have *short birth length* if their length at birth was less than 47cm. *Gestational age* was defined as the time from conception until birth and was a continuous variable measured in weeks. A *low Apgar score,* assessed at five minutes post birth, was defined as seven or lower(22). Sex of the baby was reported as male or female at birth by the mother.

Maternal reported pregnancy and birthing factors include maternal *diabetes,* maternal *hypertension,* maternal *anemia, induction* used in birthing process, birth by *caesarian section*, and if the baby was admitted to the Intensive care Unit (*ICU)* after birth. These exposures were dichotomous (yes/no). *High parity* included mothers who had had more than three previous pregnancies (whether or not these pregnancies resulted in a live birth).

Parent's education was categorized into 3 groups: 0-8 completed years, 8-11 completed years and 12 or more competed years. Fathers older than 35 years of age were considered to have *high paternal age*, whereas mothers younger than 20 years old were classified as having *lower maternal age*. *Low income* included those in the bottom 25th percentile of self-reported family income. Maternal and paternal age as well as income cut offs were influenced by a prior longitudinal study (23).

Maternal substance use was investigated with measures of perinatal smoking and drinking. *Maternal smoking* was operationalized as any cigarette smoking during pregnancy. *Maternal alcohol consumption* was classified as drinking more than one standard measure of alcohol per week during pregnancy.

Social support was assessed through self-report by mothers across multiple domains: *friend or neighbour support* (yes or no), *family support* (yes or no) and *father support* (yes or no). In addition to support, we included a variable for *parental separation* (yes or no).

We additionally considered whether the birth was a result of an *unplanned pregnancy*.

Analysis

All analyses were completed in STATA 14.2. Participants were dropped from the analyses if they did not answer all questions needed for the analysis. The quantity of missing data due to dropout can be seen in Supplementary Table 1. Pearson correlation coefficients between all the independent variables were computed (Supplementary Table 2). Crude associations between individual exposures and suicidal behaviour were assessed with separate logistic regression models. We then conducted multivariable logistic regression to predict the risk of suicidal ideation and lifetime suicide attempts from exposures, using hierarchal regression analysis. First, we included sex only, then we added maternal and paternal age, low income, parental separation and maternal and paternal education. In the next model we added the 3 support variables followed by planned pregnancy in model 4. Parity, maternal illnesses, smoking and drinking were included in model 5. For model 6 we added all baby related measures (eg. birth weight) and finally in the final model we included all variables. Odds ratios (OR) are reported for each predictor variable. 95% confidence intervals that did not include 1 and $p<0.05$ was used to assess statistical significance. AIC was computed for each model to assess model fit. Interactions between sex and statistically significant variables were assessed in multivariable analysis.

Ethical considerations

Ethics approval was granted by the Research Ethics Board of the Federal University of Pelotas Medical School and the University of Ottawa. Informed consent was provided by the mother in the 1993 interview and by the offspring participant at 18 and 22 years old.

Results

There were 5249 participants (live births) whose mothers consented to the study (99.7% response rate). At the 18- and 22-year follow-ups, 4106 (78.0%) and 3810 (72.4%) participants were successfully contacted and interviewed, respectively. The sample size included in the analysis is 3493. The characteristics of the sample at birth can be found in Table 1. The proportion of people who indicated they had lifetime suicide attempts at age 18 or 22 years of age was 10.0% (95% CI: 9.0%-11%) and indicated they had past month suicide ideation at age 18 or 22 years of age was 5.5% (95% CI: 4.8%- 6.3%).

Predictors of suicidal attempts and past month suicide ideation in 18- or 22-year-olds in bivariate analyses can be seen in Table 2. Sex, maternal age, income, parental separation, maternal education, unplanned pregnancy, maternal smoking, and induction of labour were all associated with increased lifetime suicide attempt whereas support during pregnancy from paternal education as well as father, family and friends were associated with decreased lifetime suicide attempts in bivariate analysis. Past month suicide ideation at 18- or 22- years old was positively associated with female sex, low income, low education, unplanned pregnancy, maternal smoking, and maternal alcohol consumption and negatively associated with support from friends.

