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Association between preterm birth and its subtypes and maternal sociodemographic characteristics during the post-transitional phase in a developing country with a very high human development index

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ABSTRACT

Objectives: Chile is a post-transitional country evolving towards a stationary population pyramid, which may be associated with increasing preterm birth (PTB) rates. This study aimed to compare maternal sociodemographic characteristics between the start of the post-transition phase (1994) and an established stage (2013) and to evaluate associations between these characteristics and PTB.

Study design: An observational analytic design was conducted using national birth records ($n = 4{,}956{,}311$).

Methods: Variables analysed in the 20 birth cohorts from 1994 to 2013 were: length of gestation (preterm <37 weeks) subdivided by gestational age (extreme, moderate/severe and late); maternal age (≤19, 20–35 and >35 years); education level (<8, 8–12 and >12 years of education); employment; marital status; area of residence; and type of birth (singleton, twins, and triplets or higher order). The prevalence of PTB was expressed as a percentage, and associations between PTB and predictor variables were analysed using logistic regression models.

Results: Education level, age >35 years, maternal employment, unmarried status, twin delivery and urban residency rates increased between 1994 and 2013. According to the adjusted models, age >35 years and delivery of more than two foetuses were risk factors for all PTB subtypes. Maternal employment was a risk factor for moderate/severe, late and total PTB, and a low level of education was a risk factor for late and total PTB. On the other hand, age ≤19 years was protective against all PTB subtypes.

Conclusions: All maternal characteristics changed between 1994 and 2013. Furthermore, the prevalence of PTB increased for all predictor variables studied over this period.

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Introduction

The epidemiological post-transition phase[1] is characterised by a decrease in maternal and infant mortality, a reduction in the incidence of communicable diseases, and an increase in chronic diseases. However, it is necessary to study the maternal sociodemographic profile in this context, and its association with important indicators for the health of the newborn, such as the preterm birth (PTB) rate.

PTB affects approximately 11% of newborns worldwide.[2] In Chile, PTB represents 6.4% of singleton births.[3] PTB is one of the three main causes of childhood mortality,[4,5] with 44% of such deaths occurring during the neonatal period.[4] Moreover, PTB causes both immediate complications (e.g. respiratory distress, metabolic abnormalities, hyperbilirubinaemia, infections, breastfeeding difficulties[6]) and long-term complications (e.g. cerebral palsy,[7] neurocognitive disorders, respiratory problems[8]) in the newborn.

Risk factors for PTB are numerous and may vary depending on gestational age. Among the most common psychosocial risk factors are education level (<12 years),[9] low socio-economic status, unplanned pregnancy,[10] maternal stress and work overload.[11–13] Biological risk factors include history of miscarriage or prior PTB,[14] maternal age <18 years or >38 years,[15] multiple pregnancy, cervical insufficiency, polyhydramnios and foetal or uterine malformations.[16] Furthermore, maternal pathologies associated with PTB include urinary tract infection before 30 weeks of gestation and hypertension after 30 weeks of gestation.[17] Nutritional disorders such as high free fatty acid levels[18] and obesity are associated with induced[19] and spontaneous PTB.[20] In addition, maternal malnutrition is associated with spontaneous PTB.[21] Conversely, a healthy diet is a protective factor against PTB.[22] Other factors associated with PTB include obstetric interventions such as induced labour[23] and a history of caesarean section.[14]

In Chile, several studies have reported an increasing trend of PTB in singleton births, but the causes remain unknown.[3,15] These reports describe an increase in singleton PTB in general by parity, maternal age and marital status.[3,15] This study aimed to compare maternal sociodemographic characteristics between the start of the post-transition phase (1994) and at an established stage (2013) and to evaluate associations between these characteristics (including maternal age, education level, area of residence, marital status, employment and type of birth) and PTB. Documenting changes in the maternal sociodemographic profile and associations with PTB and its subtypes constitutes the first step in determining how the stage of epidemiologic,[1] demographic and nutrition post transition[24] in a developing country with a very high human development index could affect the increment of the prevalence of PTB.

