Original Article

Predictors of delayed onset of lactation

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Abstract

The objective of this study was to identify biomedical and hospital-related factors associated with the delayed onset of lactation (>72 h postpartum) in a population of Australian women. Subjects were 453 women participating in the second Perth Infant Feeding Study. Information on mothers' perception of the timing of the onset of lactation and associated explanatory factors was collected in a questionnaire completed by women prior to or shortly after discharge from hospital. Multivariate logistic regression was used to identify those factors independently associated with delayed lactation. Risk factors for delayed lactation were being primiparous (adjusted OR 3.16, 95% CI 1.58–6.33) and having delivered by caesarean section (adjusted OR 2.40, 95% CI 1.28–4.51). We failed to find a negative association with maternal body mass index reported in previous studies. While a greater proportion of women who experienced delayed lactation were overweight or obese compared with those who did not experience delayed lactation (40.8% vs. 32.1%), this difference was not statistically significant.

Keywords: breastfeeding, perceived onset of lactation, parity, caesarean delivery, maternal obesity.

Introduction

The development of the breast as a secretory organ begins in pregnancy. The processes that occur are initiated by the rising levels of progesterone, prolactin and placental lactogen, and include an expansion of the lobular alveolar complexes and a rise in mRNA for many milk proteins and enzymes important to milk formation (Neville & Morton 2001). These physiological changes associated with pregnancy are collectively called stage I lactogenesis (LS-I), and at this point, the breast is in a state of readiness for secretion. However, it is not until the high levels of circulating progesterone fall abruptly with parturition that

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stage II lactogenesis (LS-II), or the onset of copious milk secretion, follows.

The sudden feeling of breast fullness is perceived by women as the 'coming in' of their milk and, for most, occurs some time between 48 and 72 h after birth (Pérez-Escamilla & Chapman 2001; Dewey *et al*. 2003). This large increase in milk volume is usually preceded, about 24 h beforehand, by dramatic changes in milk composition (Hartmann & Cregan 2001), which are indicative of LS-II. The gold standard for measuring LS-II is the measurement of the rate of milk synthesis by test weighing of infants before and after feeds (Pérez-Escamilla & Chapman 2001), although other researchers have used breast-milk biomarkers (Hartmann & Cregan 2001). Neither of these methods, however, is either practical or feasible in the context of a large-scale longitudinal study. Chapman & Pérez-Escamilla (2000) in a validation study assessed the onset of LS-II by both test weighing and maternal perception of onset of lactation (OL), and found the latter to be a valid clinical indicator of LS-II with a sensitivity and specificity of 71.4 and 79.3%, respectively. When studying factors associated with delayed OL, most researchers have categorized perceived timing of OL as either early (≤72 h postpartum) or delayed (>72 h postpartum) onset (Pérez-Escamilla & Chapman 2001).

As delayed OL has been independently associated with shorter breastfeeding duration (Chapman & Pérez-Escamilla 1999b; Hruschka *et al*. 2003; Oddy *et al*. 2006), it is important to identify potentially modifiable risk factors that predict OL in order that breastfeeding-promotion interventions can address these factors (Chapman & Pérez-Escamilla 1999a). A number of prospective studies have reported an independent negative association with parity, with primiparous women consistently reporting a feeling of breast fullness later than multiparous women (Pérez-Escamilla & Chapman 2001). Prelacteal formula feeding has been associated with a delay in the perception of OL (Chapman & Pérez-Escamilla 1999a), and breastfeeding frequency on day 2 postpartum was positively correlated with milk volume on day 5 postpartum in multiparous women, but not in first-time mothers (Chen *et al*. 1998). Both maternal and fetal stress during labour and delivery have been associated with poor early lactation performance (Chen *et al*. 1998; Chapman & Pérez-Escamilla 1999a; Dewey *et al*. 2003), and a number of studies have shown a direct relationship between maternal prepregnant body mass index (BMI) and delayed OL (Chapman & Pérez-Escamilla 1999a; Rasmussen *et al*. 2001; Dewey *et al*. 2003; Hilson *et al*. 2004). The objective of this study was to determine the incidence of, and investigate the sociodemographic and biomedical factors associated with, maternal perception of OL in a population of Australian women. In particular, we were interested in investigating the relation of maternal BMI and delayed OL.

