

Emerging Trends in Breastfeeding Practices in Singaporean Chinese Women: Findings from a Population-based Study

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Abstract

Introduction: This study records the prevalence and patterns of breastfeeding in Singaporean Chinese mothers who gave birth between 2000 and 2008. **Materials and Methods:** The Strabismus, Amblyopia and Refractive Error in Singaporean Children (STARS) study is a population-based survey conducted in South-Western Singapore. Disproportionate random sampling by 6-month age groups of Chinese children born from 2000 to 2008 was performed. The mothers (n = 3009) completed a standard questionnaire which recorded the initiation, content, method and duration of breastfeeding. World Health Organization (WHO) definitions for feeding content were used: Replacement (exclusive commercial formula or any liquid or solid/semi-solid food, excluding breast milk), Complementary (breast milk, solid/semi-solid foods, and any non-human liquid), and Exclusive (breast milk only, without additional food, drink or water). STARS-specific definitions for feeding method were used: Expressed (breast milk only fed via bottle, with no additional food or non-human liquid), Combination (breast milk and non-breast milk, fed via bottle and breast), and Direct (breast milk only fed via breast). **Results:** Breastfeeding initiation (overall prevalence 77.0%) and duration increased over time, and were independently associated with higher maternal education: in 2000 and 2001, 68.6% of mothers initiated breastfeeding and 12.9% breast fed for ≤ 6 months, versus 82.0% and 26.7%, respectively, from 2006 to 2008; 47.4% of primary-school-educated women initiated breastfeeding, and 11.1% fed for ≥ 6 months, vs 90.9% and 35.3%, respectively, of university-educated women ($P < 0.001$). Expressed, Combination and Complementary feeding also increased, while Replacement feeding decreased ($P < 0.001$). There was no difference in breastfeeding patterns by the child's gender. **Conclusions:** In a population-based sample of Singaporean Chinese mothers giving birth from 2000 to 2008, breastfeeding initiation and duration increased over time and were independently associated with higher maternal education. This increase was associated with increased milk expression and complementary feeding. Thus awareness of breastfeeding benefits is rising in Singapore, but future health policies may need to target less-educated mothers.

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Key words: Complementary content, Education, Expression, Maternal-child health

Introduction

The health benefits of breast milk have been well documented, with positive implications for infants' metabolic, immunologic, respiratory and digestive health.¹ The World Health Organization (WHO) and the American Academy of Pediatrics recommend exclusive breastfeeding for 6 months and partial breastfeeding thereafter for at

least 12 or 24 months.² However, actual breastfeeding practices often fall short of these guidelines.³⁻¹² Prevalence of initial breastfeeding in Canada, the United States (US), Australia and Europe has been reported to be between 58% and 99.5%,³⁻⁶ with considerably lower rates of exclusive breastfeeding (2% to 67%)¹⁰⁻¹² and continuation of breastfeeding at 3 months (38% to 71%)^{4-6,12} and 6 months (19% to 52%).^{3-6,11,12}

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Within Asia (specifically, in studies in Taiwan, Hong Kong and Japan), the prevalence of initial breastfeeding has been reported to be between 45.7% and 84.4%,⁷⁻⁹ with exclusive breastfeeding in 9.6% to 43.8% of mothers.^{8,9} In Singapore, the hospital-based Singapore National Breastfeeding Survey 2001 (n = 2098) found that 94.5% of mothers initiated breastfeeding, with 71.6%, 49.6%, 29.8% and 21.1% continuing to breastfeed at 1, 2, 4 and 6 months, respectively.¹³

Commonly cited obstacles to breastfeeding are logistic (e.g. separation from infant due to maternal employment) and physical (e.g. mastitis, inflammation of the breast due to blocked milk ducts or excess milk).¹⁴ As females become a stronger presence in the workforce, logistic barriers to breastfeeding increase. Employed mothers also are more aware of the health benefits of breast milk;^{3,4} thus, presenting a unique challenge for the modern working mother. Breast milk expression can help mothers overcome this obstacle,¹⁵ and is common in the US,¹⁴ but has not been examined in Asia. In fact, no population-based studies have comprehensively evaluated the prevalence, method, content and duration of breastfeeding in Asian women. This information is particularly important today, as it could elucidate new breastfeeding patterns among increasingly educated, urbanised mothers in Asia, and more broadly in metropolitan centres worldwide.