Methods

Study design

An observational analytic design was conducted using national birth records (n = 4,956,311). This study analysed maternal sociodemographic characteristics and the prevalence of PTB among Chilean newborn cohorts between 1994 and 2013; this period corresponds to a post-transition stage in a developing country. The study included a total of 4,956,311 newborns.

Database

The open access data source was the national birth records of the Department of Statistics and Health Information of the Chilean Ministry of Health (MINSAL), created by the National Statistics Institute. These records are originated from a certificate issued by the professional assisting parturition, and contain standardised records of anthropomorphic measurements, sex, gestational age, type of birth, and maternal demographic data (including age, education level, employment, marital status and area of residency). The gestational age is determined by the date of the last menstrual period, and confirmed by ultrasound during the first trimester of pregnancy.

PTB is defined as an infant born before 37 weeks of gestation. PTB can be categorised as extreme (<28 weeks), severe (28–31 weeks), moderate (32–33 weeks) and late (34–36 weeks).[25] Education level was categorised into three groups: <8 years, 8–12 and >12 years of education. Maternal age was also categorised into three groups: ≤19, 20–35 and >35 years. Maternal employment status, area of residence (urban and rural), marital status and newborn sex were classified as dichotomous variables. The year corresponding to each of the 20 birth cohorts (1994–2013), type of birth (subdivided according to number of foetuses [singleton, twins, and triplet or higher order]) and the area of residence of the mother (incorporated because the country is geographically heterogeneous) were considered as covariates. Between 1994 and 2007, the country was divided into 13 political regions, whereas it was divided into 15 political regions between 2007 and 2013. To compare both periods, the first period was divided into 15 regions according to the number of communes that would constitute the regions in the second period.

Data analysis

Data analysis was performed in stages. First, an exploratory analysis was performed to evaluate missing or out-of-range values. In total, 0.22% of the records were excluded due to the following criteria: newborn weight <400 g (limit between abortion and PTB[26]) and >5.6 g (mean birth weight of the male newborn plus four standard deviations, by the standard growth[27] of the World Health Organization); gestational age (<20 and >42 weeks[26]); and maternal age (<10 and >55 years).

In the second stage, a descriptive analysis of the predictor variables was performed (including maternal education level, age, employment, marital status, area of residence and sex of the newborn) for 1994, 2013 and the full period (1994–2013). In addition, the percentage change for the predictor variables between the baseline year (1994) and the last year of this study (2013) and also for the prevalence of PTB for each of the predictor variables was determined.

Third, three models of logistic regression were performed:

(1) univariate analysis to evaluate relationships between PTB, and its subtypes, with each of the predictor variables;
(2) multivariate logistic regression was performed in the second model incorporating the predictor variables and covariates including year of the cohort, type of birth and area; and
(3) the third model incorporated: (3.1) predictive variables, (3.2) significant second-order interactions according to PTB subtype between age and type of birth, education level, employment, area and marital status, (3.3) significant third-order interactions according to PTB subtype between age and type of birth and predictor variables (education level, employment, area and marital status) and (3.4) the covariables.

The results are shown as crude and adjusted odds ratios with 95% confidence intervals (CI). Stata Version 13 (StataCorp, College Station, TX, USA) was used for statistical analysis.

Ethical issues

The Chilean database is a public, open access source and MINSAL safeguards private information of the newborns and their parents, such as names, telephone numbers and addresses.