In multivariable hierarchical regression analysis (see Table 3), being female increased odds of lifetime suicide attempts at age 18 or 22 years old (OR=2.25, 95%CI: 1.76-2.89). There were reduced odds of lifetime suicide attempts in young adulthood if they have a father with 9-11 years compared to 12 or more years of completed education at birth (OR=0.60, 95%CI: 0.36-0.99). There were increased odds of lifetime suicide attempts at age 18 or 22 for offspring with mothers who have 11 or fewer completed years of education compared to 12 or more years (0-8 years OR= 2.81, 95%CI: 1.41-5.59, & 9-11 years OR= 2.21, 95%CI: 1.07-4.58). Mother smoking during pregnancy increased odds of lifetime suicide attempt (OR=1.41, 95%CI: 1.10-1.79). Having support from friends or neighbours during pregnancy was associated with decreased odds of lifetime suicide attempts (OR= 0.36 95%CI: 0.17-0.77). Interactions between sex and the perinatal factors paternal education, maternal education, smoking and support from friends were assessed and found to be not significant (Supplementary Table 3).

Table 4 shows the hierarchical logistic regression analysis describing the odds of suicidal ideation for each of the perinatal risk factors. There were increased odds of past month suicide ideation in young adults who are female sex (OR= 2.38, 95%CI: 1.68-3.37), have a mother who has only 0-8 years of completed education compared to having a mother with 12+ years of completed education (OR= 2.77, 95%CI: 1.07-7.20), and having a mother who smoked during pregnancy (OR= 1.49, 95%CI: 1. .07-2.06). Having support from friends or neighbours during pregnancy was a protective factor against past month suicide ideation (OR= 0.19, 95%CI: 0.08-0.43). In both hierarchical regression analysis, the AIC was the lowest for the final full model therefor that was used for all results.

Attrition analyses (Supplementary Table 1) showed that several indicators of early-life adversity were associated with drop-out before age 18, including low birth weight, smaller head size, low Apgar score, maternal ICU admission, low paternal education, parental separation, and lack of support from the father or from friends and neighbours.

Discussion

This large study of Brazilians followed since birth is one of the first from a low- or middle-income country setting to focus on multiple perinatal factors and their association with suicidal behaviour in early adulthood. Risk factors for lifetime suicide attempts in early adulthood included female sex, low maternal education, and maternal smoking, while social support was protective. Similar factors predicted suicidal ideation. Comparing these results to a study using two cohorts from high-income countries, many of the same predictors were found to be significant(23). Maternal smoking, maternal education were found to be significant(23). A systematic review with a majority of studies from high-income countries found that lower maternal and paternal education increased the chances of suicidal behaviour(14). In contrast to the results of this study, both of those studies found that offspring birth measurements did have a significant effect on suicidal behaviour in young adults(14,23). Comparing the prevalence of the perinatal adversities between a cohort from a high income and low income countries, many of the perinatal adversities are more common in lower income countries such as lower maternal education and age, low birth weight and low income(15,23).

Females were more likely to have past month suicide ideation and lifetime suicide attempts. This is consistent with literature in both low and middle income countries as well as high income countries(24). A systematic review showed that females were 2 times more likely to have suicide attempts compared to males and there were some different risk factors found for each sex such as being a victim of dating violence for females and conduct behaviours for males (24).

Smoking during pregnancy was found to increase the risk of both suicide ideation and suicide attempts. Other studies have found inconsistent results about smoking and offspring suicide-related behaviours. A Swedish cohort study found that smoking did lead to an increase in suicide attempts but when they looked specifically at twin pairs, they did not see that relationship(25). There was no relationship between smoking and offspring suicide related behaviours in a Quebec cohort study(26). There are no studies in low- or middle- income countries to compare these results to. There will need to be more research on this topic before it is understood.

Social support from friends and neighbours during the mother's pregnancy was a strong protective factor against offspring suicidal behaviour. Throughout the life course concurrent social support has been linked with decreased suicide attempts (27). Different mechanisms may explain how maternal perinatal support protects against offspring suicidality. Fetal programming theory speculates that offspring outcomes can be affected by negative environmental factors during critical perinatal periods by permanent alterations to fetal developmental processes, including brain development (6). Lack of social support during pregnancy may be a source of increased stress; perinatal maternal stress has been linked to numerous negative offspring mental health and behavioural outcomes (28,29). A study conducted using data from African American or Latino/Hispanic adolescents living in the United States, found that maternal depression mediated the associated between social support and child development (7). Conversely, positive social support during pregnancy may improve the mental health of pregnant women (30), which may have follow-on effects on fetal development(31).

