BMJ Open

Relationship between obesity and lower rates of breast feeding initiation in regional Victoria, Australia: an 8-year retrospective panel study

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To cite: Bish MR, Faulks F, Amir LH, *et al*. Relationship between obesity and lower rates of breast feeding initiation in regional Victoria, Australia: an 8-year retrospective panel study. *BMJ Open* 2021;**11**:e044884. doi:10.1136/bmjopen-2020-044884

► Prepublication history and supplemental material for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2020-044884).

Received 16 September 2020
Revised 23 November 2020
Accepted 18 December 2020

Check for updates

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ABSTRACT

Objectives Using routinely collected hospital data, this study explored secular trends over time in breast feeding initiation in a large Australian sample. The association between obesity and not breast feeding was investigated utilising a generalised estimating equations logistic regression that adjusted for sociodemographics, antenatal, intrapartum and postpartum conditions, mode of delivery and infant's-related covariates.

Design Population-based retrospective panel.

Setting A regional hospital that serves 26% of Victoria's 6.5 million population in Australia.

Participants All women experiencing live births between 2010 and 2017 were included. Women with missing body mass index (BMI) were excluded.

Results A total of 7491 women contributed to 10 234 live births. At baseline, 57.2% of the women were overweight or obese, with obesity increasing over 8 years by 12.8%, p=0.001. Although, breast feeding increased over time, observed in all socioeconomic status (SES) and BMI categories, the lowest proportions were consistently found among the obese and morbidly obese (78.9% vs 87.1% in non-obese mothers, p<0.001). In the multivariable analysis, risk of not breast feeding was associated with higher BMI, teenage motherhood, smoking, belonging to the lowest SES class, gravidity ≥4 and undergoing an assisted vaginal or caesarean delivery. Compared with women with a normal weight, the obese and morbidly obese were 66% (OR 1.66, 95% CI 1.40 to 1.96, p<0.001) to 2.6 times (OR 2.61, 95% CI 2.07 to 3.29, p<0.001) less likely to breast feed, respectively. The detected dose–response effect between higher BMI and lower breast feeding was not explained by any of the study covariates.

Conclusion This study provides evidence of increasing breast feeding proportions in regional Victoria over the past decade. However, these proportions were lowest among the obese and morbidly obese and those coming from the most disadvantaged backgrounds suggesting the need for targeted interventions to support breast feeding among these groups. The psychosocial and physiological associations between obesity and breast feeding should further be investigated.

Strengths and limitations of this study

- This 8-year population-based study used routinely collected maternal data from a regional hospital that serves 26% of Victoria's 6.5 million population in Australia.
- Missing information was not common as all study variables were entered into compulsory data fields that were completed by midwives and hospital staff.
- The analyses accounted for change in body mass index over time among women giving birth more than once during the study period.
- The data were limited to the hospital stay and no information was available on breast feeding after hospital discharge.
- Social status classification was based on a postcode-based composite variable which could have misclassified the true socioeconomic status.

INTRODUCTION

There is substantial evidence of significant health risks for mothers and infants related to not breast feeding.[1 2] WHO recommends that infants be breast fed exclusively until 6 months of age to achieve optimal growth, development and health, with breast feeding continuing as a part of the infant's diet up to 2 years of age or beyond.[3] However, current breast feeding rates in many countries do not reflect this recommendation. The reported trends in breast feeding over time, whether increasing or decreasing, have also not been consistent.

Initiation of breast feeding during the first month of life has substantial benefits in reducing neonatal morbidity and mortality, enhancing mother child bonding and increasing the probability of lengthening the duration of breast feeding.[2] Relative to other high-income countries, in Australia, breast feeding initiation rates are regarded as relatively high (90%).[4] However, in regional and

rural Australian populations, these rates have been consistently lower than that reported in urban populations with exclusive breast feeding decreasing in all almost immediately following hospital discharge resulting in less than 20% of babies being exclusively breast fed by 6 months.[4]