Results

The prevalence of PTB increased from 4.98% in 1994 to 7.73% in 2013. The sociodemographic characteristics of Chilean pregnant women from 1994 to 2013 are shown in Table 1. The comparison of mothers between 1994 and 2013 revealed an increase of 104% in those with >12 years of education and a corresponding decrease in mothers with ≤12 years of education. Similarly, the number of mothers aged ≥35 years increased by 48%, whereas the number of mothers aged <35 years decreased. In 2013, the number of unmarried mothers increased by 82% in comparison with 1994, and maternal employment increased by 115%. The number of mothers living in rural areas decreased by 33%. The number of twins increased by 25%, whereas the number of triplet or higher order births decreased by 20% compared with 1994. Fifty-one percent of all the newborns delivered between 1994 and 2013 were male.

Regarding maternal education level, over the entire study period, the highest prevalence of PTB was found among mothers with >12 years of education (Table 2). Nevertheless, for both 1994 and 2013, the prevalence of PTB in women with <8 years of education was higher than in mothers with >8 years of education. In addition, between 1994 and 2003, woman with <8 years of education showed the greatest increase (70% approximately) in the prevalence of PTB, whereas the other groups

Table 1 – Prevalence of sociodemographic characteristics and types of births among mothers of Chilean newborns between 1994 and 2013 (total *n* = 4,956,311 national statistics; *n* [1994] = 273,775; *n* [2013] = 242,005).

Maternal variable	1994	2013	Change in prevalence[a]	1994–2013	
	%	%	%	%	*n*[b]
Education level (years)					
<8	19.3	3.9	−80	10.8	533,811
8–12	63.8	61.7	−3	65.4	3,231,577
>12	16.9	34.5	+104	23.9	1,180,615
Age (years)					
≤19	14.2	13.4	−6	15.5	765,897
20–35	76.6	73.0	−5	72.6	3,596,726
>35	9.2	13.6	+48	12.0	593,255
Employment					
Not employed	78.7	54.2	−31	68.6	3,393,282
Employed	21.3	45.8	+115	31.4	1,551,692
Area of residence					
Urban	86.5	91.0	+5	88.8	4,402,325
Rural	13.5	9.0	−33	11.2	553,744
Marital status					
Married	60.9	28.9	−53	44.6	2,209,126
Unmarried	39.1	71.1	+82	55.4	2,747,135
Type of birth					
Singleton	98.4	98.0	−0.4	98.2	4,860,795
Twin	1.6	2.0	+25	1.8	86,710
Triplet or higher order	0.05	0.04	−20	0.05	2610

[a] Change in prevalence is the percentage change in the prevalence of sociodemographic characteristics and types of birth between the baseline year (1994) and 2013.
[b] Total number of newborns delivered between 1994 and 2013 (source: Department of Statistics and Health Information of the Chilean Ministry of Health).

Table 2 – Prevalence of preterm birth according to maternal sociodemographic characteristics and type of birth for 1994, 2013 and the entire study period (1994–2013; *n* = 4,956,311, national statistics).

Maternal variable	1994 (%)	2013 (%)	1994–2013[a] (%)	Change in prevalence between 1994 and 2013 (%)
Education level (years)				
<8	5.2	9.0	6.3	+73.1
8–12	4.8	7.6	6.3	+58.3
>12	5.0	7.9	7.0	+58.0
Age (years)				
≤19	5.4	7.6	6.7	+40.7
20–35	4.6	7.4	6.1	+60.9
>35	7.5	10.1	8.8	+34.7
Employment				
Not employed	4.9	7.7	6.3	+57.1
Employed	5.1	7.9	6.9	+54.9
Area of residence				
Urban	5.0	7.8	6.6	+56.0
Rural	4.8	7.5	5.7	+56.3
Marital status				
Married	5.0	8.2	6.4	+64.0
Unmarried	5.4	7.6	6.6	+40.7
Type of birth				
Singleton	4.4	6.6	5.6	+50.0
Twin	40.0	63.4	53.8	+58.5
Triplet or higher order	80.0	100.0	95.8	+25.0

[a] Prevalence of preterm birth for the period 1994–2013.

