

# Cumulative risks and cessation of exclusive breast feeding: Australian cross-sectional survey

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## ABSTRACT

**Objectives** To estimate the prevalence of cessation of exclusive breast feeding at each month up to 6 months and document key factors and cumulative risks associated with exclusive breastfeeding cessation for children aged from 0 to 6 months.

**Methods** Secondary analysis using a national representative sample of 22 202 mother and infant pairs derived from the 2010 Australian Institute of Health and Welfare cross-sectional survey, the Australian Infant Feeding Survey.

**Results** Among breastfed infants, 49% had ceased exclusive breast feeding before they had reached 2 months of age. In the final Cox proportional hazards model, cessation of exclusive breast feeding was most strongly associated with partners preferring bottle feeding (HR 1.86, 95% CI 1.69 to 20.6) or having no preference (HR 1.37, 95% CI 1.33 to 1.42), regular dummy use (HR 1.35, 95% CI 1.31 to 1.39) and maternal obesity (HR 1.29, 95% CI 1.24 to 1.35). Living within the most disadvantaged areas of Australia (quintile 1) was not strongly associated with cessation (HR 1.08, 95% CI 1.02 to 1.14) compared with least disadvantaged areas. Having three risk factors significantly increased the risk of cessation by 31% (HR 1.31, 95% CI 1.07 to 1.6).

**Conclusions** The prevalence of early cessation of exclusive breast feeding is alarmingly high with 50% of infants no longer exclusively breast fed by age 2 months. Given that not one factor is associated with cessation of exclusive breast feeding, the greatest public health impact is likely to be achieved when multiple risk factors are modified or prevented.

## BACKGROUND

Despite significant health benefits associated with sustained exclusive breast feeding (breast milk only) to around 6 months,<sup>1 2</sup> it is rare in many settings.<sup>3</sup> Globally 38% of the infants are exclusively breast fed at 6 months,<sup>4</sup> with the lowest rates occurring in high-income countries such as Australia, the UK and the USA.<sup>5 6</sup> In Australia, 96% of children aged 0–2 years commence breast feeding, and only 15% are exclusively breast fed up to 5–6 months.<sup>6</sup> Similar trends are seen in other high-income countries.<sup>7 8</sup>

Breastfeeding patterns are not distributed equally across populations; instead, they are socially patterned and complex.<sup>5 9</sup> Socio-economically disadvantaged women who are younger, and less well educated are more likely to have low rates of exclusive breast feeding.<sup>10</sup> Other factors strongly associated with socio-economic disadvantage (smoking, obesity, low birth weight <2500 g and preterm

## What is already known on this topic?

- ▶ Non-fatal and fatal disease burden due to the lack of exclusive breast feeding are a serious public health concern.
- ▶ It is recommended that mothers exclusively breast feed until their babies are 'around' 6 months of age.

## What this study adds?

- ▶ Early cessation of exclusive breast feeding appears to be a symptom of the accumulation of factors, many of which are outside the mother's control (partner's preference, method of birth, socio-economic indicators for areas, age, perinatal depression).
- ▶ Engaging and supporting fathers/partners to understand the importance of exclusive breast feeding is essential if we are going to reduce the high proportion of mothers interrupting exclusive breast feeding within the first six months.
- ▶ The shared impact of risk factors on cessation provides evidence for clinical and policy change in the way we educate and understand exclusive breast feeding.

births) have also been shown to have adverse associations with initiation and duration of exclusive breast feeding.<sup>11–14</sup>

The available data on dummy use show an association between dummy use and shorter duration of 'any' breast feeding; however, inconsistent results from studies make it difficult to ascertain whether dummy use is a causal factor or simply correlated with breastfeeding difficulties.<sup>15</sup> Conversely, several small studies have found that favourable attitudes towards breast feeding by fathers/partners have a positive association with mothers continuing 'any' breast feeding.<sup>16 17</sup>

How these and other factors known might impact on the cessation of exclusive as opposed to 'any' breast feeding is unclear because of knowledge gaps about the risk factors for cessation of exclusive breast feeding. International and Australian data on exclusive breast feeding are focused on rates and duration rather than cessation. To address this evidence gap, we have used data from the 2010 Australian National Infant Feeding

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Survey (ANIFS) to estimate the (1) prevalence of cessation of exclusive breast feeding at each month up to 6 months; (2) prevalence of key factors associated with exclusive breast-feeding cessation; (3) association of these factors with time to cessation of exclusive breast feeding and (4) cumulative effects on cessation of having multiple risk factors.