Thus, we propose to document the prevalence, method, content and duration of breastfeeding from birth to 6 months, using a large population-based survey of Singaporean Chinese children aged 6 to 72 months recruited through the Strabismus, Amblyopia and Refractive Error in Singaporean Children Study (STARS).

Materials and Methods

Study Design and Population

Data were collected as part of STARS, a population-based study of Singaporean Chinese children aged 6 to 72 months, undertaken to estimate the prevalence and risk factors for these eye conditions. Eligible participants included Chinese children aged 6 to 72 months residing in Housing Development Board (HDB) apartments in Southwestern Singapore, recruited from addresses obtained from the Singapore Ministry of Home Affairs.

Disproportionate stratified random sampling was conducted by 6-month age groups. Children with chronic medical or mental conditions, or who were not living at the address for the past 5 months, were excluded. All eligible children were invited to participate through mailed invitations, followed by house (door-to-door) visits by trained staff. A total of 3009 children participated in the study (participation rate 72.3%). All clinical examinations and parent interviews were performed by trained professionals

from May 2006 to October 2008, with assessments conducted at 2 sites within the study area, the Singapore National Eye Centre and the Jurong Medical Centre.

Human subject's research approval was obtained from the Institutional Review Boards of the Singapore Eye Research Institute and the National Healthcare Group, and the study was conducted according to the tenets of the Declaration of Helsinki. Informed written consent was obtained from all parents after a subject information sheet and detailed explanation of the study were given by an optometrist.

Interview

A comprehensive questionnaire was administered by trained interviewers in the English or Chinese language. Information on demographics, pregnancy history, medical history and lifestyle factors was obtained. Parents were asked about breastfeeding initiation (yes/no), method of administration (via bottle/breast/both), content (breast milk/non-breast milk/both), and duration (<6/≥6 months, <3/≥3 months, never). Questionnaire completion averaged 30 minutes.

Definitions

The 1996 and 2003 World Health Organization (WHO) definitions for content were used: "Exclusive Breastfeeding" included breast milk only, without additional food, drink or water; "Complementary Feeding" consisted of breast milk, solid/semi-solid foods, and any non-human liquid; and "Replacement Feeding" consisted of exclusive commercial formula or any liquid or solid/semi-solid food, excluding breast milk.¹⁶ STARS-specific definitions for feeding method were also used: "Expressed Feeding" included breast milk only fed via bottle, with no additional food or non-human liquid; "Combination Feeding" included breast milk and non-breast milk, fed via bottle and breast; and "Direct Feeding" included breast milk only fed via breast.

Statistical Analysis

The association between breastfeeding initiation and participant characteristics was determined using the Student's *t*-test. The association between breastfeeding method and content and participant characteristics was determined using the Fisher's analysis of variance (ANOVA) test. Multiple linear regression analysis of breastfeeding initiation was completed, with adjustment for the child's gender, birth year, birth weight, birth history, and maternal age, educational level, and health history during pregnancy. Goodness of fit test was employed to justify the appropriateness of the fitted multiple logistic model. Statistical significance was defined as *P* value <0.05. Analyses were conducted using SAS 9.1.3 Service Pack 3 (SAS Institute Inc, Cary, NC) and SPSS version 16 (SPSS Inc, Chicago, IL).

Results

Demographics

A total of 3009 children [1570 (52.2%) boys and 1439 (47.8%) girls] aged 6 to 72 months (mean age = 40.5 months) were examined in the STARS study. There was no significant difference between participants ($n = 3009$) and non-participants ($n = 1155$) for age ($P = 0.98$) and gender ($P = 0.67$). There was a difference between participants and non-participants for study recruitment area ($P < 0.001$), with more participants being from study areas nearer to the examination sites.

Initiation and Method of Breastfeeding

Overall, 77.0% of mothers in STARS initiated

breastfeeding. There was no difference in breastfeeding initiation by child's gender (76.2% of males versus 77.8% of females; $P = 0.30$). Breastfeeding initiation was associated with more recent birth year (Table 1, Fig. 1), and with higher maternal education (Table 2) ($P < 0.001$ for both).

The method of feeding (Replacement/Expressed/Combination/Direct) was also associated with birth year and the mother's educational level ($P < 0.001$ for both).

Expressed and Combination methods of feeding were higher in more recent birth years and more highly educated mothers, while Replacement feeding was lower (Tables 1 and 2). Direct feeding decreased over time and was unchanged by maternal education (Tables 1 and 2). No gender differences were observed ($P = 0.73$).