High maternal body mass index (BMI) is negatively associated with breast feeding initiation,[5–8] but it remains unclear if the association is confounded by other risk factors such as mother's age, low socioeconomic status (SES), comorbidities or antenatal, intrapartum or postpartum conditions or neonate's overall health.[9 10] Changes in breast feeding initiation rates across three national surveys in Australia concluded that although these rates increased from 86% in 1995 to 88% in 2004–2005, they were consistently lower in women belonging to lower socioeconomic groups.[10] Different breast feeding patterns have also been described by ethnicity and racial background.[9 11]

This 8-year panel study explored secular trends over time in the prevalence of breast feeding initiation before hospital discharge by maternal BMI and socioeconomic disadvantage in a large regional population in Victoria, Australia. The association between maternal obesity and not breast feeding was investigated adjusting for mother's age, SES, comorbidities, antenatal, intrapartum and postpartum conditions, mode of delivery, infant's birth weight and infant's admission to a special care unit.

METHODS

All analyses used unidentifiable data. The need for informed consent was waived by the ethics committees.

Patient and public involvement statement

Patients or the general public were not involved in the design, or research objectives of this 8-year panel study that used routinely collected hospital data. The development of the research questions and outcome measures were not informed by patients' priorities, experiences or preferences.

Participants

Data from all women giving birth to live infants at a large regional health service providing level 5 maternity care to approximately 26% of Victoria's population between January 2010 and December 2017 were included in this retrospective unbalanced panel analysis. Women with a missing anthropometric measure were excluded.

Variables

All study variables including socio-demographic, antenatal, intrapartum, postpartum and breast feeding data were collected from the Birthing Outcome System database, which is an electronic, hospital-based integrated data collection tool that facilitates longitudinal patient data recording.[12] All repeat births for women presenting more than once during the study period were included. The weight and height were measured by the midwife at the first antenatal appointment. This first visit indicates a woman's intention to give birth at the facility and initiates the pregnancy care pathway. All study variables were mandatory variables recorded by the midwives and hospital staff before the mother's discharge.

Definitions

For this analysis, breast feeding (yes/no) was defined as any breast milk feeding in hospital (during hospital stay or on day of discharge). Women who chose to feed their infants expressed breast milk were considered to be breast feeding. Similarly, those who fed their infants with any breast milk together with formula were listed as breast fed.

Socioeconomic disadvantage was estimated by constructing a relative index of socioeconomic inequality (RII),[13] which is a regression-based index that accounts for the sample size and relative disadvantage scores of each participant. The index was constructed using the Socioeconomic Indexes for Areas-Index of Relative Socio-Economic Disadvantage (SEIFA) obtained from the Australian 2006 and 2011 Census data.[14] SEIFA is a composite index of relative advantage or disadvantage based on geographic areas across Australia, with higher scores indicating less socio-economic disadvantage. The estimated RII was further introduced as quintiles categorised according to the score's distribution in the sample.

The WHO BMI classifications were utilised (underweight (BMI less than 18.5 kg/m^2), normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), obese class I (BMI 30.0–34.9 kg/m^2), obese class II (BMI 35.0–39.9 kg/m^2) and obese class III (BMI ≥40.0 kg/m^2)).[15]

Analysis

Change in breast feeding over time by BMI and RII categories was tested using Augmented Dickey-Fuller tests. The Mackinnon approximate p value of this test needs to be insignificant (ie, larger than 0.05) in order to accept the null hypothesis and conclude that the time series is non-stationary. A trendline fitting the data was drawn with R-squared estimated to ascertain a linear trend.

Characteristics of women who did and did not breast feed during their hospital stay were compared using Pearson χ^2 tests for categorical variables and Student's t-test for continuous variables. Not breast feeding was modelled in a multivariable logistic regression using the generalised estimating equations (GEE) approach. In the model, the effect of the covariates on the study outcome was averaged over individuals at each point in time and was compared over time.[16]

The dose–response effects of different levels of RII and different BMI categories on not breast feeding were tested using log likelihood ratio tests, with nested regression models compared with determine whether a model was rich enough to capture data trends. The dose–response tests were confined to the first delivery and to a randomly selected delivery per woman during the 8-year study

period. An insignificant p value of the log likelihood test indicates linearity.

All analyses were performed using Stata/SE V.15.0 (StataCorp).

