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Abstract

Aim: To examine the differences in return to work time after childbirth; the differences in income; and the differences in out of pocket healthcare costs between mothers who had a preterm birth and mothers who delivered a full term baby in Australia.

Methods: Using administrative data, the length of time and 'risk' of returning to employment for mothers whose child was born premature relative to those whose child was born full-term was reported. Multivariate linear regression models were constructed to assess the difference in maternal income and the differences in mean out-of-pocket costs between mothers who had a preterm birth and mothers who had a full term birth.

Results: The mean length of time for mothers of babies born full-term to return to work was 1.9 years and for mothers of preterm babies it was 2.8 years. Mothers of preterm babies had a significantly lower median income at 0-1; 2-3 and 4-5 years postpartum compared to mothers of full-term babies. The adjusted mean out of pocket costs for healthcare paid by mothers who had a preterm birth was \$1,298 for those whose child was aged 32 – 36 weeks; and \$2,491 for those whose child was aged <32 weeks. This is in comparison to mothers of children born 37 weeks and over, whose mean out of pocket costs were \$1,059

Conclusion: Mothers who had a preterm birth have longer return to work time, a lower weekly income and also have higher out of pocket costs compared with mothers who have a full term birth.

Keywords: Premature Birth; Health Care Costs; Cost of Illness; Employment.

Background

Globally, 15 million babies are born preterm each year and this number is rising (1). The reasons for the increasing rates of preterm birth¹ are not entirely understood. Some of the major reasons postulated for the increase include improved medical knowledge and technologies that have facilitated improved risk assessment; the changing maternal profile such as increasing maternal age; increasing use of assisted reproductive technology; and the increasing medical management of labour and birth (2-5).

There are growing concerns over the increasingly intensive and routine use of medical interventions during labour and birth, particularly the elective and routine induction of labour and caesarean section, and the contribution this makes to preterm birth (6). The increase in preterm birth rates in several high-income countries have been attributed to increasing iatrogenic delivery – that is, clinician-initiated preterm delivery either via induction of labour or caesarean section (7), with evidence of these procedures being carried out routinely (8). In some cases, clinician-initiated preterm birth is necessary due to factors such as previous pregnancy complications, growth-restricted babies, and preeclampsia, in which case a preterm delivery may prevent stillbirth or other maternal complications (9). Conversely, if babies are delivered prematurely when it is not clinically indicated, it could mean that avoidable negative neonatal and childhood health and development outcomes are experienced, which impact not only the child but all members of the family due to the potential need to provide additional ongoing care for the child and the potential out-of-pocket healthcare costs associated with accessing health services.

Rising rates of preterm birth are of great concern due to the significant long-term morbidity associated with preterm birth. This is particularly the case in high-income countries where preterm infants have high survival rates but long-term morbidities still remain (10, 11). In the short term, health outcomes as a consequence of preterm birth can include respiratory distress, apnoea, seizures, jaundice, difficulties feeding, hypoglycemia, readmission to hospital and potentially infant death (12-14). In the long term, children may experience neurodevelopment conditions such as cerebral palsy, visual and auditory deficits, cognitive dysfunction, and respiratory conditions that can all extend well into adulthood (11). As an adult, there is also an increased risk of obesity, diabetes and hypertension (15). In addition to potential health outcomes associated with birth before 37 weeks gestation, there are possible health complications that can arise from the mode of the

¹ The World Health Organization defines 'preterm birth' as a birth that occurs before 37 weeks of gestation 1. World Health Organization. Preterm birth. Fact sheet. 2012(363).

delivery itself. That is if the labour and birth are not spontaneous and are achieved via methods such as induction of labour or caesarean section, then both the mother and baby can face additional short and long term health consequences posed by these modes of delivery (16) which could lead to ongoing out-of-pocket healthcare costs for the family.