increased by 58%. For the entire period, and also in 1994 and 2013, the prevalence of PTB was higher in mothers aged >35 years. However, the largest increase between 1994 and 2013 was in women aged 20–35 years (Table 2). For all the analysed years, the prevalence of PTB was greater among women who were employed and residents of urban areas, with increases of 55% and 56%, respectively. The prevalence of PTB was greater among unmarried women in 1994 and over the entire period, but this was reversed in 2013 (Table 2). The increases between 1994 and 2013 for married and unmarried mothers were 64% and 41%, respectively. Regarding type of birth, between 1994 and 2013, there was an increase in PTB among singletons of 50%, twins showed a 59% increase and triplets or higher-order births showed a 25% increase. Strikingly, in 1994, 80% of births of three or more foetuses were preterm, and this reached 100% in 2013.

The univariate analysis for the whole period (1994–2013) showed that being aged ≤19 years or >35 years were common risk factors for total PTB and for all PTB subtypes. Conversely, living in a rural area was a protective factor for all PTB subtypes (Table 3). In addition, <8 years and >12 years of education were protective factors against extreme PTB, compared with 8–12 years of education. More than 12 years of education was a risk factor for PTB and total PTB. Maternal employment was a risk factor for moderate/severe, late and total PTB, and being married was a protective factor for extreme, moderate/severe and total PTB (Table 3).

Multivariate analysis adjusted by covariates (area, type of birth and year of the cohort) confirmed that maternal age ≤19 years and >35 years were risk factors for all PTB subtypes compared with 20–35 years. It was also confirmed that delivery of more than two foetuses increased the risk of PTB compared with singleton deliveries. Living in a rural area remained a protective factor for all PTB subtypes (Table 4). Employment was the only risk factor for moderate/severe PTB. Marital status was a protective factor for total, moderate/severe and extreme PTB. Less than 8 years of education was a risk factor for total, moderate/severe and late PTB. On the other hand, >12 years of education was a protective factor for extreme and severe/moderate PTB but was a risk factor for total PTB and late PTB (Table 4).

The most notable result of the multivariate model that incorporated significant second- and third-order interactions was that maternal age ≤19 years became a protective factor for PTB, so adolescent pregnant women are 1.7 times less likely to have extreme PTB compared with women aged 20–35 years. Adolescents also showed 1.8 times less risk of moderate/severe PTB, 1.2 times less risk of late PTB and 1.4 times less risk of total PTB than women aged 20–35 years. While the risk of PTB among women aged >35 years was greater than the risk in women aged 20–35 years, this was more than doubled for total and late PTB (2.4 and 2.1, respectively). The risk of extreme and moderate/severe PTB increased more than three-fold (3.1 and 3.5, respectively). Other results show that maternal employment increased the probability of moderate/severe, late and total PTB and rural residency and <8 years of education were protective factors against extreme PTB (Table 5).

Table 3 – Risk factors associated with preterm birth and its subtypes between 1994 and 2013 (univariate analysis).

Maternal variable	Preterm births			
	Extreme[a]	Moderate/severe[b]	Late[c]	Total[d]
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Education level (years)				
<8	0.9 (0.88–0.97)	1.0 (0.97–1.02)	1.0 (0.98–1.01)	1.0 (0.98–1.01)
8–12	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
>12	0.9 (0.86–0.92)	1.1 (1.07–1.11)	1.1 (1.12–1.14)	1.11 (1.10–1.12)
Age (years)				
≤19	1.3 (1.28–1.38)	1.1 (1.10–1.15)	1.1 (1.07–1.10)	1.11 (1.10–1.12)
20–35	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
>35	1.4 (1.30–1.42)	1.6 (1.57–1.63)	1.5 (1.48–1.51)	1.51 (1.49–1.52)
Employment				
Not employed	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Employed	1.0 (0 .97–1.03)	1.1 (1.10–1.14)	1.1 (1.10–1.12)	1.1 (1.10–1.12)
Area of residence				
Urban	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Rural	0.9 (0.89–0.97)	0.9 (0.85–0.89)	0.9 (0.85–0.87)	0.9 (0.85–0.87)
Marital status				
Unmarried	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Married	0.7 (0.69–0.73)	0.9 (0.90–0.93)	1.0 (0.99–1.01)	0.96 (0.96–0.97)
Type of birth				
Singleton	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Twin	18 (17–19)	21 (21–22)	19 (19–19)	20 (19–20)
Triplet or higher order	678 (541–849)	980 (806–1191)	175 (143–214)	383 (316–464)