## METHODS

### Study design and subjects

#### The ANIFS

The 2010 ANIFS was the first state and territory cross-sectional survey conducted to collect infant feeding practices in a manner consistent with the standard WHO definitions and indicators.<sup>18</sup> The response rate was 56%, and the data were weighted to adjust for differential non-response (reported elsewhere<sup>6</sup>).

#### Exclusive breastfeeding study subsample

Our sample consisted of 22 202 infants derived from the ANIFS sample of 28 436 infants (figure 1). We included infants who had initiated breast feeding at birth (fed directly from the breast or expressed breast milk)<sup>18</sup> and were aged <6 completed months at the time of the survey. The ANIFS database was systematically checked for outliers, inconsistencies and missing data.

Multiple imputation using chained regression equations was used to manage missing covariate data, range from 1% to 30%. The imputation models included all 18 covariates including the survival time and event status.<sup>19</sup> The estimates were combined using Rubin Rules.<sup>20</sup> We then fitted the Cox proportional hazards (PH) model to the imputed data.

#### Study variables

The ANIFS database consisted of predominantly fixed categorical and/or binary demographic and infant feeding variables. Variables of interest were potential predictors<sup>2 9 13 21</sup> and not intervening variables,<sup>22</sup> and included maternal age (years), highest educational standard, socio-economic indicators for areas (SEIFA) quintiles (quintile 1 representing the most and quintile 5 the least disadvantaged areas),<sup>23</sup> parity, smoking status, current body mass index (BMI kg/m<sup>2</sup> underweight <18.5, normal 18.5 to <25, overweight 25 to <30, obese

≥30),<sup>6 24</sup> perinatal depression (PND) (defined as a range of mood disorders affecting a woman during pregnancy and after the birth of her child); prenatal depression, ‘baby blues’, postpartum depression and postpartum psychosis;<sup>25</sup> currently on/had taken employment leave; currently living with spouse/partner, partner’s preference for infant feeding method (breast/bottle/no preference); country of birth; infant sex, birth method, skin-to-skin contact after birth,<sup>18</sup> receiving expressed breast milk (EBM) and regularly dummy use. Gestational age and birth weight were recorded as continuous variables.

‘Initiated exclusive breast feeding’ refers to infants whose first feed was breast milk (direct from the breast or expressed).<sup>18</sup> Only valid responses were used to calculate the proportion of infants who had only had breast milk for their first feed (missing cases were excluded).

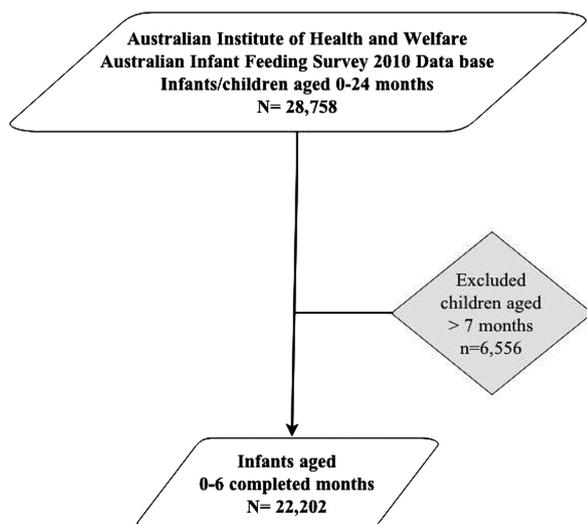
‘Exclusive breast feeding’ refers to infants whose first feed was only breast milk and who had not been fed any other food or fluid with the exception of vitamins, minerals oral rehydration salts and were still being fed either directly at the breast or with expressed breast milk,<sup>6 18</sup> during the study period 0–6 months. If the infant was exclusively breast fed at the time of the survey completion, as per the survival analysis method, they were classified as a ‘censored case’.<sup>26</sup>