Table 1. Initiation and Method of Breastfeeding for Singaporean Chinese Children Being Examined in the STARS Study, Overall and by Birth Year of Child, $n = 3008$, $P < 0.001$

Child's birth year	Initiation of breastfeeding (any method) n (%) [*]	Method of feeding breast milk			
		Replacement feeding [†] n (%)	Expressed feeding n (%)	Combination feeding n (%)	Direct feeding n (%)
2000-2001	144 (68.6%)	66 (31.4%)	18 (8.6%)	54 (25.7%)	72 (34.3%)
2002-2003	782 (73.9%)	276 (26.1%)	166 (15.7%)	311 (29.4%)	305 (28.8%)
2004-2005	853 (78.6%)	232 (21.4%)	157 (14.5%)	407 (37.5%)	289 (26.6%)
2006-2008	538 (82.0%)	118 (18.0%)	118 (18.0%)	269 (41.1%)	142 (21.7%)
Overall ($N = 3008$)	2317 (77.0%)	692 (23.0%)	467 (15.5%)	1041 (34.6%)	808 (26.9%)

* Prevalence within each birth-year group (i.e. row percentage).

† "Replacement Feeding" is defined as exclusive commercial infant formula or combined with any liquid or solid/semi-solid food, but excluding breast milk. "Expressed Feeding" is defined as mother's breast milk fed via bottle, with no additional food or non-human liquid such as formula. "Combination Feeding" is defined as breast milk and non-breast milk fed via bottle and breast. "Direct Feeding" is defined as breast milk only via breast, with no additional food or non-human liquid.

Table 2. Initiation and Method of Breastfeeding for Singaporean Chinese Children Being Examined in the STARS Study, by Mother's Educational Level, $n = 2964$, $P < 0.001$

Maternal education	Initiation of breastfeeding (any method) n (%) [*]	Method of feeding breast milk			
		Replacement feeding [†] n (%)	Expressed feeding n (%)	Combination feeding n (%)	Direct feeding n (%)
None	5 (45.5%)	6 (54.5%)	1 (9.1%)	0 (0.0%)	4 (36.4%)
Primary school	90 (47.6%)	99 (52.4%)	23 (12.2%)	17 (9.0%)	50 (26.5%)
Secondary school	253 (60.7%)	164 (39.3%)	48 (11.5%)	77 (18.5%)	128 (30.7%)
O / N level	449 (72.4%)	171 (27.6%)	95 (15.3%)	179 (28.9%)	175 (28.2%)
A levels / Polytechnic/ Diploma/ ITE/ Certificate	734 (83.7%)	143 (16.3%)	153 (17.4%)	341 (38.9%)	240 (27.4%)
University education	757 (90.9%)	76 (9.1%)	144 (17.3%)	411 (49.4%)	201 (24.2%)
Other education	15 (83.3%)	3 (16.7%)	2 (11.1%)	9 (50.0%)	4 (22.2%)

* Prevalence within each maternal-education group (i.e. row percentage).

† "Replacement Feeding" is defined as exclusive commercial infant formula or combined with any liquid or solid/semi-solid food, but excluding breast milk. "Expressed Feeding" is defined as mother's breast milk fed via bottle, with no additional food or non-human liquid such as formula. "Combination Feeding" is defined as breast milk and non-breast milk fed via bottle and breast. "Direct Feeding" is defined as breast milk only via breast only, with no additional food or non-human liquid.

Table 3. Duration of Breastfeeding for Singaporean Chinese Children Being Examined in the STARS Study, Overall and by Birth Year of Child, $n = 3007$, $P < 0.001$

Child's birth year	Duration of breastfeeding			
	Never n (%)	<3 months n (%)	>3 months, <6 months n (%)	>6 months n (%)
2000-2001	66 (31.4%)	99 (47.1%)	18 (8.6%)	27 (12.9%)
2002-2003	276 (26.1%)	506 (47.9%)	102 (9.6%)	173 (16.4%)
2004-2005	232 (21.4%)	456 (42.1%)	139 (12.8%)	257 (23.7%)
2006-2008	118 (18.0%)	285 (43.4%)	78 (11.9%)	175 (26.7%)
Overall (N = 3007)	692 (23.0%)	1346 (44.8%)	337 (11.2%)	632 (21.0%)

* Prevalence within each birth-year group (i.e. row percentage).