RESULTS

Maternal characteristics

During the 8-year study period, 10 382 births were recorded, of which 77 (0.7%) were stillborn. Of the 10 305 live births, 71 births (0.7%) had missing information on maternal weight or height and were excluded. Of the 7491 women contributing to the remaining 10 234 births, 5151 (68.8%) were primiparous, 1988 (26.5%) delivered twice, while the remaining 352 (4.7%) had ≥3 births. Overall mean parity was 1.1 (SD 1.2) remaining constant over the study period (p=0.51). Mean length of maternal postpartum hospital stay was 2.2 (SD 1.2) days remaining relatively constant over time (2.3 days in 2010 vs 2.2 days in 2017).

A total of 161 women experienced twin births (1.6% of the total 10 234 births). Other maternal descriptive characteristics are shown in table 1.

Breast feeding

In the study, 10 234 women–child pairs, women exclusively breast fed in hospital in 62.5% of the births, whereas in 22.2% of the births, women breast fed and/or gave expressed breast milk with or without formula. In the remaining 15.4% of the births, the infants were exclusively fed with formula. Compared with women who breast fed, women who did not breast feed were younger, belonged to lower socioeconomic classes, had higher BMI, smoked more, had more comorbid conditions and were less likely to deliver vaginally (table 2). Breast

Table 1 Sociodemographic characteristics of study sample by breast feeding status during hospital stay at baseline

		Mothers who breast fed	Mothers who did not breast feed	
		N=6373 (85.1%)	N=1118 (14.9%)	P value
Age, mean (SD)		29.2 (5.8)	27.7 (6.3)	<0.001
Age categories, %				<0.001
19 or less		4.2	9.3	
20–34		76.8	73.1	
35–39		14.8	14	
40 or more		4.3	3.6	
Region of birth, %				<0.001
Oceania		90.4	95.3	
Asia/Africa/Middle East		7	3.4	
All else		2.6	1.3	
Aboriginal or Torres Strait Islander, %		5.6	10.7	<0.001
Relative index of inequality, %				<0.001
First quintile (lowest SES)		32.3	42.9	
Second quintile		6.2	6	
Third quintile		27.4	24.2	
Fourth quintile		13.7	12.4	
Fifth quintile (highest SES)		20.4	14.5	
Body mass index, %				<0.001
Underweight	<18.5	2	3.1	
Normal weight	18.5–24.9	42.5	30.5	
Overweight	25.0–29.9	27.9	26.2	
Obese class I	30.0–34.9	15.5	19.4	
Obese class II	35.0–39.9	7	10.8	
Obese class III	≥40.0	5.2	9.9	
Past or current smoking, %		18.9	38.8	<0.001
Alcohol consumption during pregnancy (any quantity), %		2.8	3.7	0.096

SES, socioeconomic status.

Table 2 Medical and birthing history of women by breast feeding status during hospital stay at baseline

	Mothers who breast fed N=6373 (85.1%)	Mothers who did not breast feed N=1118 (14.9%)	P value
Pre-existing diabetes mellitus type one or 2, %	0.9	1.8	0.005
Pre-existing hypertension, %	1.8	3.1	0.005
Other than hypertension and diabetes pre-existing comorbidity, %	39.7	43.2	0.029
Primiparous, %	55.8	43.1	<0.001
Gravida, mean (SD)	2.3 (1.6)	2.7 (1.9)	<0.001
Gestational diabetes, %	10.4	12	0.103
Gestational hypertension, %	3.7	4.5	0.206
Preeclampsia, %	2.9	2.6	0.606
Primary blood loss, ml %			0.136
Up to 500	79	76.5	
501–749	10.8	11.1	
750–999	4.9	5.6	
1000 or more	5.4	6.9	
Induction of labour, %	29.6	25.1	0.002
Type of birth, %			<0.001
Unassisted vaginal	52.4	47.1	
Assisted vaginal	17.9	16.3	
Elective caesarean section	12	19.3	
Emergency caesarean section	17.8	17.4	
Infant birth weight, g %			<0.001
<2500	4.9	12.1	
2500–3999	80.5	74.3	
>4000	14.6	13.6	
Infant admitted to special care unit, %	18.3	27.4	<0.001

feeding was also significantly lower in women of infants admitted to special care units.