Abbreviations: OR, odds ratio; CI, confidence interval.
[a] <28 weeks of gestation.
[b] 28–33 weeks of gestation.
[c] 34–36 weeks of gestation.
[d] <37 weeks of gestation.

Table 4 – Risk factors associated with preterm birth and subtypes of preterm birth during all the 1994–2013 period (multivariate analysis, adjusted by year, region and type of birth[a]).

Maternal variable	Preterm births			
	Extreme[b]	Moderate/severe[c]	Late[d]	Total[e]
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Education level (years)				
<8	1.0 (0.98–1.10)	1.1 (1.04–1.10)	1.1 (1.05–1.08)	1.1 (1.06–1.09)
8–12	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
>12	0.9 (0.83–0.90)	0.97 (0.95–0.99)	1.05 (1.03–1.06)	1.01 (1.00–1.02)
Age (years)				
≤19	1.3 (1.26–1.37)	1.2 (1.20–1.25)	1.2 (1.20–1.23)	1.2 (1.20–1.23)
20–35	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
>35	1,3 (1.27–1.38)	1.5 (1.49–1.55)	1.4 (1.40–1.44)	1.5 (1.44–1.47)
Employment				
Not employed	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Employed	1.0 (0.98–1.05)	1.0 (1.01–1.05)	1.0 (0.99–1.01)	1.0 (0.99–1.01)
Area of residence				
Urban	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Rural	0.9 (0.89–0.99)	0.9 (0.91–0.96)	0.9 (0.92–0.95)	0.9 (0.92–0.95)
Marital status				
Unmarried	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Married	0.8 (0.77–0.82)	0.9 (0.92–0.95)	1.0 (1.01–1.03)	0.98 (0.98–0.99)
Type of birth				
Singleton	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Twin	19 (18–20)	21 (21–22)	19 (19–20)	20 (19–20)
Triplet or higher order	819 (652–1029)	999 (821–1214)	185 (152–226)	384 (317–466)

Abbreviations: OR, odds ratio; CI, confidence interval.

[a] The adjusted model incorporated predictor variables (education level, maternal age, maternal employment status, area of residence and marital status) and covariates (year corresponding to each of the 20 birth cohorts [1994–2013], type of birth subdivided by number of foetuses [delivery of singleton, twins or triplets or higher order] and the area of residence of the mother [$n = 15$]).

[b] <28 weeks of gestation.

[c] 28–33 weeks of gestation.

[d] 34–36 weeks of gestation.

[e] <37 weeks of gestation.

Discussion

The year 1994 corresponds to the beginning of the post-transitional phase,[1] whereas 2013 corresponds to an advanced post-transitional stage. The prevalence of PTB increased over this period from 4.98% to 7.73%. However, the causes of this increase are still unknown. Comparison between 1994 and 2013 showed an increase in maternal education level and employment status. These results coincided with the characteristics described for the postdemographic stage.[28] In addition, maternal age, unmarried status, urban residency and twin births increased. This study showed an alarming increase in the prevalence of PTB for all of the predictor variables studied.

