Teenage smoking in pregnancy and birthweight: a population study, 2001–2004

Denise L Chan and Elizabeth A Sullivan

ABSTRACT

Objective: To determine the association between smoking in pregnant teenagers and baby birthweight.

Design, setting and participants: A retrospective population-based study of women aged < 20 years who gave birth to liveborn singletons in Australia between January 2001 and December 2004. Data were drawn from the National Perinatal Data Collection.

Main outcome measures: Maternal smoking, birthweight, low birthweight (LBW).

Results: The prevalence of LBW in babies born to teenage smokers was 9.9%, compared with 6.0% in babies born to teenage non-smokers (odds ratio [OR], 1.72 [95% CI, 1.57–1.90]). On average, babies born to teenage smokers were 179.8 g lower in birthweight than babies born to teenage non-smokers (95% CI, 165.5 –194.1 g; $t = 24.6$, $P < 0.001$). Smoking, Indigenous status, Socio-Economic Indexes for Areas category and parity were independently associated with LBW (all ORs > 1.3; $P < 0.001$) after adjusting for maternal age group. Teenagers smoking > 10 cigarettes a day had babies with lower birthweight that those who smoked ⩽ 10 cigarettes a day, demonstrating a dose–response relationship. The babies of teenage smokers who stopped smoking before 20 weeks' gestation had birthweights similar to those of babies born to teenage non-smokers. One in 15 teenage smokers stopped smoking during pregnancy.

Conclusion: Babies whose mothers smoked during pregnancy were more likely to have LBW than babies whose mothers did not smoke. Mothers who continue to smoke in the second half of pregnancy increase their baby's risk of LBW. There is significant scope to improve the quitting rate, and health professionals need to target smoking cessation at all contacts with pregnant women who continue to smoke.

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Rates of smoking during pregnancy in Australia in 2003 were highest among teenage mothers, with 42.1% reporting smoking compared with 17.3% for all mothers.[1] The high prevalence of smoking among teenage mothers is consistent with international studies (eg, 46.2% in Liverpool, United Kingdom, and 47.0% in Nova Scotia, Canada),[2,3] which also reflect overall higher rates of other perinatal risk behaviours such as substance misuse, poor nutritional intake and low attendance at antenatal classes.[4] Despite various initiatives in the past decade and trials reporting efficacy of smoking interventions in pregnant women, rates of smoking in teenagers remain high and affect the health of their unborn babies.[5,6]

Cigarette smoking during pregnancy is one of the few modifiable risk factors for low birthweight (LBW), preterm birth, placental complications and perinatal mortality.[7-9] Maternal smoking status has been shown to be a more important determinant of baby birthweight and growth than maternal height, weight, number of previous pregnancies and their outcomes, or sex of the baby.[10] LBW is not only significant as a key indicator of a newborn's overall health, but also, according to the fetal origins hypothesis,[11] affects childhood development and predisposes children to chronic disease in later life. Moreover, intrauterine exposure to smoking has been linked with health problems such as sudden infant death syndrome,[9] childhood obesity[12] and diabetes.[13]

Smoking during the third trimester of pregnancy is an important risk factor for LBW, as this is a period of rapid fetal weight gain.[14] A randomised controlled trial has shown that women who quit smoking in the first 3–4 months of pregnancy give birth to infants of similar birthweight to infants of women who have never smoked.[15] Thus it is important that prenatal smoking cessation programs persist throughout pregnancy and target mothers who continue to smoke.

Young maternal age has also been associated with LBW and poor perinatal outcomes.[2,7,16] High rates of smoking among Australian teenagers make it difficult to ascertain whether young maternal age, smoking behaviour or other factors are responsible for the high incidence of LBW in babies of teenage mothers.

We conducted a population study to examine the association between smoking during pregnancy and the birthweight of babies born to teenage mothers in Australia. We also investigated the association between the quantity of cigarettes smoked during pregnancy and infant birthweight.