Compared with women with normal weight, breast feeding was less prevalent among the obese and morbidly obese groups (p<0.001). This association was consistent over the years and in each type of delivery (online supplemental table 1). Significantly lower proportions of breast feeding were also observed in lower SES groups; however, this was not consistently observed in each of the years as shown in online supplemental table 2).

During the study period, the prevalence of breast feeding increased from 82% in 2010 to 87% in 2017, p<0.001. Not breast feeding varied from 12.7% to 18.3%, being consistently lower in women with a normal BMI ranging from 9.2% to 15.3% and higher in the obese class I (ranging from 14.6% to 23.7%), obese class II (ranging from 16.4% to 26.8%), and obese class III (ranging from 20.7% to 40.7%). However, over time, breast feeding significantly increased in each of the BMI categories (with MacKinnon test p>0.05 in each BMI category), with an R-squared of 0.754 for all groups together (figure 1). Increasing trends in breast feeding were similarly detected in each SES class.

Prevalence of not breast feeding increased in a dose–response manner with increasing BMI (likelihood ratio test χ^2=1.7 (p=0.649)). These dose–response effects were detected when the test was run on the first and a randomly selected birth per woman during study period.

In the multivariable GEE model that accounted for all variables listed in online supplemental table 3) and repeat births over time, lower rates of breast feeding were also independently associated with teenage motherhood, belonging to the most disadvantaged SES quintile, past or current smoking, being an Indigenous Australian or Torres Strait Islander, gravidity ≥4, having underweight infants (<2500 g) and admission of infant to a special care unit. Mothers who underwent an unassisted vaginal delivery were significantly more likely to breast feed compared with instrumental or caesarean births (figure 2). Morbidly obese women coming from the most disadvantaged SES class had the highest risk of not breast feeding as shown in figure 3.

DISCUSSION

This large-scale study provides evidence that breast feeding is increasing in a regional Australian population. However, breast feeding initiation was lower among women with high BMIs and those coming from the most disadvantaged backgrounds.

Obesity remains a significant challenge to our public health strategy as recent data indicate that over 58% of Australian women are overweight or obese[17] and while breast feeding rates remain relatively stable in Australia, our study suggests women with high BMI continue to initiate breast feeding at lower rates than normal weight women. Our findings are similar to the Canadian cohort study conducted in Quebec City from 2005 to 2010,[18] which found 20% of women in the obese category did not initiate breast feeding before hospital discharge compared with 12% of women in the normal weight category. Their definition of