According to this study, the direction of the association between maternal education level and PTB is not yet clear, and it seems to differ according to the type of PTB and the model used for analysis. The final model showed that <8 years of education was a risk factor for total and late PTB compared with 8–12 years of education. These results were in agreement with two previous studies: one was undertaken in 2004 in Chile and found a higher risk of PTB among women with <12 years of education[9] in comparison with those who had more years of education; and another was undertaken in Bangladesh and reported that higher education levels provided a protective effect against PTB and that low socio-economic status was associated with greater risk.[29] Bangladesh is a developing country with a moderate human development index, and a large proportion of the population live in poverty. Further, this country faces the burden of under- and overnutrition, high levels of infectious disease and growing levels of non-communicable disease.[30] Therefore, the lower the socio-economic and education levels, the higher the probability of developing infection, and this was clearly associated with PTB before 30 weeks of gestation.[17,25] In Chile, in turn, lower education level could be associated with higher prevalence of chronic disease, as shown by national health surveys performed in 2003 and 2009–2010.[31,32] These pathologies, most of which are linked to overnutrition,[1] are common events in countries in an advanced epidemiologic and nutritional post-transitional phase,[33] with declining rates of infectious disease, malnourishment and poverty.[34] PTB in this case would be related to chronic pathologies such as obesity and hypertension.[17,19,21] On the contrary, >12 years of education was only a risk factor for late PTB compared with groups between 8 and 12 years of education. Late PTB accounts for the greatest proportion of total PTB (data not shown); this is possibly related to sociodemographic[3] and epidemiological factors and to deliveries induced through obstetric interventions. In post-transition countries, obstetric

Table 5 – Associations between subtypes of preterm birth, maternal sociodemographic characteristics and types of birth between 1994 and 2003 (Multivariate model adjusted by year, region and type of birth. This model included second- and third-order interactions[#]).

Maternal variable	Preterm births			
	Extreme[a]	Moderate/severe[b]	Late[c]	Total preterm[d]
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Education level (years)				
<8	0.9 (0.78–0.99)	1.0 (0.97–1.20)	1.1 (1.07–1.10)	1.1 (1.07–1.10)
8–12	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
>12	1.0 (0.90–1.15)	1.0 (0.95–1.08)	1.03 (1.02–1.04)	1.0 (0.99–1.01)
Age (years)				
≤19	0.6 (0.53–0.67)	0.6 (0.51–0.59)	0.9 (0.82–0.89)	0.7 (0.72–0.77)
20–35	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
>35	3.1 (2.71–3.49)	3.5 (3.30–3.78)	2.1 (2.00–2.17)	2.4 (2.33–2.51)
Employment				
Not employed	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Employed	1.0 (0.98–1.05)	1.1 (1.14–1.35)	1.1 (1.08–1.19)	1.2 (1.11–1.21)
Area of residence				
Urban	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Rural	0.9 (0.89–0.99)	1.0 (0.93–1.11)	1.0 (0.95–1.05)	1.0 (0.96–1.05)
Marital status				
Unmarried	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Married	0.8 (0.76–0.81)	0.8 (0.77–0.89)	1.0 (1.00–1.03)	0.9 (0.89–0.96)
Type of birth				
Singleton	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Twin	58 (49–69)	61 (55–67)	32 (30–34)	39 (36–41)
Triplet or higher order	7023 (4651–10,605)	7413 (5615–9788)	495 (388–631)	1394 (1107–1755)

Abbreviations: OR, odds ratio; CI, confidence interval.

[#] Significant second-order interactions for total preterm birth were: age* (type of birth, employment, area and marital status), and the significant third-order interactions were between age*type of birth*(education level, employment and area). Significant second-order interactions for extreme preterm birth were age*(education level and type of birth) and the significant third-order interactions were: age*type of birth (education level and marital status). Significant second-order interactions for moderate/severe preterm birth were: age*(employment, marital status, type of birth, education level and area) and the significant third-order interactions were: age*type of birth*(education level and employment). For late preterm birth, significant second-order interactions were age* (type of birth, employment and area). Significant third-order interactions for late preterm birth were: age*type of delivery*(area, education level, marital status and employment).