A second mechanism which could explain these associations is the continued social support the mother and child may have from the same network the mother had when she was pregnant or they may have continuity in social support levels. Effective social support through childhood and adolescence could improve mental health and lead to decreased risk of suicide(32). Mothers who receive less support from friends may employ less effective parenting behaviours (33) a factor which can affect offspring mental health and suicidal behaviour(34). Parents who have adequate social support tend to model healthy coping strategies, which may lead to mode effective coping among children (35). The effect of social support on offspring suicide may have been particularly notable in the current study because people who have a lower socioeconomic status are less likely to have strong social support (36), and social support has been shown to have a stronger protective effect against poor mental health in low socio-economic settings. Additionally, mental health systems tend to be under-resourced in low- and middle-income countries; community support from friends and neighbours can be even more important due to barriers to accessing mental health care in these communities (37).

The results of this study also point to the importance of maternal education and its impact on child mental health. A 2022 systematic review that included 59 studies found that the odds of having a suicide attempt are 12% higher for people whose parents have a lower education(38). Over half of the studies in that review specifically focused on maternal education. Low maternal education is also associated with other negative outcomes such as poor child development scores (39) and child depression (40,41). This association is especially consequential for those in low- and middle-income countries where educational opportunities may be limited (42). Paternal education was shown to be associated with suicide attempts but to a lesser extent. This may be explained by fathers with less education may not be employed or have lesser employment and therefor may be able to parent better. A study conducted recently found that fathers who were not fully employed scored better on the parent child relationship inventory(43).

Future research

This study was one of the first studies looking at associations between the perinatal period and offspring suicidal behaviour and has implications for future research. To start off with, it would be important for more studies on middle-income countries and other studies that look at low-income countries to understand if these findings hold true. In the future, researchers should also investigate pathways from perinatal factors through suicidal behaviour to identify appropriate times for intervention.

Strengths and limitations

The largest strength of this study is the nature of the longitudinal birth cohort study and the high retention rates into early adulthood. We were able to limit recall bias using a prospective design and investigate many exposures in one study. This study also uses a validated questionnaire

(MINI) to measure the outcomes. This is one of the first studies to investigate many perinatal factors using data from an upper-middle income country.

Longitudinal studies are prone to selection bias due to the dropout of participants throughout the course of the study. There was a notable amount of missing data due to drop out because the follow-up period was of great length. Notably, several indicators of early-life adversity were associated with dropout; many of these same indicators of adversity were also associated with suicidality. Given that studies have shown that depression and higher severity of symptoms are associated with dropout in epidemiological studies(44), it is likely that suicidal individuals would be more likely to drop out. Such drop out is likely to bias associations towards the null, suggesting our findings may under-estimate true associations between perinatal factors and suicidality. Similarly, we did not account for deaths, suicide or by other causes which could increase bias. An additional limitation is that although we were able to include a large list of predictor variables, there is a chance that there were confounding variables that remain unmeasured. For example, parental mental health, which is likely to be associated with offspring suicidal behavior(45), was not measured at the time of the birth.

Conclusion

This large study of Brazilians followed since birth showed that many factors during the perinatal period are associated with risk of suicide in early adulthood. Early-life factors associated with suicidality in early adulthood were similar to those observed in studies from high-income settings(14), however, the prevalence of such factors may be higher in lower-income settings. Policies and interventions that focus on potentially modifiable factors, such as, providing social support for new mothers, may result in decreases in later suicides in low- and middle-income settings.

Declarations

Ethics approval and consent to participate

Ethics approval was granted by the Research Ethics Board of the Federal University of Pelotas Medical School and the University of Ottawa. Ethics approval was granted. Informed consent was provided by the mother in the 1993 interview and by the offspring participant at 18 and 22 years old.

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to the privacy of individuals that participated in the study but are available from the corresponding author on reasonable request.

Competing interests

There are no conflicts of interest to disclose

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Author contributions

IC, MK, JM, MG, and AM conceived and designed the study. Data collection was done by AM, FW, and HG. HE performed the data analyses and wrote the first draft of the manuscript. All authors interpreted the results and critically reviewed the manuscript.