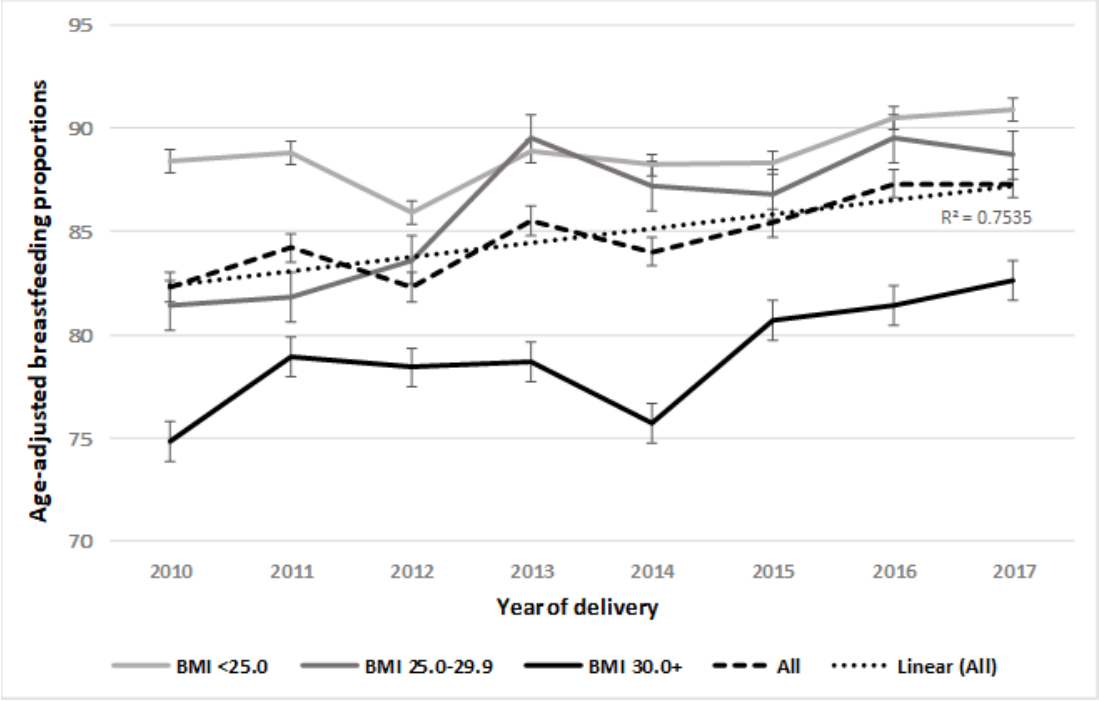

Figure 1 Age-adjusted proportions of women who breast fed before hospital discharge over time by BMI category. BMI, body mass index.

initiation was 'any provision of the mother's own breast milk (expressed or directly from the breast) to the infant at least once between birth and hospital discharge', as in our study. These authors found that lower initiation was partially mediated by mode of delivery, gestational diabetes, type of anaesthesia and transfer to neonatal unit.[18] They further argued that the association between intention to breast feed and actual breast feeding was not as strong in women with obesity, who encountered higher perinatal risk factors than normal weight women. In our study, overall, 21% of obese women did not initiate breast feeding before hospital discharge compared with 14% and 12% of overweight and normal weight women, respectively. Maternal and neonatal conditions, however, did not explain the lower breast feeding rates among the obese.

In addition to the high risk of maternal and infant complications secondary to maternal obesity,[19] large women are more likely to experience physical difficulties with attaching their newborn to their breasts and to have delayed lactogenesis and low milk supply.[20 21] Specific interventions targeted at improving breast feeding rates in the individuals with high BMIs need to be explored with a focus on preconception weight loss and public awareness of the associated perinatal outcomes for women who are over their ideal weight. There is a paucity of evidence demonstrating any positive impact of specific interventions to address breast feeding initiation rates among women with high BMI. In their study of targeted interventions for women with high BMI—additional telephone-based support from lactation consultants and provision of a breast pump to stimulate milk supply—Rasmussen *et al* were unable to demonstrate improved breast feeding duration among women with high BMI.[22] Similarly, Chapman *et al* evaluated peer counselling (in person) targeting overweight/obese women from low income environments with no impact on exclusive breast feeding rates or breast feeding continuation.[23] However, these authors did demonstrate improvements in breast feeding intensity (providing ≥50% of feedings as breast milk) 2 weeks after birth and lower rates of infant hospitalisation at three and 6 months.[23]

The link between socioeconomic disadvantage and risk of obesity is well reported and public health strategies aimed at women, particularly those who are living with social deprivation and disadvantage, would be most beneficial.[24] Recognition and response to the significant link between social disadvantage and obesity would assist in guiding public health initiatives to improve breast feeding initiation rates within this vulnerable group. Continuity of midwifery care (an intervention that aims to improve breast feeding rates among socially disadvantaged women) may mitigate some of the factors that contribute to low breast feeding rates in women with high BMI through the development of a safe, trusting relationship with a midwife that continues throughout the pregnancy, birth and into the postnatal period.[25 26] In addition, ensuring access to services within the most disadvantaged neighbourhoods may also support women in these communities to engage and benefit from initiatives that aim to increase breast feeding success in this