Cessation of exclusive breast feeding was the primary outcome variable. An ‘event’ variable, ‘cessation of exclusive breast feeding’, was generated for the purposes of survival analysis using the existing ANIFS variables; first feed; ever received non-human milk (infant formulas), water, soya, cow’s milk, fruit juices, semi-solid and or solid foods. We used the ANIFS ‘current age variable’ measuring the infants’ age in monthly intervals (0 through to 6 completed months) to estimate the age of cessation.

#### Statistical analysis

The prevalence of cessation of exclusive breast feeding at each month up to 6 months was calculated using all those who had experienced an ‘event’ up to that month and dividing it by the total number of infants (N=22 202). The prevalence of factors associated with breastfeeding cessation was calculated for the whole sample and for those who ceased exclusive breast feeding within the first six months. We estimated the Kaplan–Meier survival curves and used log-rank test for equality/significance for all maternal and infant predictors. Cox PH were used to estimate adjusted associations with cessation of exclusive breast feeding within the first six months. A purposeful selection method was used for multivariable model building. Covariates for the full model were identified based on clinical or biological plausibility, and known to have a potential effect on breastfeeding practices.<sup>2 9 22 26</sup> Covariates were systematically added and removed from the full model, and retained in the model based on the significance of their respective Wald test statistics. Partial likelihood ratio test was used to assess the covariate’s contribution to the model. Final models were adjusted for confounders. Model adequacy and PH were assessed using goodness-of-fit statistics; Schoenfeld residuals for the global test, scaled Schoenfeld residuals for each covariate, and plotted scaled and smooth Schoenfeld residual were obtained from the model.<sup>19 26</sup> Proportionality was met for all variables in the final model with the exception of mother’s country of birth, which was used to stratify the final model.<sup>26</sup>

We also conducted a cumulative ‘fraction of risk’ analysis using risk factors identified in the final model to estimate the hazard of having multiple competing risk factors.<sup>19 27</sup> A separate Cox PH model was fitted for the event of interest, and



**Figure 1** Derivation of the sample 22 202 from the Australian Institute of Health and Welfare 2010 Australian National Infant Feeding Survey.

cumulative fraction of risk was estimated for all risk factors simultaneously. CIs and p values were obtained using Wald test and log-log statistics.<sup>19</sup> STATA V.12.1 (Stata Corp, College Station, Texas, USA) was used for all analyses.

## RESULTS

Maternal and infant characteristics are shown in table 1. The majority of the mothers were aged >25 years (90%), 59% had completed tertiary education or below, 43% were first-time

**Table 1** Prevalence, HRs and 95% CIs for factors associated with cessation of exclusive breast feeding within the first six months (N=22 202)