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Table 1: Sample Characteristics at birth (n= 3493)

Variables		Mean	SD
Gestational age (weeks)		39.6	2.24
	Categories	n	%
Sex	Female	1867	53.45
	Male	1626	46.55
Birth length	<47cm	507	14.51
	≥47 cm	2986	85.49
Birth weight	<2500g	303	8.67
	≥2500g	3190	91.33
Head size	<33 cm	85	2.43
	≥33 cm	3408	97.57
APGAR score	<7	28	0.80
	≥7	3465	99.20
Induced labour	Yes	1132	32.41
	No	2361	67.59
Cesarean section	Yes	1116	31.95
	No	2377	68.05
ICU^{+}	Yes	79	2.26
	No	3414	97.74
Maternal diabetes	Yes	98	2.81
	No	3395	97.19
Maternal hypertension	Yes	540	15.46
	No	2953	84.54
Maternal Anemia	Yes	1607	46.01
	No	1886	53.99
Parity	>3	651	18.64
	≤2	2842	81.36
Maternal age	<20	603	17.26
	≥20	2890	82.74
Paternal age	>35	724	20.73
	≤35	2769	79.27
Maternal education	< 9 years	2488	72.66
	9-11 years	646	18.87
	>11 years	290	8.47
Paternal education	< 9 years	2354	68.67
	9-11 years	605	17.65
	>11 years	469	13.60
Maternal smoking	Yes	1129	32.32
	No	2364	67.68
Maternal alcohol consumption	>1drink/week	113	3.24
	≤1 drink/ week	3380	96.76
Family income	< 1^{st} quartile	910	26,05
	≥ 1^{st} quartile	2583	73.95
Unplanned pregnancy	Yes	2133	61.06
	No	1360	38.94
Parental separation	Yes	399	11.42
	No	3094	88.58
Father support	Yes	3266	93.50
	No	227	6.50
Family support	Yes	3413	97.71
	No	80	2.29
Friend and neighbour support	Yes	3422	97.97
	No	71	2.03

*Intensive care unit

Table 2: Bivariate analysis between perinatal variables and suicidal behvaiour

		Suicide attempt			Suicide ideation		
Variable		Odds Ratio	CI	p-value	Odds Ratio	CI	p-value
Female sex		**2.08**	**1.64-2.63**	**<0.001***	**2.40**	**1.74-3.23**	**<0.001***
Low maternal age		**1.32**	**1.001-1.73**	**0.049***	1.41	0.99-2.00	0.057
High paternal age		0.85	0.64-1.13	0.263	0.84	0.58-1.22	0.360
Low income		**1.5**	**1.19-1.90**	**0.001***	**1.83**	**1.35-2.47**	**<0.001***
Parental separation		**1.42**	**1.04-1.95**	**0.027***	1.17	0.76-1.80	0.488
Paternal education	(9-11 years)	**0.57**	**0.36-0.90**	**0.015***	0.84	0.46-1.51	0.555
Paternal education	(0-8 years)	1.11	0.80-1.54	0.535	1.28	0.81-2.03	0.290
Maternal education	(9-11 years)	**2.38**	**1.19-4.76**	**0.014***	2.47	0.94-6.49	0.066
Maternal education	(0-8 years)	**3.47**	**1.83-6.61**	**<0.001***	**3.69**	**1.50-9.08**	**0.004***
Father support		**0.64**	**0.44-0.94**	**0.025***	0.62	0.38-1.01	0.055
Friends support		**0.32**	**0.19-0.55**	**<0.001***	**0.25**	**0.13-0.46**	**<0.001***
Family support		**0.52**	**0.29- 0.93**	**0.029***	0.71	0.31-1.66	0.431
Unplanned pregnancy		**1.30**	**1.03-1.65**	**0.025***	**1.44**	**1.06-1.97**	**0.022***
High parity		1.24	0.95-1.63	0.111	1.36	0.96-1.92	0.082
Maternal anemia		1.14	0.91-1.42	0.247	1.10	0.82-1.47	0.532
Maternal diabetes		1.25	0.68-2.32	0.470	0.72	0.26-1.97	0.519
Maternal hypertension		1.12	0.83-1.50	0.469	0.81	0.52-1.24	0.328
Maternal smoking		**1.54**	**1.23-1.93**	**<0.001***	**1.66**	**1.24-2.23**	**0.001***
Maternal alcohol consumption		1.63	0.96-2.76	0.070	**1.90**	**1.003-3.61**	**0.049***
Gestational age		1.01	0.96-1.07	0.609	1.01	0.94-1.08	0.793
Small head size		1.32	0.69-2.50	0.401	1.07	0.43-2.68	0.877
Short birth length		1.30	0.97-1.74	0.078	1.38	0.95-2.01	0.090
Low birth weight		1.35	0.95-1.93	0.096	1.02	0.61-1.71	0.933
Low Apgar		1.51	0.52-4.38	0.447	0.63	0.09-4.69	0.655
Induced labour		**1.27**	**1.01-1.60**	**0.041***	1.26	0.93-1.70	0.137
Caesarean section		0.79	0.62-1.01	0.060	0.93	0.68-1.28	0.667
ICU		1.28	0.65-2.50	0.472	0.90	0.33-2.49	0.841