The authors postulate, that due to the potential long-term health consequences of having a preterm baby and the potential need for the child to require ongoing care, that mothers who have a preterm birth will be more likely to need additional time out of the labor force and will have a reduced income compared to mothers who have a full-term birth. Due to the body of evidence outlining the potential long-term health outcomes associated with pre-term birth, this study captures the impacts on mothers labor force participation and income over the first five years of a child's life. Concern regarding preterm birth stems not only from the potential negative health and development consequences but also the resultant costs due to excess health service use. There is extensive literature describing the increased hospital-based and non-hospital based health care expenditure associated with premature birth (17, 18), however, little is known about the range of direct and indirect costs faced by the families who have a premature baby. The financial implications of preterm birth on families should be a key concern, as in most health systems families are expected to make co-payments for healthcare (19), which preterm children will be more likely to need due to their increased risk of long term health conditions.

As such, this study aims to address the following questions:

1. Is having a premature baby associated with longer return to work time for mothers after childbirth relative to mothers who did not have a premature baby?
2. What are the differences in income between mothers with a premature baby not in the labour force, and mothers whose babies were full term who are in employment?
3. What are the differences in out of pocket healthcare costs between mothers who had a preterm birth and mothers who had a full term birth?

In the context of the increasing rate of iatrogenic preterm birth in Australia, the results of this study should be of interest to clinicians who may be in the situation where preterm birth is preventable to consider the enduring financial implications experienced by families as a result of having a preterm baby.

Methods

Study population

This study utilises Australian data, where the rates of preterm birth have mirrored the global upward trend, increasing from 7.9% in 2000 (20) to 8.5% in 2016 (21). Similar to other high-income countries, the increase in the use of obstetric interventions in Australia has coincided with an increase in preterm birth (20-22), with the greatest increase in preterm births in Australia majorly attributable to iatrogenic delivery (5).

Data sources and variable identification

Labour force participation and income

To quantify differences in labour force participation and income (questions 1 and 2), the Longitudinal survey, *Growing up in Australia: The Longitudinal Study of Australian Children* (LSAC) (23) was utilised. LSAC is conducted in partnership with the Department of Social Services, the Australian Institute of Family Studies and the Australian Bureau of Statistics. The survey collects information on children's health, education, and development from parents, carers, teachers, and the children themselves. Information on both mothers' and fathers' employment, income, health, and parenting practices are also collected. More than 10,000 children and their families participated in the survey between March and November of 2004. Participants are interviewed every 2 years and mail-out questionnaires are sent to families in the year between interviews. The sample is representative of all states and territories in Australia, including children from urban and rural areas (23). We used waves 1-6 in this study, with wave 6 containing data from 2014. Two cohorts of infants and children were initially recruited into the study: the B-cohort, who were aged 0 to 1 year in 2004 (born March 2003-February 2004), and the K-cohort, who were aged 4 to 5 years in 2004. The focus of this study is on the B cohort.

In Australia, gestational age is the length of pregnancy in completed weeks and is generally calculated from the first day of the menstrual period or is estimated by perinatal assessment. The LSAC records birth in three groups; ≥ 37 weeks, 32-36 weeks and < 32 weeks. Those born ≥ 37 weeks were considered 'full term' in this study.

The LSAC asks mothers about their current employment status, with response options being "employed", "unemployed" and "not in the labour force". The difference between unemployed and not in the labour force is those who are "unemployed" are actively seeking employment, whereas those who are "not in the labour force" are not actively seeking employment. The LSAC asks the mother's what their usual weekly income is, with responses recorded as a continuous variable.

Out of pocket fees

In order to address question number 3 of this study, the Maternity1000 dataset was used. Maternity1000 utilises the Queensland Perinatal Data Collection (PDC) to identify mothers who gave birth in Queensland between 1 July 2012 and 30 June 2015 (n=186,789, plus their babies, n=189,909). All individuals were identified from the Queensland Perinatal Data Collection and Queensland Birth Registry by Queensland Health's Statistical Services Branch (SSB). The records were linked to Queensland Hospital Admitted Patient Data Collection (QHAPDC), Deaths Registry, Emergency Department Information System (EDIS) and Hospital and Health Service (HHS) Funding and Costing Unit records between 1 July 2012 and 30 June 2015. The records were then linked by the Australian Institute of Health and Welfare (AIHW) to their corresponding Medicare Benefits Schedule (MBS) and Pharmaceutical Benefits Scheme (PBS) claims records (24). The MBS and PBS claim records identify the actual provider charge and government rebate. The out of pocket fee was the difference in the provider charge and government rebate for each occasion of service assessed. We included fees incurred from birth through to the time the child was two years of age.