METHODS

Study population

A retrospective population-based study was conducted using the National Perinatal Data Collection, a state- and territory-based collection of data on all births of at least 400 g birthweight or at least 20 weeks' gestation.[1] Data on singleton live births occurring between January 2001 and December 2004 were obtained, giving a sample size of 46 938 teenage mothers aged < 20 years and 755 393 mothers aged 20–34 years at the date of delivery. Restricting the sample to births in the five states and territories in which smoking data were available, 55% of teenage mothers (25 828) remained. Of the states and territories with smoking data available, three had information on smoking status and quantity of cigarettes (dose) in the second half of pregnancy (38.9% of the teenage mothers [18 276] resided in those three states). Where information on smoking status was not available (0.55% of all records), data were excluded from the analysis.

Definitions

A teenage mother was defined as any mother giving birth at an age of less than 20 years. Teenage mothers were compared with mothers aged 20–34 years, who represented the standard cohort of mothers. A smoker was defined as a mother who self-reported smoking at least one cigarette during pregnancy, while a quitter was defined as a mother who reported smoking during pregnancy but not during the second half of pregnancy. LBW was defined as a birthweight of less than 2500 g.[1]

1 Mothers' smoking status during pregnancy, 2001–2004

	Teenage mothers		Mothers aged 20–34 years	
Year	Total number	Proportion who were smokers	Total number	Proportion who were smokers
2001	6647	44.5%	101 175	19.3%
2002	6557	43.4%	100 788	18.4%
2003	6137	42.8%	100 870	17.4%
2004	6094	42.2%	100 023	16.6%
Total	*25435*	*43.2%*	*402 856*	*17.9%*

2 Cessation of smoking in second half of pregnancy, in mothers who reported smoking during pregnancy, 2001–2004*

	Teenage mothers		Mothers aged 20–34 years	
Year	Number of smokers	Proportion of quitters	Number of smokers	Proportion of quitters
2001	2077	6.3%	14 390	7.9%
2002	2034	6.5%	13 688	8.2%
2003	1812	7.1%	12 968	8.2%
2004	1807	7.0%	12 259	8.0%
Total	*7730*	*6.7%*	*53 305*	*8.1%*

* Data from three states/territories on mothers who reported smoking at some time during pregnancy. Quitters were defined as mothers who reported smoking during pregnancy but not in the second half of pregnancy. ◆

Smoking status

Data were collected through two questions, which were not standardised nationally. In five states and territories, maternal smoking status (yes/no) was self-reported at the first antenatal visit or at delivery through a question asking whether the mother smoked at all during pregnancy. Three of the states/territories also collected data ascertaining the average number of cigarettes smoked per day in the second half of pregnancy (categorised as none, ≤ 10 per day, > 10 per day, or unknown).[1]

Geographical and socioeconomic categories

Data on the geographical location of usual residence were mapped to levels of remoteness using the Australian Bureau of Statistics Australian Standard Geographical Classification remoteness structure.[17] The remote and very remote groups were combined into one category.

The Socio-Economic Indexes for Areas (SEIFA) Index of Advantage/Disadvantage[18] was used as a measure of the social and economic wellbeing of Australian mothers. Data were stratified into quintiles for analysis, with the lowest quintile representing the most disadvantaged group.

Statistical analysis

Birthweight and gestational age were summarised using means and standard deviations. Differences between categories were compared using χ^2 and independent sample *t* tests. A forward stepwise multiple logistic regression model was used to determine factors associated with LBW. Data were analysed using SPSS software, version 14.0 (SPSS Inc, Chicago, Ill, USA).

Ethical approval

Our study was approved by the Human Research Ethics Advisory Panel of the University of New South Wales.

RESULTS

Over the period 2001–2004, 25 828 teenage women gave birth to a singleton liveborn baby in Australia in a state or territory in which smoking status was recorded. Of these women, 31.7% were aged < 18 years.