Methods

Subjects were women participating in the second Perth Infant Feeding Study (PIFS II), which was a prospective longitudinal study. Women delivering at two public hospitals in Perth, Australia, between mid-September 2002 and mid-July 2003 were invited to participate in the study. The PIFS II was designed primarily to identify and investigate infant feeding patterns in the first year of life, and results and methodology have been reported elsewhere (Graham *et al*. 2005; Scott *et al*. 2006a,b). Data were collected at baseline on maternal perception of the OL, which allowed us to investigate factors associated with delayed OL in this secondary analysis of the data.

Attempts were made to visit all women delivering a live infant within the first 3 days following the birth of their infant. Women who had delivered an infant with a serious health problem requiring hospital transfer to a neonatal intensive care unit were excluded from the study. However, women whose infants were admitted to the special care nursery (SCN) of the participating hospitals for less-serious problems were eligible for recruitment.

The study was approved by the Human Ethics Committee of the Curtin University of Technology and the Research Ethics Committees of the two participating hospitals. Signed informed consent was obtained from participants. Confidentiality was assured, and mothers were advised that their participation was voluntary and that they could withdraw at any time without prejudice.

Data collection and categorization of delayed onset of lactogenesis

Participants completed a self-administered baseline questionnaire while in hospital or shortly after discharge from hospital. Of the 587 women participating in the PIFS II, 561 had ever breastfed their infant. These mothers were asked to indicate on what day following parturition their milk had 'come in'. Perceived timing of OL was categorized as either early or delayed (≤72 vs. >72 h postpartum) (Dewey *et al*. 2003).

As delayed OL was not the primary focus of the PIFS II, mothers were not requested to postpone completing the questionnaire until after 72 h postpartum, but were recommended to complete the questionnaire before discharge. As a result, 356 women had completed the baseline questionnaire at or after 72 h postpartum, and the remaining 205 women had completed the questionnaire before 72 h postpartum. We compared the characteristics of women according to whether they had completed their questionnaire before or after 72 h postpartum, and found no significant differences in any of the explanatory variables investigated in this analysis (data not presented). While a greater proportion of women who completed before 72 h postpartum were multiparous and had delivered vaginally, these differences failed to reach statistical significance. Of those women who had completed their questionnaire before 72 h postpartum, 108 were still waiting for their milk to come in, and the remaining 97 women had reported that their milk had come in. We then compared the characteristics of these two groups of women. As there were no statistical differences between the two groups for any of the explanatory variables being investigated in this analysis, the 97 women whose milk had come in were included in the analysis, bringing the total sample to 453 women.

Explanatory factors

A variety of maternal, infant and biomedical factors known or suspected to be associated with lactogenesis (Dewey 2001) were investigated. These included: maternal age, parity, whether the mother smoked prior to becoming pregnant, gestational age, delivery method, whether the infant was put to the breast within 30 min of birth, whether the infant received prelacteal feeds or had been admitted to the SCN following delivery, and the period of time that the infant roomed-in with the mother during the night while in hospital. Maternal prepregnancy BMI was calculated [weight (kg)/height (m)^2], using self-reported height and prepregnancy weight, and was categorized as low (BMI < 18.5 kg m^{-2}), healthy (BMI 18.5–24.99 kg m^{-2}), overweight (BMI 25.01–29.99 kg m^{-2}) and obese (BMI ≥ 30 kg m^{-2}). Women with a low BMI were categorized separately in order to detect a possible J-shaped curve, which might go undetected if these women were grouped with those with a BMI in the healthy weight range.