Statistical analysis

To address question number 1 and 2 of this study, the analysis was limited to mothers who had been employed prior to the birth of their child in order to assess return to work time. Baseline demographic characteristics (at birth) of mothers were assessed, comparing the characteristics between mothers who had a premature baby and those who did not. In the LSAC, mothers were asked if they identify as either Aboriginal or Torres Strait Islander, for those who answered yes to either will be referred to as 'First Nations' from hereon. Marital status was classified as 'married' or 'not married' (response options were married; divorced; separated; widowed or never married). The LSAC survey does not have 'de facto' relationships as an option on their survey. It is possible that couples living together but not married may have an advantaged of a higher household income, and therefore they might delay returning to work. . Highest level of education attainment was classified as 'year 11 or less', 'certificate/diploma' (advanced diploma/diploma or certificate), 'bachelor degree', or 'postgraduate degree'.

A Cox proportional hazards model showing the length of time, and 'risk' of returning to employment for mothers whose child was born premature relative to those whose child was not born prematurely was constructed.

To demonstrate the impact of pre-term birth on income, we compared to average income for mothers of full-term and preterm babies on waves 1-3 of the LSAC survey prior to birth, when the child was aged 0-1, 2-3, and 4-5. Multivariate linear regression models were constructed to assess the difference in maternal income at the time the child was aged 0-1, 2-3, and 4-5 between mothers

of babies born prematurely, and mothers of babies born full term. These models were conducted separately at the time the child was aged 0-1, 2-3, and 4-5. Mothers of full-term were used as the reference group. All analysis that was conducted to address aims 1-2 of this study adjusted for pre-birth maternal income, First Nations Status, education attainment and marital status (please refer to Appendix 1 for correlation matrix).

To undertake the analysis of aim number 3 of this study, the Maternity1000 dataset was then used to quantify and compare the out-of-pocket fees between mothers who had a preterm birth and mothers who had a full term birth. Multivariate analysis was undertaken using generalised linear regression modelling and specifying a negative binomial distribution to assess differences in mean costs between mothers who had a preterm birth and mothers who had a full term birth. The total costs incurred by mothers were disaggregated time periods: birth; birth to 1 year postpartum; and 1-2 years postpartum. Mean healthcare costs are adjusted for a pre-existing health condition, maternal age, previous pregnancy complications, complications arising during the current pregnancy, area-based socioeconomic deprivation, distance from the birthing facility, smoking and Body Mass Index (BMI) at birth.

All analysis was undertaken using SAS V9.4 (SAS Institute, Inc., Cary, NC, USA). All costs are reported in 2016/17 Australian dollars (AUD). Weighted results are reported unless otherwise stated.

Results

There were 4,865 records of children on the LSAC survey whose mothers were working prior to their birth. Of these, 4,530 were born full term and 257 were born between 32-36 weeks gestation and 78 were born less than 32 weeks gestation. Once weighted these records represented 177,000 children within the population born in 2004, whose mothers were working prior to their birth. There were 163,500 children born at 37 weeks or more; 10,400 born between 32 and 36 weeks; and 3,100 born at less than 32 weeks.

Table 1 presents the baseline demographic and socioeconomic characteristics of mothers from the LSAC survey. A higher percentage of mothers who had a baby born prematurely in 2004 were First Nations, compared with mothers who had a full-term baby. A slightly higher proportion of mothers who had a full-term baby were married at birth. The mean age of the mother at birth was also similar across all groups. Education attainment level was consistently higher for mothers of babies born full-term, with lower education attainment levels amongst mothers whose baby was born prematurely.