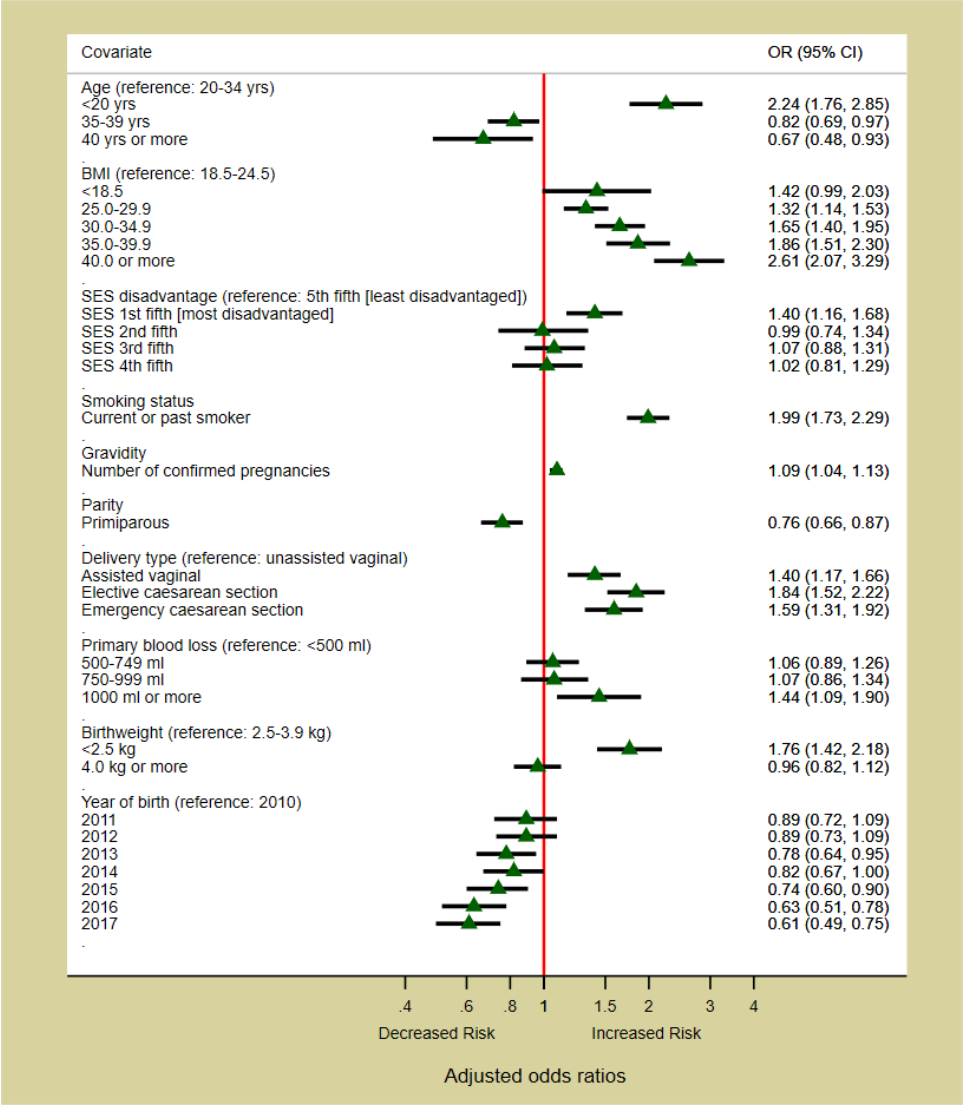

Figure 2 GEE model-based risk adjusted ORs of not breast feeding before hospital discharge by selected covariates. BMI, body mass index; GEE, generalised estimating equations; SES, socioeconomic status.

vulnerable group.[27] Additionally, effectively managing maternal obesity among the most socioeconomically disadvantaged would have a direct and positive impact on maternal health of this vulnerable group and the perinatal sequalae that follow.

The strong associations we found between higher BMI and less breast feeding could not be explained by maternal sociodemographic or antenatal, intrapartum or postpartum factors. These were also not explained by the infant's birth weight or admission to a special care unit. These findings warrant future studies to further investigate and understand the psychosocial and physiological associations between obesity and breast feeding.

Limitations

Utilisation of an electronic system in retrospect for diagnosis of conditions and complications relies on accuracy of coding, limiting the ability to confirm a standardisation in definition of disease.[28] Our data were limited to the hospital stay and we had no information on breast feeding after hospital discharge. Breast feeding was recorded as a yes/no event occurring at any time following birth until discharge. We did not have any data on whether women who initiated breast feeding continued breast feeding on their day of discharge. We had no information on intention to breast feed. SEIFA is a composite variable which could have misclassified the actual SES.