Variable	Whole sample (%) n	Unadjusted		Adjusted	
		HR (95% CI)	p Value	HR (95% CI)	p Value
<b>Mother's age (years)</b>					
+35	(29.0) 6420	1 (Ref)			
30–34	(36.0) 7997	0.98 (0.95 to 1.02)	0.39	0.98 (0.94 to 1.02)	0.28
25–29	(25.3) 5620	1.08 (1.04 to 1.13)	<0.001	1.02 (0.97 to 1.05)	0.43
15–24	(9.7) 2165	1.33 (1.26 to 1.40)	<0.001	1.11 (1.07 to 1.22)	0.001
<b>Education level</b>					
Postgraduate/bachelor degree	(41.0) 9119	1 (Ref)			
Diploma/certificate	(36.0) 7986	1.28 (1.24 to 1.33)	<0.001	1.16 (1.12 to 1.21)	<0.001
<Year 12	(23.0) 5097	1.28 (1.23 to 1.33)	<0.001	1.15 (1.10 to 1.20)	<0.001
<b>SEIFA</b>					
Quintile 5 (least disadvantaged)	(26.2) 5818	1 (Ref)			
Quintile 4	(23.1) 5141	1.08 (1.04 to 1.14)	<0.001	1.05 (1.01 to 1.10)	0.02
Quintile 3	(21.1) 4675	1.10 (1.05 to 1.15)	<0.001	1.02 (0.97 to 1.06)	0.48
Quintile 2	(16.2) 3593	1.14 (1.09 to 1.20)	<0.001	1.06 (1.01 to 1.11)	0.02
Quintile 1 (most disadvantaged)	(13.4) 2975	1.19 (1.13 to 1.25)	<0.001	1.08 (1.02 to 1.14)	0.01
<b>Mother's current smoking status</b>					
No	(90.2) 20 034	1 (Ref)			
Yes (daily/occasional)	(9.8) 2168	1.42 (1.35 to 1.49)	<0.001	1.20 (1.14 to 1.26)	<0.001
<b>Mother's body mass index</b>					
Normal	(47.9) 10 628	1 (Ref)			
Underweight	(2.4) 524	1.06 (0.96 to 1.18)	0.22	1.13 (0.79 to 0.98)	0.02
Overweight	(29.8) 6624	1.26 (1.14 to 1.41)	<0.001	1.16 (1.12 to 1.20)	<0.001
Obese	(19.9) 4426	1.52 (1.37 to 1.69)	<0.001	1.29 (1.24 to 1.35)	<0.001
<b>Perinatal depression</b>					
No	(91.6) 20 336	1 (Ref)			
Yes	(8.4) 1866	1.26 (1.20 to 1.33)	<0.001	1.15 (1.09 to 1.21)	<0.001
<b>Method of birth</b>					
Vaginal	(66.8) 14 835	1 (Ref)			
Caesarean*	(33.2) 7367	1.25 (1.21 to 1.29)	<0.001	1.11 (1.07 to 1.15)	<0.001
<b>Currently on leave from employment</b>					
Yes	11 961 (53.9)	1 (Ref)			
No	10 241 (46.1)	0.98 (0.95 to 1.01)	0.13	0.95 (0.92 to 0.98)	0.003
<b>Living with spouse/de facto partner</b>					
Yes	(93.3) 20 707	1 (Ref)			
No	(6.7) 1495	1.31 (1.24 to 1.39)	<0.001	1.06 (0.99 to 1.12)	0.04
<b>Partner's feeding preference</b>					
Breast	(56.7) 12 596	1 (Ref)			
Bottle	(1.9) 421	2.08 (1.89 to 2.31)	<0.001	1.86 (1.69 to 2.06)	<0.001
No preference	(41.4) 9185	1.47 (1.43 to 1.52)	<0.001	1.37 (1.33 to 1.42)	<0.001
<b>Skin-to-skin contact at birth</b>					
Yes	(77.4) 17 185	1 (Ref)			
No	(22.6) 5017	1.39 (1.34 to 1.44)	<0.001	1.20 (1.16 to 1.25)	<0.001
<b>Dummy use</b>					
No	(46.9) 10 416	1 (Ref)			
Yes	(53.1) 11 786	1.47 (1.43 to 1.52)	<0.001	1.35 (1.31 to 1.39)	<0.001
<b>Received expressed breast milk</b>					
No	(64.7) 14 369	1 (Ref)			
Yes	(35.3) 7833	1.13 (1.09 to 1.17)	<0.001	1.07 (1.03 to 1.11)	<0.001