The prevalence of teenage pregnancy did not differ significantly between the states and territories that had smoking data available (4.8%) and those that did not (4.6%). There was no difference by parity or mean age. There was a significantly higher prevalence of teenage Indigenous mothers residing in states and territories that reported smoking status than in other states (20.5% v 12.8%; $\chi^2 = 464.3$; $P < 0.001$). These states and territories also had significantly higher proportions of mothers residing in remote or very remote areas (11.4% v 4.7%) and significantly lower proportions of mothers in the lowest SEIFA quintile (34.6% v 37.9%) than states and territories that did not report smoking status ($P < 0.001$).

Smoking status and cessation during pregnancy

Smoking prevalences in pregnant women, by year and maternal age group, are shown in Box 1. The smoking status of smokers during the second half of pregnancy (in the three states in which data were available) is shown in Box 2.

One in 15 teenagers (6.7%) who reported smoking during pregnancy had ceased smoking by the second half of pregnancy, which was significantly lower than the one in 12 (8.1%) of older mothers who were classified as quitters ($\chi^2 = 17.6$; df = 1; $P < 0.001$).

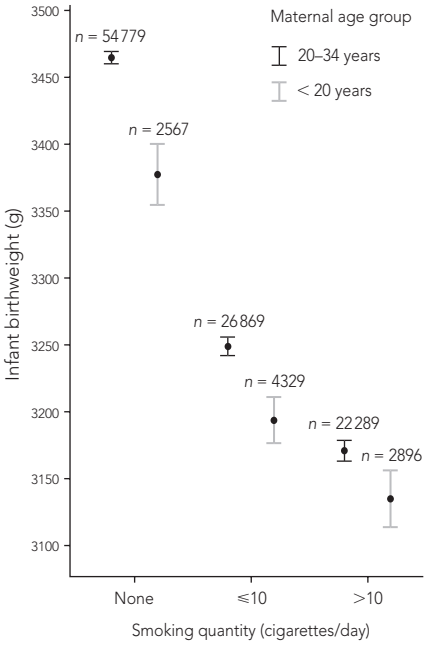
Demographics of teenage mothers by smoking status

Teenage mothers who smoked were significantly more likely to be multiparous (21.2% v 14.4%; $\chi^2 = 203.2$; df = 1; $P < 0.001$) and Indigenous (23.8% v 16.3%; $\chi^2 = 225.5$; df = 1; $P < 0.001$) than teenage mothers who did not smoke. Over half of Indigenous teenage mothers (52.7%) smoked during pregnancy, compared with 40.9% of other teenage mothers ($\chi^2 = 225.5$; df = 1; $P < 0.001$). Teenage mothers who smoked were more likely to live in remote or very remote areas compared with their non-smoking counterparts (11.7% v 9.7%; $\chi^2 = 25.8$; $P < 0.001$). They were also 34% more likely (odds ratio [OR], 1.34 [95% CI, 1.27–1.41]) to score in the lowest quintile of the SEIFA Index of Advantage/Disadvantage than their non-smoking counterparts (38.1% v 31.5%; $\chi^2 = 119.9$; df = 1; $P < 0.001$).

Birthweight by maternal age group and smoking status

The prevalence of LBW was significantly higher in babies born to smoking mothers than babies born to non-smoking mothers in the teenage group (9.9% v 6.0%; OR, 1.72 [95% CI, 1.57–1.90]). These prevalences were higher than the 8.6% and 3.6%, respectively, among babies of smoking and

3 Relationship between infant birthweight and quantity of cigarettes smoked by pregnant women, by maternal age group*



* The proportion of data missing in relation to dose was, on average, 3.0% in both maternal age groups. Bars represent 95% CIs. ◆

non-smoking mothers aged 20–34 years. The proportion of LBW babies varied by maternal age group, smoking status and term gestation. Of LBW babies born to teenagers, 60.7% were born at term to teenage smokers. This compared with 40.3% in mothers aged 20–34 years. The mean birthweight of babies born to teenage smokers (3169 g; SD, 582 g) was significantly lower than that of babies born to teenage non-smokers (3349 g; SD, 573 g), with a mean difference of 179.8 g (95% CI, 165.5–194.1 g; $t = 24.6$; $P < 0.001$). For mothers aged 20–34 years, the mean birthweight was 3228 g (SD, 576 g) for babies of smokers and 3452 g (SD, 535 g) for babies of non-smokers ($t = 96.0$; $P < 0.001$).