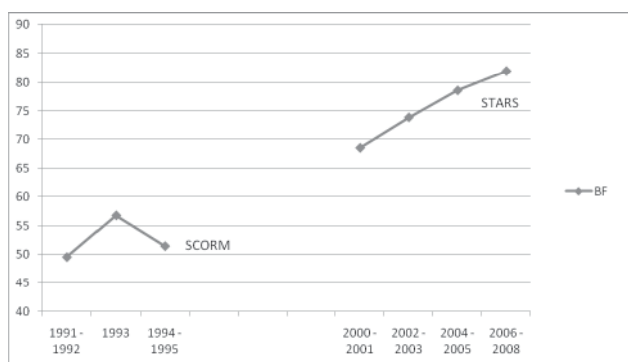


Fig. 1. Prevalence (%) of breastfeeding* over time in Singapore, as recorded in the Singapore Cohort Study of the Risk Factors for Myopia (SCORM)¹⁸ and the STARS study.

* Refers to breastfeeding initiation (including Exclusive and Complementary feeding, via any feeding method).

Content of Breastfeeding

Feeding content (Replacement/Complementary/Exclusive) changed with birth year and maternal education ($P < 0.001$ for both). In 2000 and 2001, 52.4% of mothers practiced Complementary feeding, versus 66.1% in 2006 to 2008; over the same period, Replacement feeding decreased from 31.4% to 18.0%. Similarly, 20.4% and 70.5% of university-educated women practiced Exclusive and Complementary breastfeeding, respectively, versus 12.8% and 34.6% of primary-school-educated women. Meanwhile, 9.1% of university-educated mothers practiced Replacement feeding, versus 52.7% of primary-school-educated women. Exclusive feeding did not change with birth year, and no gender effects were seen ($P = 0.26$).

Duration of Breastfeeding

From 2000 to 2008, the proportion of children being breast fed <3 months decreased, and the proportion of children being fed >3 or >6 months increased ($P < 0.001$) (Table 3). This trend also was seen with higher maternal education: 53.5% of university-educated mothers breast

fed ≤3 months, and 35.3% for ≥6 months, compared to 14.8% and 11.1%, respectively, of primary-school-educated mothers ($P < 0.001$). No gender effects were seen ($P = 0.52$ and 0.56 for </≥ 3 months and </≥ 6 months, respectively).

Predictive Factors for Breastfeeding Initiation

Univariate analyses showed that child's gender, birth weight and birth history, and maternal age, dialect and health during pregnancy, were not significantly associated with breastfeeding initiation. In multiple linear regression analysis, the child's age and maternal education were associated with breastfeeding initiation (Table 4).

Discussion

In this population-based sample of Singaporean Chinese mothers, breastfeeding initiation and duration increased with a more recent birth year, and were independently associated with higher maternal education. This increase was associated with a higher prevalence of breast milk expression and complementary feeding.

This study provides the most recent data available on Singapore breastfeeding practices, and is, to our knowledge, the only population-based study of mothers to comprehensively document initiation, method, content, and duration of breastfeeding in Singapore. It is possible that the observed cohort and maternal-education effects represent not only local trends, but broader 21st century breastfeeding patterns. Thus, these findings are relevant to health policies worldwide as urbanisation, female employment and education rise.

Initiation, Content and Method of Breastfeeding

This study reports a similar prevalence (77.0%) of breastfeeding initiation to that reported in Canada³ and Taiwan,⁸ higher prevalence than in the US,⁴ and lower than in Australia and Europe (Fig. 2).^{5,6,17} Our prevalence is higher than that reported in the Singapore Cohort Study of the Risk Factors for Myopia (SCORM), in which 49% to 57% of Singaporean women giving birth from 1991 to 1995 reported

breastfeeding (Fig. 1).¹⁸ It is also higher than the 36% to 60% of Singaporean mothers who reported breastfeeding in 1985,^{19,20} but lower than the 94.5% of mothers who reported breastfeeding in the National Breastfeeding Survey 2001.¹³ The 1985 Singapore data were based upon local surveys with relatively small sample sizes. The 2001 Singapore

Table 4. Factors associated with Initiation of Breastfeeding in Mothers of Singaporean Chinese Children Being Examined in the STARS Study