As breastfeeding is a health behaviour that may be influenced by attitudes and beliefs, each mother's attitude towards infant feeding was estimated by the Iowa Infant Feeding Attitude Scale (IIFAS) (De la Mora *et al*. 1999). The IIFAS is a 17-item scale which measures attitudes towards both breastfeeding and formula feeding with regards to the health and nutritional benefits, and the cost and convenience of each method, with a high score being indicative of favourable breastfeeding attitudes. The IIFAS has been shown previously to be a valid and reliable measure of infant feeding attitudes and predictor of breastfeeding outcome among women in the USA (De la Mora *et al*. 1999) and Scotland (Scott *et al*. 2004).

Statistical analysis

All data were entered and analysed using the Statistical Package for Social Sciences, Version 14 (SPSS for Windows, SPSS Inc., Chicago, IL, USA). Univariate logistic regression was used to explore the relation between delayed OL and each individual explanatory factor. Multivariate logistic regression was used to evaluate the independent relation between delayed OL and the explanatory variables. All variables were entered into the first step of the full model, and variables found to have a non-significant effect on the model were then removed in a backward stepwise fashion (P for removal < 0.05). All variables in the final model were variables for which, when excluded, the change in deviance compared with the corresponding chi-squared test statistic on the relevant degrees of freedom was significant.

Results

Only 53 (11.7%) of the 453 women included in the analysis reported delayed OL. Univariate analysis revealed that delayed OL was significantly associated with being primiparous, having a caesarean section, and having put an infant to breast for the first time 30 min or more after the birth (Table 1). While a greater proportion of women who experienced delayed OL were overweight or obese compared with those who did not experience delayed OL (40.8% vs. 32.1%), this difference was not statistically significant.

After controlling for potentially confounding factors, the only variables independently associated with delayed OL were method of delivery and parity (Table 2). Women who had undergone a caesarean section (adjusted OR 2.40, 95% CI 1.28–4.51), and

Table 1. Characteristics of subjects and crude odds ratio (95% confidence interval) for delayed onset of lactation

Variable	Onset of lactation				Crude OR	95% CI
	≤72 h		>72 h			
	Mean	SD	Mean	SD		
Maternal age (years)	28.2	5.6	29.7	5.1	1.04	0.99–1.10
Gestational age (weeks)	39.2	1.3	39.1	1.3	0.94	0.75–1.16
Mother's IIFAS*	65.4	7.5	65.7	7.0	1.01	0.97–1.04
	n	%	*n*	%		
First infant-to-breast contact						
<30 min	168	42.0	12	22.6	1.00	
≥30 min	232	58.0	41	77.4	2.48	1.26–4.85
Infant's first feed						
Colostrum/breastmilk	349	87.5	46	86.8	1.00	
Formula/other	50	12.5	7	13.2	1.06	0.45–2.48
Delivery method						
Vaginal delivery	280	70.4	27	50.9	1.00	
Caesarean delivery	118	29.6	26	49.1	2.28	1.28–4.08
Parity						
Multiparous	251	62.8	23	43.4	1.00	
Primiparous	149	37.3	30	56.6	2.19	1.23–3.92
Infant admitted to special care nursery						
No	342	87.2	50	94.3	1.00	
Yes	50	12.8	3	5.7	0.41	0.12–1.37
Night-time rooming-in						
All night	212	53.0	28	52.8	1.00	
Part of the night	144	36.0	19	35.8	0.99	0.54–1.86
Separated at night	44	11.0	6	11.3	1.03	0.40–2.64
Mother smoked during pregnancy						
No	249	62.3	28	53.3	1.00	
Yes	151	37.8	24	46.2	1.41	0.79–2.53
Mother's BMI (kg m^{-2})						
<18.5	32	8.3	1	2.0	0.26	0.03–1.94
18.5–24.99	229	59.6	28	57.1	1.00	
25.0–29.99	72	18.8	10	20.4	1.14	0.53–2.45
≥30	51	13.3	10	20.4	1.60	0.73–3.51

*Iowa Infant Feeding Attitude Scale (IIFAS): scores could range from 17 (indicative of attitudes which favour formula feeding) to 85 (indicative of attitudes favouring breastfeeding). BMI, body mass index.