The mean birthweight of babies was also related to smoking quantity, with mothers who smoked more than 10 cigarettes a day having significantly lower birthweight babies. Teenage mothers had poorer birthweight outcomes than older mothers for all categories of smoking quantity (Box 3).

Multiple regression analysis

On univariate analysis of mothers aged < 35 years, factors significantly associated with LBW were smoking (OR, 2.53 [95% CI, 2.45–2.60]), Indigenous status (OR, 3.09 [95% CI, 2.96–3.23]), SEIFA category (OR [lowest quintile], 1.76 [95% CI, 1.68–1.84]), remoteness category (OR [most remote category], 2.37 [95% CI, 2.20–2.55]), parity (OR [multiparity, 4–8], 2.22 [95% CI, 2.07–2.37]) and maternal age group (OR, 1.81 [95% CI, 1.73–1.90]). After multiple regression analysis, a significant association remained between LBW and smoking, Indigenous status, SEIFA category and parity, but maternal age group was no longer significant. (Remoteness was not included in the multiple regression model, as it was highly correlated with the SEIFA Index of Advantage/Disadvantage.) Smoking and Indigenous status were the strongest predictors of LBW (Box 4).

To further investigate the impact of smoking on the birthweight of babies born to teenage mothers, we constructed birthweight-for-gestational-age curves for smokers compared with non-smokers (Box 5). After 33 weeks' gestation, babies born to teenage smokers had persistently lower average birthweights than babies born to non-smokers. In a further analysis of the same data, the birthweight of babies born to teenage mothers who ceased smoking in the second half of pregnancy were plotted alongside smokers and non-smokers (Box 6). For births at 38–41 weeks' gestation, teenage mothers who had quit smoking in the second half of pregnancy had babies with mean birthweights that were no different from those of babies born to non-smokers.

DISCUSSION

Smoking by teenage mothers during pregnancy remains a significant public health problem in Australia, with potential lifelong implications for both mother and baby.[11] The significantly higher rates of LBW seen in babies of teenage mothers reflect the high overall level of smoking observed in this age group. As almost half of all teenage mothers and over half of Indigenous teenage mothers are smoking during pregnancy, current smoking reduction strategies appear to be having limited effect. In our study, the quitting rates of one in 15 among teenage mothers and one in 12 among mothers aged 20–34 years indicate how difficult smoking cessation remains for pregnant women. Nevertheless, pregnancy remains a unique opportunity for the health sector to engage this highly vulnerable group in reducing all risk behaviours, including smoking.

Our birthweight-for-gestational-age curve (Box 5) concurs with other studies showing that maternal smoking affects baby birthweight after 33 weeks' gestation,[2,16]

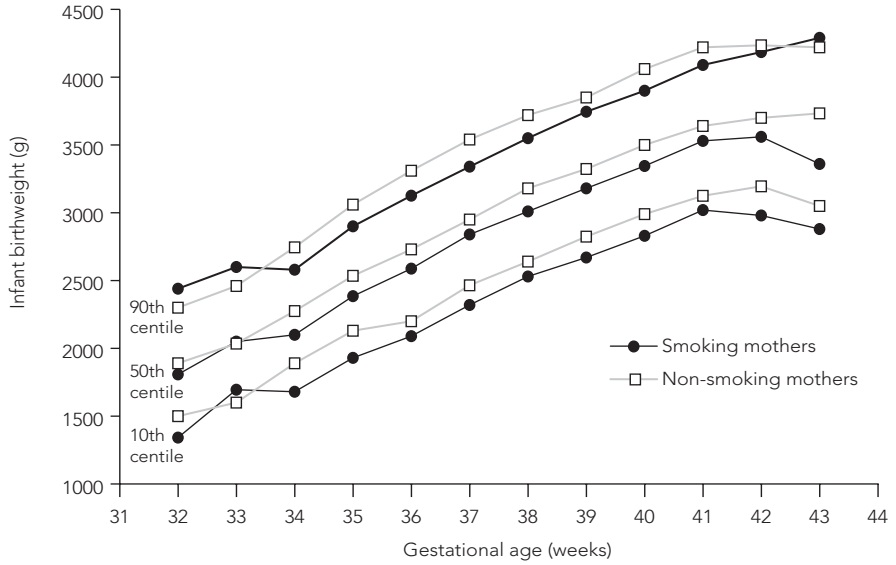
4 Factors associated with low birthweight, 2001–2004*