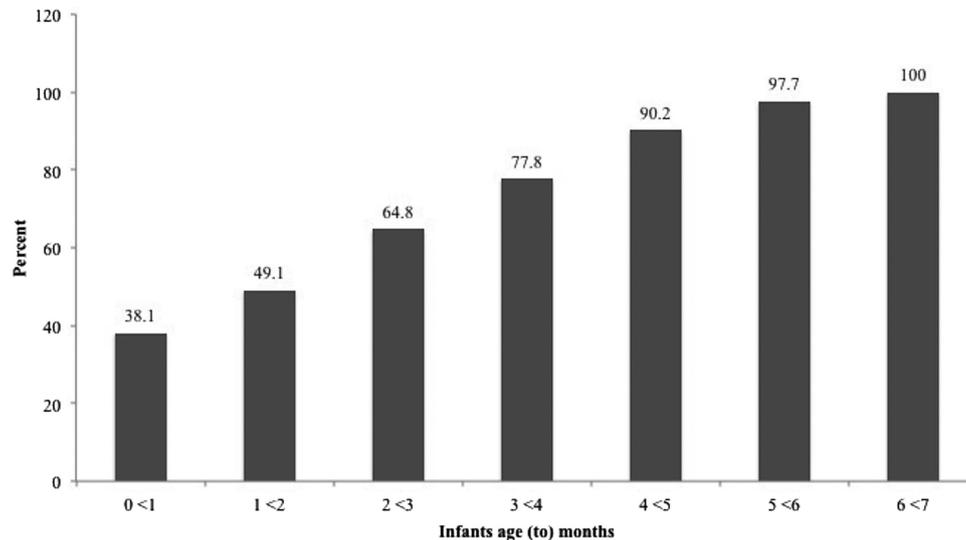
Values are in % (n).

Log likelihood 798 142.78 (1-df). p<0.05 indicates statistically significant. Test for trend p>0.001 is based on Cox proportional hazards (PH) models.

aHR adjusted Cox PH regression analysis imputed model (stratified by mother's country of birth). Model adjusted for parity, infant sex, birth weight, gestational age.

\*Caesarean section; combined elective or planned and emergency.

SEIFA, socio-economic indexes for areas.



**Figure 2** Percentage of infants who commenced being breast fed ceasing exclusive breast feeding to 6 completed months (N=22 202).

mothers and 30% lived in the most disadvantaged areas of Australia. Forty-one per cent of the mother's partners were indifferent to the infant feeding method (either breast or bottle) with 2% preferring bottle feeding. Over half of the infants regularly used a dummy within their first six months of life, the mean gestational age (completed weeks) was 39.5 weeks (95% CI 39.3 to 39.6) and mean birth weight was 3426 g (95% CI 3419 to 3433).

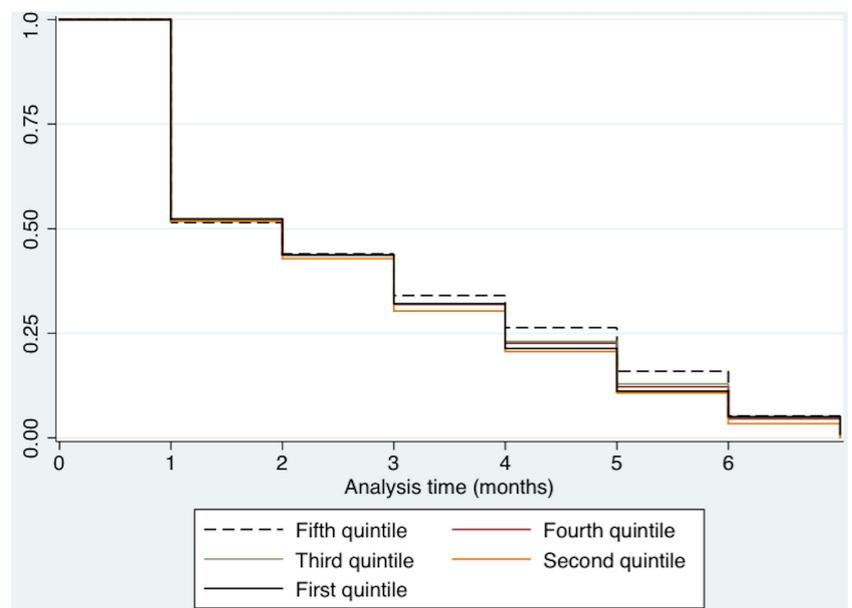
### Cessation of exclusive breast feeding