The mean length of time between childbirth and mother's return to work is shown in Table 2. The mean length of time for mothers of babies born full term was 1.9 years. The mean length of time for mothers of babies born prematurely in both groups was 2.8 years. Table 2 also shows the hazard ratio of returning to work for mothers of babies born prematurely. The model was adjusted for, First Nations status and marital status. Mothers of babies born prematurely had a significantly lower hazard ratio of returning to paid employment following childbirth. Mothers of babies born between 32-36 weeks of gestation were 12% less likely to return to the workforce (95% CI: 0.86-0.90), relative to mothers whose baby was born at full-term.

Table 3 presents the mean and median income for mothers of preterm and full-term babies pre-birth and when their child was at different ages. Mothers of pre-term babies employed full time and casual both had a reduction in pre-birth and post-birth (0-1 years) weekly income.

Table 4 contains the results of three separate multivariate linear regression models of weekly maternal income for mothers who had a preterm baby, with mothers who had a full-term baby used as the reference group. After adjusting for confounding factors, mothers of preterm babies have a significantly lower weekly income than mothers of full-term babies. Mothers of preterm babies when their child is aged 0-1 earn \$249.8 less, at age 2-3 they earn \$332.3 less and at 4-5 earn \$337.7 less per week than mothers of full-term babies.

Table 5 shows the adjusted mean out of pocket costs for healthcare paid by mothers who had a preterm birth was \$1,298 for those whose child was aged 32 – 36 weeks; and \$2,491 for those whose child was aged <32 weeks. This is in comparison to mothers of children born 37 weeks and over, whose mean out of pocket costs were \$1,059. Mean out of pocket costs increased with decreasing gestational age at birth across all time periods – from time of birth through to the time the child was 2 years of age.

Discussion

The results of this study report on three key findings. First, having a preterm birth was associated with a significantly longer return to work time for mothers compared with mothers that had a full term birth. Second, having a preterm birth was associated with a significantly lower weekly income compared with mothers who had a full term birth. Finally, having a preterm birth was associated with significantly higher out of pocket costs compared with mothers who had a full term birth, which was particularly high for mothers of babies born less than 32 weeks gestation.

This study has shown that there is an association between having a preterm birth and not returning to the labour force for almost 3 years following childbirth, which could be due to the mother

needing to provide ongoing care for her baby. The Australian Government introduced the Paid Parental Leave (PPL) scheme for eligible working mothers to receive 18 weeks of 'pay', set at the minimum wage rate, in the form of transfer payments when they take time off from work to care for a newborn (25). This policy penalises mothers who are unable to return to work 12 months after childbirth making them ineligible for PPL in the future if they have another child (13). This study demonstrates that mothers who have a preterm birth are adversely affected by this policy at a time when they would typically be in need of extra financial support. It is likely that mothers of preterm babies who are unemployed due to caring responsibilities are therefore reliant upon payments provided by Australia's welfare system. This is of concern as over one third of people receiving social security payments in Australia are living below the poverty line (48). This undermines the government's direct role in ensuring adequate income support payments to prevent poverty. Serious policy consideration is needed in Australia to ensure that mothers who have a baby with a health condition and spend a lengthy period of time out of the labour force are adequately financially supported whilst caring for their baby.

A second finding from this study was the association between mothers having a preterm birth and having a significantly lower weekly income compared with mothers who had a full term birth. A mother's income is crucial for ensuring the financial ability to afford the health care needs of the child and also for mothers' long-term living standards, with evidence to suggest that mothers who have reduced earnings have poorer health and wellbeing. The poverty line in Australia for a single parent household who is not in the labour force is \$561.15 a week. Those with an income less than this figure are considered to be in poverty (15). This study has shown that most mothers of preterm babies (except for those in full-time work when their child is 4-5 years) earn a weekly income below this figure. Due to this potential systemic failure, mothers caring for their preterm baby may not be able to afford health care and medications for their child and may be forced to relinquish necessary health care.