Maternal factors	Number of mothers	Crude OR (95% CI)	AOR† (95% CI)
Smoking status			
Smoker	83 208	2.53 (2.45–2.60)	2.25 (2.18–2.32)
Non-smoker	345 005	1.00	1.00
Indigenous status			
Indigenous	20 551	3.09 (2.96–3.23)	2.11 (2.01–2.21)
Non-Indigenous	409 801	1.00	1.00
SEIFA index quintile			
20th centile‡	85 765	1.76 (1.68–1.84)	1.33 (1.27–1.39)
40th centile	91 125	1.46 (1.39–1.53)	1.21 (1.16–1.27)
60th centile	80 691	1.45 (1.39–1.53)	1.28 (1.22–1.34)
80th centile	81 971	1.30 (1.24–1.36)	1.19 (1.13–1.25)
100th centile	89 190	1.00	1.00
Parity			
Primipara	194 591	1.36 (1.32–1.40)	1.48 (1.44–1.52)
Multiparous (1–3)	224 366	1.00	1.00
Multiparous (4–8)	11 398	2.22 (2.07–2.37)	1.43 (1.33–1.54)

AOR = adjusted odds ratio. OR = odds ratio. SEIFA = Socio-Economic Indexes for Areas.[18]

* Low birthweight was defined as birthweight < 2500 g. Maternal age was significant in the univariate analysis, but not after multiple regression. † OR after multiple regression analysis. ‡ The lowest quintile represents the most disadvantaged socioeconomic group. ◆

5 Teenage mothers: relationship between infant birthweight and gestational age, by maternal smoking status



although the trend was more marked and consistent in our population. We speculate that the difference can be attributed to the large population size in our study, which minimised information and selection biases.

The important clinical and public health message from our study is that quitting smoking before the second half of pregnancy has a positive impact on birthweight, bringing average birthweights into line with those for babies of non-smoking mothers.

Reducing the quantity of cigarettes smoked during pregnancy also has an impact on the risk of LBW in infants. A 2005 hospital-based study of 534 teenage mothers giving birth at Liverpool Women's Hospital, UK, found lower average baby birthweights were associated with increasing quantity of cigarettes smoked.[2] Another study showed that reducing cigarette smoking to eight cigarettes a day significantly improved baby birthweight.[19] These findings are consistent with our results showing an association between higher cigarette dose and LBW.

A limitation of our study was the potential for recall and information bias relating to self-reported smoking status and smoking behaviour. However, the large population size gives our analysis greater stability.

Our multivariate analysis showed that maternal smoking and Indigenous status were the strongest predictors of LBW in infants, with maternal age no longer being a significant factor. The clear association observed between smoking and birthweight is consistent with other studies.[2,7,8,16]