Table 2. Independent predictors of delayed onset of lactation

Variable*†	Adjusted OR‡	95% CI	*P*-value
Delivery method			
Vaginal delivery	1.00		
Caesarean delivery	2.40	1.28–4.51	0.007
Parity			
Primiparous	3.16	1.58–6.33	0.001
Multiparous	1.00		
–2 Log likelihood 274.882			

*Variables in the full model were: maternal age, method of delivery, parity, gestational age, time by which the infant was first put to the breast, whether the infant had received prelacteal feeds or been admitted to the special care nursery, period of time the infant was with the mother during the night while in hospital, mother's BMI, whether the mother smoked prior to this pregnancy, and mother's total IIFAS score. †All variables in the final model were variables for which, when excluded, the change in deviance compared with the corresponding chi-squared test statistics on the relevant degrees of freedom was significant. ‡Adjusted odds ratios were derived from the logistic regression coefficients. BMI, body mass index; IIFAS, Iowa Infant Feeding Attitude Scale.

primiparous women (adjusted OR 3.16. 95% CI 1.58–6.33), were more likely to have experienced delayed OL. We failed to show an independent association between maternal overweight or obesity and delayed OL.

Discussion

The 11.7% incidence of delayed OL reported in this study was much lower than that reported for women in the USA (22–35%) (Chapman & Pérez-Escamilla 1999a; Dewey *et al.* 2003) and closer to that reported for Guatemalan women (10%) (Hruschka *et al.* 2003). This wide variation in the incidence of delayed OL between countries may point to cultural differences in birthing and infant feeding practices that, for example, promote early and frequent breastfeeding, possibly resulting in fewer cases of delayed OL.

It should be noted that it was not possible to estimate the 'true' incidence of delayed OL in the PIFS II, as 108 women who completed the questionnaire before 72 h postpartum were still waiting for their breastmilk to come in. If all of these women went on to experience OL before 72 h postpartum, then the incidence would have been as low as 9.4%. On the other hand, if all of these women experienced delayed OL, then the incidence would be as high as 28.7%. Both of these extreme scenarios are, however, unlikely. The incidence of delayed OL among the 356 women who completed the questionnaire after 72 h postpartum was 14%, and the 'true' incidence of OL is more likely to be closer to this figure, which is still markedly lower than the rates reported for women in the USA.

The contribution that milk removal and/or effective suckling make to delayed lactogenesis is unclear. Neville & Morton (2001) cite evidence from an early study of engorgement and changes in milk composition in non-breastfeeding women, suggesting that milk removal is 'not needed for the programmed physiological changes that bring about lactogenesis stage II' (p. 3007S). However, other studies have found that prelacteal formula feeding was associated with a delay in the perception of lactogenesis (Chapman & Pérez-Escamilla 1999a), and breastfeeding frequency on day 2 postpartum was positively correlated with milk volume on day 5 postpartum in multiparous women, but not in first-time mothers (Chen *et al.* 1998). In this study, we failed to find an independent association between delayed OL and prelacteal feeding, the length of time after the birth when the infant was first put to the breast, or any of the factors which we measured, which may either promote or interfere with effective suckling, such as 'rooming-in' and admission of the infant to the SCN.

We found that primiparous women were more likely to experience delayed OL than multiparous women. This finding is consistent with the results of a review which reported a consistently higher incidence of delayed OL among primiparous women compared with mulitparous women in a number of prospective studies (Pérez-Escamilla & Chapman 2001). Chapman & Pérez-Escamilla (2000), however, found no independent association between parity and delayed OL when delayed OL was determined by either milk transfer or maternal perception. But Dewey *et al.* (2003) reported an interaction between parity and birthweight. Primiparous women giving birth to a larger infant (>3600 g) were at greater risk for delayed OL compared with primiparous women giving birth to a smaller infant. Giving birth to a larger infant was not a significant risk factor for delayed OL among multiparous women.