* p<0.05

Table 3: Hierarchical multivariable logistic regression analysis between perinatal factors and suicide attempt
* p<0.05

Level	Variable		Suicide attempt OR (CI)
1	Female sex		**2.25*** **(1.76-2.89)**
2	Low maternal age		1.04 (0.76-1.43)
	High paternal age		0.87 (0.63-1.19)
	Low income		1.30 (0.999-1.70)
	Parental separation		1.27 (0.88-1.85)
	Paternal education	(9-11 years)	**0.60*** **(0.36-0.99)**
	Paternal education	(0-8 years)	0.89 (0.60-1.32)
	Maternal education	(9-11 years)	**2.21*** **(1.07-4.58)**
	Maternal education	(0-8 years)	**2.81*** **(1.41-5.59)**
3	Father support		1.15 (0.65-2.01)
	Friends support		**0.36*** **(0.17-0.77)**
	Family support		1.31 (0.55-3.11)
4	Unplanned pregnancy		1.09 (0.85-1.41)
5	High parity		1.06 (0.77-1.58)
	Maternal anemia		1.06 (0.83-1.35)
	Maternal diabetes		1.39 (0.72-2.68)
	Maternal hypertension		1.08 (0.79-1.49)
	Maternal smoking		**1.41*** **(1.10-1.79)**
	Maternal alcohol consumption		1.66 (0.96-2.87)
6	Gestational age		0.63 (0.39-1.01)
	Small head size		0.64 (0.23-1.77)
	Short birth length		1.06 (0.70-1.60)
	Low birth weight		1.27 (0.75-2.16)
	Low apgar		1.56 (0.44-5.44)
	Induced labour		1.20 (0.91-1.59)
	Caesarean section		1.00 (0.74-1.35)
7	ICU		1.14 (0.37-2.49)

ICU- Intensive care unit; OR= odds ratio; CI= Confidence interval
Variables in each level are controlled by variables in all previous levels

Table 4: Hierarchical multivariable logistic regression analysis between perinatal factors and suicide ideation
* p<0.05

Level	Variable		Odds Ratio (CI)
1	Female sex		**2.38*** **(1.68-3.37)**
2	Low maternal age		1.12 (0.74- 1.69)
	High paternal age		0.85 (0.55-1.31)
	Low income		**1.51 *** **(1.07-2.13)**
	Parental separation		1.05 (0.63-1.75)
	Paternal education	(9-11 years)	0.81 (0.41-1.57)
	Paternal education	(0-8 years)	0.97 (0.56-1.67)
	Maternal education	(9-11 years)	2.10 (0.77-5.74)
	Maternal education	(0-8 years)	**2.77*** **(1.07-7.20)**
3	Father support		0.76 (0.37-1.58)
	Friends support		**0.19*** **(0.08-0.43)**
	Family support		2.19 (0.70-6.83)
4	Unplanned pregnancy		1.34 (0.95-1.90)
5	High parity		1.47 (0.97-2.22)
	Maternal anemia		1.03 (0.75-1.41)
	Maternal diabetes		0.65 (0.20-2.11)
	Maternal hypertension		0.81 (0.51-1.30)
	Maternal smoking		**1.49*** **(1.07-2.06)**
	Maternal alcohol consumption		**1.95*** **(1.01-3.79)**
6	Gestational age		0.55 (0.54-1.10)
	Small head size		1.56 (0.48-5.11)
	Short birth length		1.28 (0.75-2.18)
	Low birth weight		0.72 (0.33-1.58)
	Low Apgar		0.94 (0.12-7.43)
	Induced labour		1.22 (0.84-1.77)
	Caesarean section		1.09 (0.73-1.63)
7	ICU		0.71 (0.15-3.43)