Among those who initiated exclusive breast feeding at birth, 49% had ceased (received non-human milk, food or other fluids) by 2 months and 78% by 4 months of age (figure 2). Table 1 shows the unadjusted and adjusted HRs for factors associated with cessation of exclusive breast feeding within the first six months. After adjusting for potential confounders, the risk of cessation increased by 86% when the partner preferred bottle feeding and by 73% when the partner was indifferent to the method of feeding (no preference). Regular dummy use was

associated with a 37% increased risk of cessation, mothers who were obese had a 29% increased risk compared with mothers of normal weight and being underweight was associated with a 13% risk of cessation. Maternal smoking and no skin-to-skin contact at birth were associated with a 20% increased risk of cessation, whilst lower education level, PND, younger mothers, giving birth via caesarean section, and regular feeding with EBM was associated with a 7–15% increased risk of cessation within the first six months. Employment leave did not significantly affect the risk of cessation in the univariable analysis compared with taking leave; however, after adjustment, not taking leave showed a 5% reduction in the risk of cessation.

Overall socio-economic status (SEIFA) appears to effect the risk of cessation only slightly. In the adjusted model, a lower SEIFA quintile (most disadvantaged) was not strongly associated with cessation ( $p \leq 0.001$  for test for trend) compared with the higher quintiles (least disadvantaged). The lowest two quintiles (most disadvantaged) showed only a 6% and 8% increased hazard of ceasing compared with 5% for quintile 4 (table 1).

**Figure 3** Kaplan–Meier curves for cessation of exclusive breast feeding by socio-economic indexes for areas, comparing quintile first (most disadvantaged) through to least disadvantaged fifth quintiles (least disadvantaged) ( $p$ =adjusted for mother's age and parity, education level).



**Table 2** An estimate of cumulative relative risk of cessation of exclusive breast feeding within the first six months for increasing number of risk factors (N=22 202)

Number of risk factors*	(%) n	RR (95% CI)	p Value
0	(0.7) 160	1.00 (ref)	
1	(4.0) 877	1.02 (0.82 to 1.26)	0.89
2	(10.2) 2269	1.12 (0.91 to 1.37)	0.29
3	(17.4) 3873	1.31 (1.07 to 1.60)	0.01
4	(21.3) 4728	1.54 (1.26 to 1.88)	<0.001
5	(19.2) 4259	1.83 (1.50 to 2.24)	<0.001
6	(14.1) 3123	2.16 (1.76 to 2.64)	<0.001
7	(8.1) 1803	2.33 (2.08 to 3.19)	<0.001
8	(3.4) 763	2.58 (3.18 to 4.35)	<0.001
9	(1.2) 258	2.83 (2.24 to 3.58)	<0.001
10	(0.3) 77	3.25 (2.41 to 4.38)	<0.001
>11	(0.1) 12	3.99 (2.19 to 7.26)	<0.001

p≤0.05 indicates statistically significant.

\*Risk factors included dummy use, partner's preference for bottle/no preference, smoker, obese, perinatal depression, caesarean section, no skin-to-skin contact, expressed breast milk feeding, socio-economic indexes for areas most disadvantaged, mother's age <25 years, gestational age, birth weight, parity.

Adjusted Kaplan–Meier curves illustrate the similarity in survival curves for the SEIFA quintiles (figure 3).

The results for the analysis of the cumulative effect of having multiple risk factors are shown in table 2. Eighty-five per cent of the population had three or more risk factors, with accumulation of three factors significantly increasing the risk of cessation by 31% (95% CI 1.07 to 1.6).

## DISCUSSION

This is the first time a sample of this size has been used to estimate prevalence of exclusive breast feeding and the key factors associated with cessation of exclusive breast feeding. The results show that in Australia, among a sample of mothers and infants who initiated exclusive breast feeding at birth, 50% had stopped exclusive breast feeding in the first two months, while at 4 months over three quarters had ceased. This confirms that exclusive breast feeding up until 6 months of age is not common practice despite recommendations to do so.<sup>28</sup> There is clearly an urgent need to re-examine how exclusive breast feeding is promoted, and how mothers and families are supported to exclusively breast feed.<sup>29</sup>