Nevertheless, primiparous women have consistently reported in numerous studies a feeling of breast fullness later than multiparous women (Pérez-Escamilla & Chapman 2001), and in most studies, this finding is independent of delivery method. For instance, Chen *et al*. (1998) reported a mean OL of 54 h among multiparous women who delivered vaginally, compared with 89 h among primiparous women who delivered vaginally. This suggests that it may be normal for primiparous mothers to experience breast fullness after 72 h. Both health professionals and mothers need to be aware of this possibility, so that first-time mothers receive appropriate and continued support and encouragement until their breastmilk comes in, and any concerns about their inability to produce sufficient milk can be allayed.

Compared with women who had a vaginal delivery, those women who underwent a caesarean section were significantly more likely to experience delayed OL. We did not distinguish between an emergency caesarean section and a scheduled caesarean section, but in those studies that have, the incidence of delayed OL is significantly higher among women undergoing an emergency caesarean section (Chapman & Pérez-Escamilla 1999a; Dewey *et al*. 2003). Delayed OL has been associated also with prolonged (stage 2 labour) vaginal deliveries (Chapman & Pérez-Escamilla 1999a; Dewey *et al*. 2003). This is most likely related to the level of maternal and fetal stress associated with an emergency caesarean section or a protracted labour. Stress in labour is associated with higher cortisol levels in both the mother and the infant, which in turn have been linked to delayed OL (Chen *et al*. 1998). While emergency caesareans are by their nature unavoidable, women undergoing them should be targeted for closer postpartum breastfeeding support to assist them in successfully establishing breastfeeding prior to discharge from hospital. Women considering an elective caesarean should be advised of the possible negative effect of this operation on breastfeeding success.

We were particularly interested in investigating the effect of maternal obesity, which has been linked to impaired lactogenesis in both human (Chapman & Pérez-Escamilla 1999a; Dewey *et al*. 2003) and animal studies (Rasmussen 1998; Rasmussen *et al*. 2001). We failed, however, to find an association between delayed OL and being either overweight (adjusted OR 1.03, 95% CI 0.46–2.30) or obese (adjusted OR 1.43, 95% CI 0.61–3.35). Previously, Chapman & Pérez-Esamilla (1999a) have reported that women classified as having a heavy/obese build were three times more likely to have experienced delayed OL (adjusted OR 3.2 95% CI 1.5–6.7) compared with women classified as having a slim/average build. Similarly, Dewey *et al*. (2003) reported that mothers with a BMI > 27 kg m^{-2} were more than twice as likely to have delayed OL (adjusted RR 2.00, 95% CI 1.07–3.22) compared with women with a BMI ≤ 27 kg m^{-2}, even after controlling for the infant having suboptimal breastfeeding behaviour.

We further investigated the relation of BMI and delayed OL by entering BMI into the multivariate model as either a continuous or a dichotomous variable, using the cut-off point employed by Dewey *et al*. (2003) (BMI > 27 vs. BMI ≤ 27 kg m^{-2}), but failed to find a significant independent relationship in either case. We have, however, previously reported a weak, but significant negative association between BMI and exclusive breastfeeding at discharge from hospital among women in the PIFS II. While overweight and obese women were no less likely than women with a BMI < 25 kg m^{-2} to leave hospital breastfeeding, they were less likely to be discharged from hospital exclusively breastfeeding (P for trend = 0.047) (Scott *et al*. 2006b).

Hilson *et al*. (2004) calculated that a 1-unit (1 kg m^{-2}) increase in prepregnant BMI was associated with a 0.5-h delay in the onset of LS-II. While the mechanisms for this relationship are not fully understood, a recent study provides evidence that overweight and obese women have a lower prolactin response to suckling at 48 h (Rasmussen & Kjolhede 2004). Rasmussen and Kjolhede (2004) postulated that, as adipose tissues concentrate progesterone, obese women may have higher levels of progesterone, which would lead to a reduced prolactin response and a subsequent delay in the onset of LS-II. Although overweight and obese women had a significantly lower prolactin response to suckling than normal-weight women, no differences were seen in the levels of either progesterone or oestradiol and insulin at either 48 h or 7 days.