ICU- Intensive care unit; OR= odds ratio; CI= Confidence interval
Variables in each level are controlled by variables in all previous levels

Supplementary Table 1: description of missing outcome variables and their association with perinatal factors

Variables	Category	Sample	Missing outcomes	Proportion missing	p-value
Sex	Female	2220	425	16.1%	0.000
	Male	2083	520	20.0%	
Short birth length	<47cm	633	155	19.7%	0.192
	≥47 cm	3670	791	17.7%	
Low birth weight	<2500g	381	129	25.3%	0.000
	≥2500g	3922	817	17.2%	
Small head size	<33 cm	106	43	29.9%	0.000
	≥33 cm	4197	903	17.7%	
Low apgar score	<7	38	28	42.4%	0.000
	≥7	4265	918	17.7%	
Induced labour	Yes	1360	316	18.9%	0.283
	No	2943	630	17.6%	
Cesarean section	Yes	1330	272	17.0%	0.192
	No	2973	674	18.5%	
ICU [+]	Yes	103	71	40.8%	0.000
	No	4198	869	17.2%	
Maternal diabetes	Yes	112	30	21.1%	0.306
	No	4100	887	17.8%	
Maternal hypertension	Yes	665	141	17.5%	0.738
	No	3557	780	18.0%	
Maternal Anemia	Yes	1933	387	16.7%	0.069
	No	2266	519	18.6%	
High parity	>3	822	202	19.7%	0.114
	≤2	3481	744	17.6%	
Low maternal age	<20	744	171	23.0%	0.564
	≥20	3559	775	17.9%	
High paternal age	>35	912	203	18.2%	0.857
	≤35	3391	743	18.0%	
Low maternal education	0-8 years	552	210	5.6%	0.000
	9-11 years	898	25	2.7%	
	>11years	472	7	1.6%	
Low paternal education	0-8 years	3317	154	4.4%	0.000
	9-11 years	886	22	2.4%	
	>11 years	680	66	8.8%	
Maternal smoking	Yes	1432	320	18.3%	0.746
	No	2871	626	17.9%	
Maternal alcohol consumption	>1drink/week	131	33	20.1%	0.477
	≤1 drink/week	4172	913	18.0%	
Low family income	< 1st quartile	1155	273	19.1%	0.207
	≥ 1st quartile	3148	673	17.6%	
Unplanned pregnancy	Yes	2677	617	16.8%	0.078
	No	1625	328	18.7%	
Parental separation	Yes	509	140	21.6%	0.012
	No	3794	806	17.5%	
Father support	Yes	3978	839	17.4%	0.000
	No	296	97	32.8%	
Family support	Yes	4179	903	17.7%	0.113
	No	115	34	22.8%	
Friend and neighbour support	Yes	4191	908	17.8%	0.034
	No	99	33	33.3%	