CONCLUSION

Although breast feeding is on the rise, strong independent inverse associations between BMI and breast feeding were detected in a population-based sample. A regional healthcare context demands the identification of obese women accessing maternity services as a high-risk group to be targeted for directed, strategic interventions to support breast feeding. Fundamental

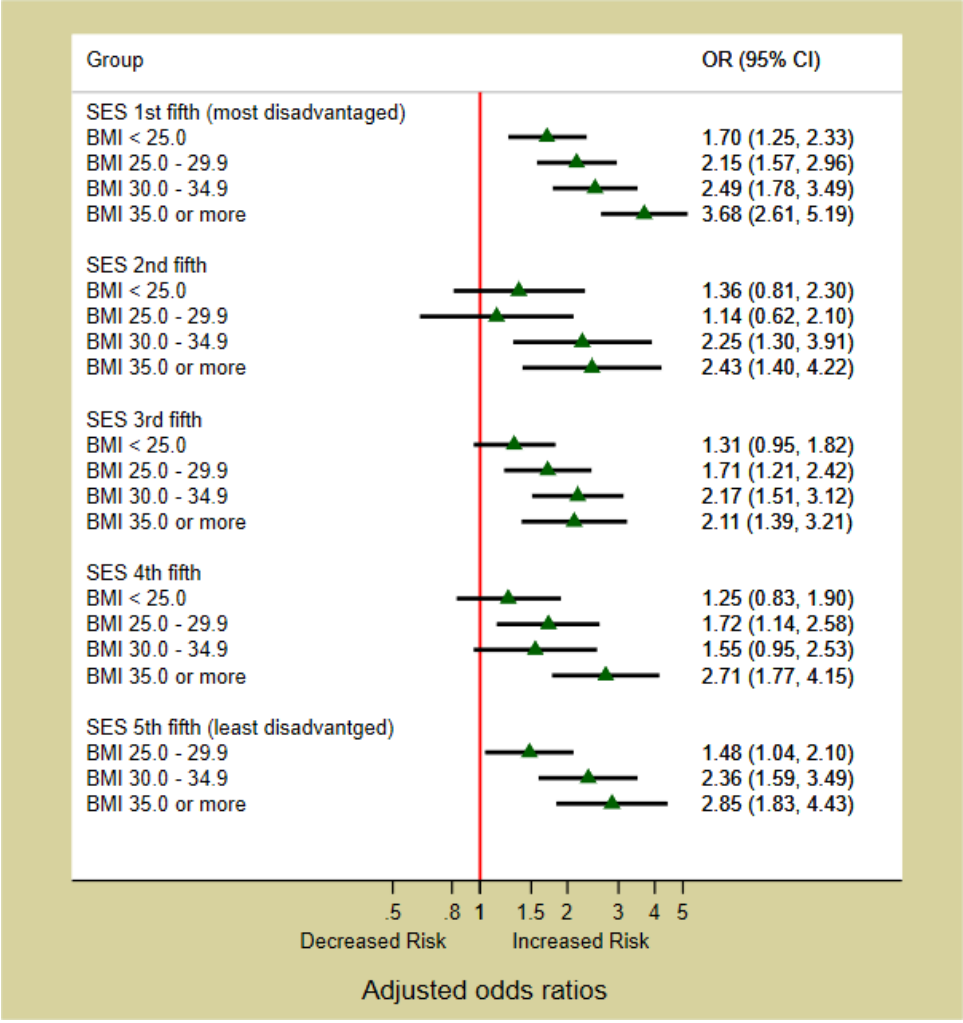

Figure 3 GEE model-based risk adjusted ORs of not breast feeding before hospital discharge by BMI and socioeconomic disadvantage categories (reference group: 'SES fifth quintile (least disadvantaged) and having a BMI <25.0'). BMI, body mass index; GEE, generalised estimating equations; SES, socioeconomic status.

to improvements in breast feeding and breast feeding rates is the recognition that promoting and supporting breast feeding 'is a collective societal responsibility'.[29] Women need support from their partner, their family, their community and their government to create and protect an environment of safety in which women are enabled and actively emboldened to breast feed their babies.

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Acknowledgements The authors thank all staff members who facilitated data acquisition especially Ms Jennifer Pitson.

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Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Ethics approval for the study was obtained from the Human Research Ethics Committees of the hospital and La Trobe University (reference number LNR/16/BHCG/50).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as online supplemental information.

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