Finally, our study demonstrated that there was an association between having a preterm birth and higher out-of-pocket costs compared with mothers who did not have a preterm birth. This could be a result of paying for health services to meet the additional health care requirements of their babies. Despite Australia having a universal healthcare scheme, Medicare, 17% of total health spending comes from individuals out-of-pocket spending (26), and financial strain due to high expenditure on healthcare is common (27). The ongoing out of pocket costs experienced by mothers of preterm babies creates concern as 1 in 4 Australians who have a chronic health condition skip care as a result of financial barriers (28), and also have a reduced likelihood to obtain pharmaceutical prescriptions (16). For families of preterm babies who might already be missing an income due to ongoing caring

responsibilities, out of pocket costs on top of this could significantly affect the living standards of the entire family.

The main limitation of this study was the inability to capture all out of pocket costs associated with preterm birth and therefore, it is likely that these costs are underestimated. Due to the nature of the data we were not able to include items such as over the counter medicines, costs associated with attending appointments such as transport and car parking and other healthcare items that are not covered by Medicare (particularly allied health services). Further, the out of pocket fees were based upon mothers in only one state in Australia. We expect there might be some variation among other states as some other Australian states have a larger urban population, whereby higher out of pocket fees are typically experienced. However, mothers in the state of Queensland where this study was conducted might experience greater fees in regards to travelling to appointments due to the large geographical area compared with some Australian states.

Conclusion

In Australia, the individual economic hardship associated with health care costs, particularly long-term health conditions and disability, are generally overlooked. The existence of universal health care and social welfare system potentially provides a sense of security in the event of poor health. However, this study has demonstrated that having a preterm birth is associated with a significantly reduced attachment to the labour force and a reduced income for at least 5 years following childbirth, potentially placing mothers in poverty whereby they are further burdened by long-term out of pocket health care costs.

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Tables

Table 1: Mother's socioeconomic characteristics, weighted to the Australian population, 2004.

Gestation	Demographics, n (%)			Education level, n (%)				
	First Nations	Married	Age, mean	Postgraduate	Bachelor degree	Certificate/ diploma	Year 12	Year 11 or less
≥37	2,7795 (1.7)	151,401 (92.6)	30	23,544 14.4	32,700 20.0	5,9841 (36.6)	20,928 (12.8)	26,650 (16.3)
32-36 weeks	520 (5.0)	9,214 (88.6)	31	1,196 (11.5)	1,851 (17.8)	3,920 (37.7)	1,071 (10.3)	2,371 (22.8)
<32 weeks	65 (2.1)	2,716 (87.6)	32	295 (9.5)	508 (16.4)	1,070 (34.5)	273 (8.8)	958 (30.9)

Table 2: Hazard ratio of returning to paid employment between Wave 1 and Wave 6 of the LSAC survey for mothers whose baby was born prematurely, adjusting for mother's age, education attainment and marital status

Parameter	Mean length of time in years until return to the labour force	Hazard Ratio	95% CI	p-value
Mothers whose child was 37+ weeks	1.9	REFERENCE		
Mothers whose child was 32-36 weeks	2.8	0.88	0.86-0.90	<.0001
Mothers whose child was 32 weeks or less	2.8	0.92	0.88-0.95	<.0001

Table 3: Average income for mothers of full-term and preterm babies on waves 1-3 of the LSAC survey pre-birth and when the child was aged 0-1, 2-3, and 4-5.

	Mean \$	Median \$	Standard Deviation
Pre-birth			
Mothers of pre-term babies, employment status: full time	528.37	275.98	724.09
Mothers of full term babies, employment status: full time	499.21	300.00	642.85
Mothers of pre-term babies, employment status: part time	309.76	135.00	360.26
Mothers of full term babies, employment status: part time	327.54	239.00	353.93
Mothers of pre-term babies, employment status: casual	387.59	350.00	379.57
Mothers of full term babies, employment status: casual	250.60	191.64	245.37
Child aged 0-1			
Mothers of pre-term babies, employment status: full time	510.11	229.97	715.38
Mothers of full term babies, employment status: full time	497.78	300.00	663.33