[+] Intensive care unit

Supplementary Table 2: Correlation coefficients between independent variables

	head	length	weight	Apgar	Induce	caesarian	Gest age	premature	Diabetes	Hypertension	Smoking	Alcohol	Separation	Mat age	Pat age	Parity	Maternal education	Paternal education	Low income	Father support	Friend support	Family support	Anemia	Unplanned pregnancy	Sex
Head	1.00																								
length	0.299	1.00																							
Weight	0.408	0.534	1.00																						
Apgar	0.055	0.031	0.106	1.00																					
Induce	-0.021	-0.024	-0.036	-0.017	1.00																				
caesarian	0.008	0.004	-0.003	0.013	-0.234	1.00																			
ICU	0.213	0.113	0.254	0.162	0.009	0.055	1.00																		
Gest age	0.202	0.231	0.287	0.059	-0.026	0.022	0.216	1.00																	
Diabetes	0.003	-0.012	-0.013	0.002	-0.017	0.053	0.024	0.030	1.00																
Hypertension	0.045	0.036	0.058	0.027	-0.047	0.109	0.043	0.046	0.074	1.00															
Smoking	0.034	0.120	0.095	-0.001	0.026	-0.086	-0.001	0.028	-0.023	-0.026	1.00														
Alcohol	0.0001	0.005	0.002	-0.000	-0.011	-0.009	-0.009	0.011	-0.011	-0.005	0.063	1.00													
Separation	0.036	0.029	0.026	0.002	0.020	-0.034	0.017	0.010	-0.024	-0.007	0.051	0.025	1.00												
Mat age	0.034	0.034	0.030	-0.013	0.031	-0.056	0.006	0.018	-0.031	-0.028	-0.041	-0.007	0.254	1.00											
Pat age	-0.016	-0.011	0.002	0.006	-0.044	0.049	-0.006	0.013	0.051	0.063	0.018	0.007	-0.027	-0.187	1.00										
Parity	-0.027	-0.011	0.005	0.046	0.004	-0.077	0.007	0.029	0.014	0.068	0.099	-0.003	-0.068	-0.211	0.259	1.00									
Mat education	0.029	0.045	0.052	0.016	0.028	-0.199	0.010	0.049	-0.012	0.054	0.134	0.017	0.054	0.170	-0.052	0.133	1.00								
Pat education	0.034	0.020	0.045	0.016	0.024	-0.108	0.012	0.027	0.014	0.032	0.043	-0.025	-0.175	0.055	-0.129	0.063	0.405	1.00							
Low income	0.013	0.033	0.002	0.006	0.024	-0.076	-0.010	0.018	0.007	0.009	0.069	-0.008	0.009	0.079	-0.063	0.098	0.259	0.144	1.00						
Father support	-0.048	-0.018	-0.011	-0.009	-0.022	0.031	-0.024	-0.023	0.013	-0.009	-0.055	-0.029	-0.561	-0.104	-0.002	0.002	-0.061	0.131	-0.044	1.00					
Friend support	-0.076	-0.056	-0.052	-0.005	0.002	0.019	-0.055	-0.003	-0.029	0.002	-0.043	-0.004	-0.068	-0.047	-0.012	-0.026	-0.045	-0.012	-0.067	0.134	1.00				
Family support	-0.069	-0.046	-0.044	-0.021	0.004	0.040	-0.039	-0.022	-0.014	-0.004	-0.021	-0.020	-0.074	0.002	-0.014	-0.053	-0.038	-0.005	-0.053	0.167	0.425	1.00			
Anemia	0.003	-0.011	0.008	-0.014	-0.021	-0.006	-0.020	-0.010	0.010	0.015	-0.005	0.018	0.018	0.042	-0.030	0.011	0.010	-0.011	0.009	-0.024	0.005	-0.008	1.00		
Unplanned preg	-0.008	0.007	0.002	0.006	-0.013	-0.025	0.006	0.053	0.029	0.012	0.058	-0.002	0.146	0.057	0.036	0.188	0.077	-0.030	0.063	-0.124	-0.060	-0.071	0.042	1.00	
Sex	0.051	0.092	0.056	0.013	-0.031	0.0002	0.001	-0.004	0.0004	-0.025	0.014	0.021	-0.022	-0.019	-0.001	-0.016	0.011	-0.004	-0.000	0.010	0.008	0.001	0.039	0.001	1.00

Supplementary Table 3: Interactions assessed in final multivariable model (model 7)

Variables		Suicide attempt		Suicide ideation	
		Odds ratio	Confidence interval	Odds ratio	Confidence interval
Sex*Paternal education	(9-11 years)	1.12	0.41-3.07	Not assessed	Not assessed
Sex*Paternal education	(0-8 years)	1.39	0.66-2.92	Not assessed	Not assessed
Sex*Maternal education	(9-11 years)	3.07	0.69-13.74	3.56	0.44-28.84
Sex*Maternal education	(0-8 years)	1.37	0.36-5.15	3.58	0.47-27.08
Sex*Smoking		1.42	0.82-2.45	1.62	0.78-7.17
Sex*Friend support		2.53	0.57-11.21	0.90	0.21-3.89