[a] <28 weeks of gestation.

[b] 28–33 weeks of gestation.

[c] 34–36 weeks of gestation.

[d] <37 weeks of gestation.

interventions could explain part of the increase in PTB. In fact, in the USA, caesarean section and induced labour were associated with an increased tendency for PTB.[23] In Chile, the prevalence of caesarean section[35] is much higher than the 15% recommended by the World Health Organization.[36] For example, in 2010, the prevalence of caesarean section was 37% in the public sector and 66% in the private sector.[37] Women with a higher level of education are more likely to seek care in the private health system, in which the prevalence of caesarean section is greater than in the public sector.[38] Unfortunately, variables associated with induction of labour and caesarean section are not contained in the database used in this study.

The univariate and multivariate models showed that mothers aged ≤19 years or >35 years had a higher risk of PTB. However, the incorporation of significant second- and third-order interactions changed the relationship between variables of age and PTB. Age ≤19 years decreased the probability of all PTB subtypes, mainly due to the fact that women aged >35 years have a higher prevalence of deliveries of more than two foetuses (2.5%), compared with 1.0% in women aged ≤19 years and 1.9% in women aged 20–34 years; an increase of 149% and 25%, respectively. In addition, this study showed an increase in twin or higher-order deliveries in the analysed period.

Women aged >35 years have had longer exposure times to chronic pathologies and unhealthy lifestyles, as indicated in studies reporting higher circulating levels of free fatty acids[18] and higher prevalence of maternal obesity in older mothers. These two factors have been associated with chronic pathologies such as gestational hypertension, pre-eclampsia and eclampsia, all of which are risk factors for PTB.[16,17,19] Regrettably, the database does not contain data about maternal medical characteristics. In contrast, a healthy diet decreases the risk of PTB.[22] This is particularly relevant for post-transitional countries, given the increasing rates of pregnancy among women aged >35 years and women with chronic diseases such as obesity.[39]

Maternal employment increased over the study period, which is a characteristic of countries in a post-transitional phase,[28] and this study showed that maternal employment was a risk factor for moderate/severe, late and total PTB. This result was consistent with another study that reported an association between maternal employment and spontaneous PTB

(unfortunately, the databases do not contain the variable that would enable PTB to be classified as spontaneous or induced).[14] The association between PTB and maternal employment can be influenced by stress levels, depression or anxiety generated by some types of jobs.[2,11,13] Living in a rural area was protective against extreme PTB, probably because women who live in rural areas are exposed to lower stress levels, and this condition is associated with lower probability of PTB.

Married status was a protective factor for extreme, moderate/severe and total PTB. This finding could be related to a lower probability of exposure to stress due to a lack of social support and the strain associated with an unplanned pregnancy;[10] situations that increased the risk of PTB. Unfortunately, marital status was only classified as married and unmarried, and cohabitation was not registered in the database.

To the authors' knowledge, this is the first study carried out in a developing, post-transitional country with a high human development index to describe the relationship between PTB and its subtypes and maternal variables of education, employment and area of residence. The main limitation of this study in terms of explaining associations between predictor variables and PTB subtypes is the lack of information in the database regarding maternal health history, nutritional status, reasons for obstetric interventions and whether the PTB was spontaneous or induced.

Conclusion

When comparing the prevalence of PTB, in a post-transitional country, for each of the maternal variables (education level, age, employment, marital status and area of residence), prevalence was shown to increase from the beginning of the post-transitional stage until an advanced stage.

To reverse the current trend towards increasing rates of PTB in a post-transitional country, it is necessary to investigate the causes of the association between PTB and the risk factors identified in this study, according to the current epidemiological and demographic context.

Author statements

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Ethical approval

This study was not presented to an ethics committee because the Chilean database is a public, open access source and MINSAL safeguards the private information of the newborns and their parents, such as names, telephone numbers and addresses.

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Competing interests

None declared.

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