Whilst multiple factors are associated with the cessation of exclusive breast feeding,<sup>3 12</sup> our analysis has shown that the most strongly associated were partner preference, regular use of a dummy and maternal obesity. Australian mothers and their infants who initiated exclusive breast feeding and whose partners preferred bottle feeding had an 86% higher risk of ceasing compared with those whose partners preferred breast feeding. Similarly, when partners were indifferent to how the infant was fed, mothers and infants ceased at a rate 1.37 times higher than those whose partners preferred breast feeding. This relation may be a reflection of fathers' feelings of marginalisation<sup>17</sup> and confirms that partner's views have a significant impact on infant feeding practices.<sup>17 30 31</sup> Engaging the support of fathers/partners is likely to be critical in increasing rates of exclusive breast feeding.

Consistent with previous research,<sup>12 32</sup> our findings confirm that regular dummy use in the first six months is strongly associated with cessation of exclusivity. This suggests that the use of

dummies is a 'flag' for potential infant feeding and/or settling problems rather than causal.<sup>15</sup>

Interrupting exclusive breast feeding within the first six months was observed in mothers who were obese, overweight and underweight even after adjusting for confounding factors (SEIFA, smoking, PND).<sup>14</sup> Considering that 56% of women in Australia are obese or overweight,<sup>24</sup> and 20–25% of pregnant women are obese,<sup>33</sup> our findings provide more evidence that obesity is a life-course public health problem that requires urgent intervention.<sup>34</sup>

We observed that older mothers (>25 years) and not being on employment leave were not associated with the interruption of exclusive breast feeding. It is possible that the variable used to estimate the mother's employment was not sensitive enough to capture the mother's actual employment status. Previous work has shown a strong correlation with returning to full-time work and reduced breast feeding (any).<sup>35 36</sup>

Our results found a much smaller relationship between socio-economic status and cessation of exclusive breast feeding that would be expected on the basis of the widely acknowledged relationship between socio-economic disadvantage and lower rates of any and exclusive breast feeding.<sup>10 31 37</sup> SEIFA was only weakly associated with cessation. Women living in the most disadvantaged areas in Australia had only a slightly higher hazard of stopping (8%) compared with those from least disadvantaged areas (third to fifth quintiles). We did not find large disparities between the fourth and second quintiles as reported elsewhere.<sup>10</sup> We interpret these findings with caution. As a single measure, SEIFA may not show and/or explain the complexity or strength of the association between cessation of exclusive breast feeding and increasing levels of disadvantage. SEIFA measures socio-economic characteristics of the mother's area of residence and is thus only a proxy estimate for the mother's own level of socio-economic status. Furthermore, several of the key factors identified in our analysis as contributing to higher risk of premature cessation (smoking, obesity, low education levels, younger mothers) are strongly associated with child and maternal social-economic disadvantage.<sup>38</sup>

In the cumulative model, we estimate that 85% of the population has multiple risk factors and having three or more risk factors significantly increased the risk of cessation compared with not having any. This suggests it is the accumulation of risk factors that increases the risk of cessation for mothers and infants. Theoretically eliminating three risk factors may reduce the rate of cessation. The most public health impact is likely to be achieved when multiple risk factors are modified and/or prevented.<sup>29 39</sup> Indeed, early cessation of exclusive breast feeding appears to be a symptom of the accumulation of factors, many of which are outside the mother's control (partner's preference, method of birth, SEIFA, age and PND).

## STRENGTHS AND LIMITATIONS

Limitations include the potential of non-sampling and recall error bias due to the self-reported survey data and the potential for imprecise estimates due to imputed missing covariate data. The major strength of the study is the generalisability of the results given the large sample size and the precision of the exclusive breastfeeding measurement.<sup>18</sup>

## CONCLUSION

Given that not one factor is associated with cessation of exclusive breast feeding, by identifying the strongest associated factors (namely partner's views, dummy use and obesity) and the shared impact of the risk factors on cessation provides

strong evidence for clinical and policy-level changes in the way we understand and try to promote exclusive breast feeding. The greatest public health impact is likely to be achieved when multiple risk factors are modified or prevented.

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