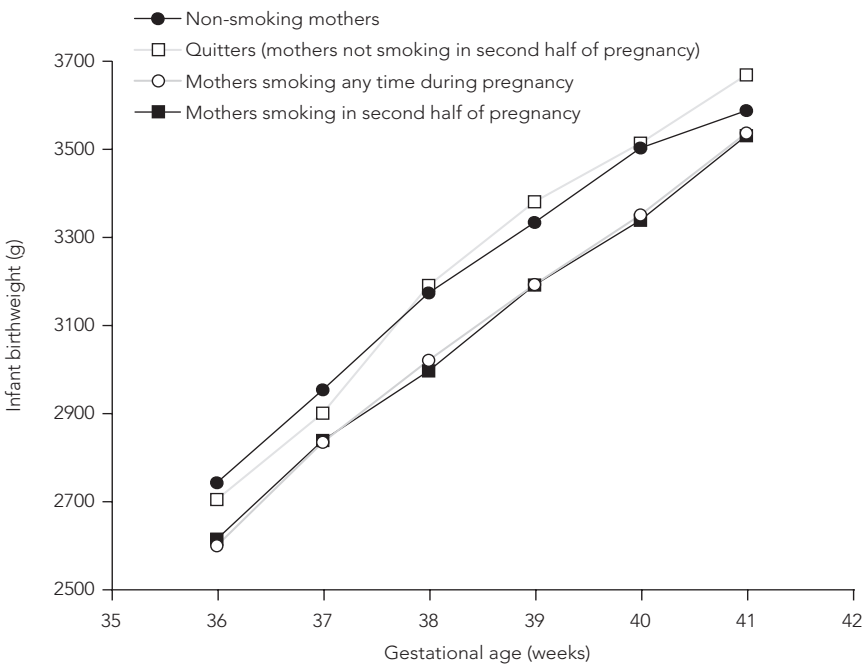
We were not able to distinguish between spontaneous quitters and those who quit due to an intervention. Questioning pregnant women about whether a smoking cessation intervention was offered during pregnancy, and whether it was adopted, would allow specific interventions to be evaluated.

Our study reports baseline data from five states and territories, with the remaining three states not collecting smoking data in the period 2001–2004. In 2005, two of those states began collecting smoking data, but there is still a need for uniform national data. A Smoking in Pregnancy workshop was held in 2007 to initiate a program of data development as part of a federally funded initiative to stop smoking during and after pregnancy.[20] The aim of this process is to gain agreement on a method of collecting nationally uniform data to monitor the effects of smoking during pregnancy and to enable accurate monitoring of smoking and quitting rates among women who give birth.

Smoking remains one of the few modifiable risk factors in pregnancy. Teenagers often present later for their first antenatal visit than older mothers, and may not access health services at all.[4] Indigenous teenagers are a particularly vulnerable group, with heightened disparities in reproductive health outcomes seen both in Australia and internationally.[7,21-23]

Access to antenatal care and related health education, including breastfeeding promotion, is often compromised by cultural, linguistic and geographical barriers.[24] A recent study investigating factors to consider in smoking interventions for Indigenous moth-

6 Teenage mothers: relationship between infant birthweight and gestational age, by maternal smoking cessation status



ers emphasised the need for culturally appropriate programs that included subsidised nicotine replacement therapy, support groups and community education about the harmful effects of active and passive smoking. Such programs would ideally be delivered through Aboriginal Medical Services.[23]

Health care providers, especially general practitioners, are in an ideal position to influence maternal smoking rates. However, studies have demonstrated that doctors only occasionally implement smoking cessation interventions or offer advice on how to quit.[25] Our results show that harm minimisation strategies need to target not only smoking cessation but also smoking reduction, particularly in teenage mothers. Primary health care providers should first counsel pregnant women to cease smoking, and, if this is unsuccessful, advise them to continually reduce their cigarette intake.

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COMPETING INTERESTS

None identified.

AUTHOR DETAILS

Denise L Chan, Medical Student[1]
Elizabeth A Sullivan, MB BS, MPH, MMed(Sexual Health), Director and Associate Professor[2]

1 Faculty of Medicine, University of New South Wales, Sydney, NSW.
2 Perinatal and Reproductive Epidemiology and Research Unit, School of Women's and Children's Health, University of New South Wales, Sydney, NSW.

Correspondence: e.sullivan@unsw.edu.au

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