Obese women have been reported to experience greater mechanical difficulties of latching on, and proper positioning of, the infant (Rasmussen & Kjolhede 2004), and Lovelady (2005) argues that it is impaired suckling as a result of mechanical difficulties that leads to the diminished prolactin response and not elevated levels of circulating progesterone, suggesting a physical rather than a physiological mechanism. Despite initial difficulties, with lactation guidance the vast majority of overweight women are able to successfully establish exclusive breastfeeding (Dewey *et al*. 2003). Nevertheless, it is likely that in populations in which alternative methods of infant feeding are readily available, women may choose to offer infant formula to supplement their breastfeeds while they endeavour to establish breastfeeding (Rasmussen *et al*. 2001).

Our population differed from earlier studies investigating the relation between BMI and delayed OL in two ways. First, the proportion of women breastfeeding at hospital discharge was high at 93.8% (Graham *et al*. 2005), with 76.5% of women exclusively breastfeeding at discharge (Scott *et al*. 2006b). The rate of delayed OL reported in our study was closer to that reported for Guatemalan women, where the initiation of breastfeeding was also high (Hruschka *et al*. 2003). Conversely, higher rates of delayed OL have been reported in the USA, where breastfeeding initiation rates (Li *et al*. 2005) are lower than that reported in our study. While not investigated in this study, it may be that the higher incidence of breastfeeding in Australia was related to hospital practices that, for example, promote frequent and early breastfeeding, resulting in fewer cases of delayed OL.

Second, the prevalence of overweight and obesity was lower than that reported for other studies. Dewey *et al*. (2003) reported that 32% of their sample had a BMI > 27 kg m^{-2}, while in this study, only 25% of women had a BMI above this level. In fact, the prevalence of overweight or obesity (BMI > 25 kg m^{-2}) among women in our study was only 33%, which is more than 10% lower than the prevalence reported for women of child-bearing age (18–44 years) in the general Australian population. This is not necessarily unexpected, as the average age of mothers in our study was less than 30 years and it is well recognized that BMI increases with age. Furthermore, in our study BMI was calculated using self-reported weight and height, and people tend to under-report weight and over-report height, resulting in an underestimation of BMI (Spencer *et al*. 2002). This is a limitation of other studies (Hilson *et al*. 1997; Chapman & Pérez-Escamilla 1999a; Donath & Amir 2000; Baker *et al*. 2004) which have reported an association between maternal obesity and breastfeeding outcome.

Alternatively, the lower-than-average prevalence of overweight and obesity among our sample may represent a selection bias. However, there was no significant difference in either the age or level of maternal education between participants and non-participants in the PIFS II, suggesting that the sample was representative of the population from which it was drawn (Graham *et al*. 2005). While we did not collect data on self-reported weight and height from non-participants, we have no reason to believe that non-participants were more or less likely to be overweight or obese than participants.

Conclusions

Delayed OL was independently associated with primiparity and having had a caesarean section. Delayed OL has in turn been identified as a risk factor for the early cessation of breastfeeding. As such, women at increased risk of delayed OL should be warned of the possibility that lactation may not occur within the first 72 h and targeted for increased levels of postpartum breastfeeding support to help them establish exclusive breastfeeding prior to hospital discharge. While we did not find an association between maternal BMI and delayed OL reported in other studies, obese women do have increased mechanical difficulties with breastfeeding, and it therefore seems prudent to provide these women also with extra postpartum breastfeeding support.

Acknowledgements

This study was funded by the Australian Government Department of Health and Ageing. The authors declare no conflict of interest. The authors thank all of the women who participated in the PIFS II and Michele Robertson for advice regarding the statistical analyses.

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