Mothers of pre-term babies, employment status: part time	337.89	229.97	362.09
Mothers of full term babies, employment status: part time	365.95	230.00	471.55
Mothers of pre-term babies, employment status: casual	274.64	258.72	151.32
Mothers of full term babies, employment status: casual	305.44	250.00	229.99
Child aged 2-3			
Mothers of pre-term babies, employment status: full time	733.08	460.00	675.39
Mothers of full term babies, employment status: full time	695.78	500.00	737.22
Mothers of pre-term babies, employment status: part time	437.90	400.00	352.73
Mothers of full term babies, employment status: part time	536.92	400.00	550.05
Mothers of pre-term babies, employment status: casual	453.03	400.00	271.30
Mothers of full term babies, employment status: casual	373.54	350.00	288.18
Child aged 4-5			
Mothers of pre-term babies, employment status: full time	966.62	689.91	926.87
Mothers of full term babies, employment status: full time	812.41	670.75	864.35
Mothers of pre-term babies, employment status: part time	499.23	400.00	422.66
Mothers of full term babies, employment status: part time	640.92	517.43	658.11
Mothers of pre-term babies, employment status: casual	511.81	500.00	293.97
Mothers of full term babies, employment status: casual	497.90	402.45	402.94

Table 4: Multivariate linear regression of income difference between mothers of full-term babies and mothers of preterm babies on wave 1-3 of the LSAC survey pre-birth and when the child was aged 0-1, 2-3, and 4-5.

	Child aged 0-1		Child aged 2-3		Child aged 4-5	
	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Pre-term	-249.67***	18.12	-332.29***	27.34	-337.68***	34.44
Full term	Reference					
Pre-birth income	-123.68***	26.02	-204.19***	28.92	-167.26***	36.84
First Nations	-24.77	45.15	1.43	78.66	-21.30	82.42
Education	-77.56***	12.95	-91.18***	14.66	-90.65***	16.34
Mum married when child aged 0-1	-105.94***	26.04				
Mum married when child aged 2-3			-112.32	43.46		
Mum married when child aged 4-5					-98.16	38.73

***p sig at .001.

Table 5. Adjusted^a mean out-of-pocket costs for mothers who had a preterm birth and mothers who had a full-term birth in Queensland between 1st July 2012 and 30th June 2015

	Baby <32 weeks Mean (\$) and SE	Baby 32 - 36 weeks Mean (\$) and SE	Baby 37 weeks+ Mean (\$) and SE
Total out-of-pocket costs	2,491 (121)*	1,298 (29)*	1,059 (9)
Time of cost			
Birth	1,015 (78)*	343 (16)*	249 (3.9)
Year 1	882 (57)*	364 (12)*	273 (3)
Year 2	682 (47)*	457 (15)*	393 (5)

[^] Adjusted for private birth, mother's age, singleton pregnancy, vertex presentation, pre-existing medical conditions of the mother, complications that developed during the pregnancy, First Nations status, mother's smoking status before week 20, mother's BMI, socioeconomic status, year of birth.

*significant at the >0.001 level compared with those born 37+ weeks.

What is already known on this topic

- Babies that are born preterm in high-income countries have high survival rates but long-term morbidities.
- There is significant hospital-based and non-hospital based health care expenditure associated with premature birth. However, little is known about the costs faced by families.

What this study adds

- Mothers of babies born preterm have significantly longer return to work times, and significantly reduced income following childbirth compared with mothers of full term babies.
- Mothers of babies born preterm face significantly higher out of pocket healthcare costs than mothers of full term babies.

Appendices

Appendix 1. Correlation coefficients (p value).

	Pre-birth income	Post-birth income	Education	First Nations status	Marital Status
Pre-birth income		-0.10 (<.0001)	0.14 (<.0001)	0.05 (0.04)	-0.07 (0.005)
Post-birth Income	-0.10 (<.0001)		-0.19 (<.0001)	-0.02 (0.19)	0.04 (0.03)
Education	0.14 (<.0001)	-0.19 (<.0001)		0.13 (<.0001)	-0.12 (<.0001)
First Nations Status	0.05 (0.04)	-0.02 (0.19)	0.13 (<.0001)		-0.11 (<.0001)
Marital Status	-0.07	-0.04 (0.03)	-0.12 (<.0001)	-0.11 (<.0001)	

	(0.005)				
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