Adjusted covariates *	Adjusted odds ratio (95% CI)	Regression coefficient (β)	P
Child's birth year	0.99 (0.99, 1.00)	-0.01	<0.001
Child's gender			
Male	1.00 (reference)		
Female	1.05 (0.87, 1.27)	0.05	0.59
Child's birth weight	1.00 (1.00, 1.00)	0.00	0.21
Maternal age	1.00 (0.98, 1.02)	0.00	1.00
Child's birth history			
No complications	1.00 (reference)		
Complications	1.08 (0.70, 1.67)	0.08	0.72
Mother's health history during pregnancy			
No complications	1.00 (reference)		
Complications	1.21 (0.92, 1.62)	0.19	0.18
Mother's educational level			
None	1.00 (reference)		
Primary	1.35 (0.31, 5.89)	0.30	0.69
Secondary	2.13 (0.50, 9.17)	0.76	0.31
O/N-level	3.90 (0.91, 16.73)	1.36	0.07
A-level	7.65 (1.78, 32.88)	2.04	0.01
University	14.65 (3.38, 63.47)	2.69	<0.001
Other education	6.80 (1.01, 45.87)	1.92	0.05

* Multiple linear regression analysis of breastfeeding initiation, with adjustment for all factors in the table. Goodness of fit test was employed to justify the appropriateness of the fitted multiple logistic model.

survey was limited by low response rate (36.3%), immediate post-delivery recruitment, and over-representation of highly educated mothers,¹³ making the sample less representative of the Singapore population than the population-based STARS study. The SCORM population also included other races in addition to Chinese, which would tend to result in higher breastfeeding prevalence, as Malay and Indian mothers have shown higher rates of breastfeeding than Chinese mothers.^{19,20} However, the multi-ethnic SCORM population (1991 to 1995) shows a lower breastfeeding prevalence compared to the all-Chinese STARS cohort (2000 to 2008); thus, further suggesting a true increase in breastfeeding prevalence over time in Singapore.

The association of maternal education with breastfeeding initiation is consistent with previous studies.^{5,7,13,21,22} However, this is the first time that maternal education has been evaluated in relation to breastfeeding content in Asian women. We report higher rates of Complementary feeding in more educated women and in more recent birth years. In all educational levels and birth years within STARS, Complementary feeding prevalence (34.6% to 66.1%) was higher than in the Avon Longitudinal Study of Parents and Children (ALSPAC), which reported Complementary feeding in 22% of English-educated mothers giving birth from 1991 to 1992.¹⁶ The higher prevalence of Complementary feeding in STARS compared to early-1990s English-educated mothers suggests that a cohort effect may be occurring more broadly than just in Singapore or Asia.

Regarding breastfeeding methods, breast milk Expression and Combination feeding are common practices among Singaporean women, and are more common in more highly educated women. This is similar to the US, where expression was reported in 68% of US mothers in the 2005 to 2007 Infant Feeding Practices Study II.¹⁴

Duration of Breastfeeding

We observe a longer duration of breastfeeding in more highly educated mothers and in more recent birth years,

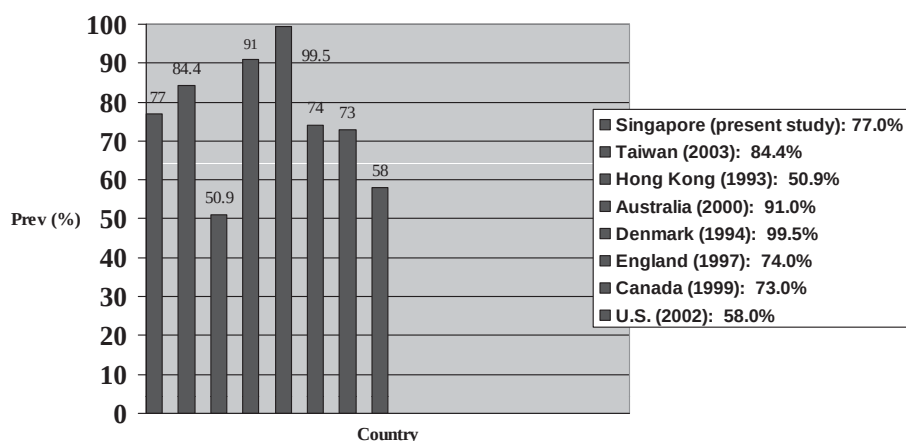


Fig. 2. Prevalence of breastfeeding initiation* in Singapore in comparison to other countries.†

* Breastfeeding initiation includes Exclusive and Complementary feeding, via any feeding method.

† For countries with more than one prevalence survey, only the most recent is pictured.

consistent with previous hospital- and population-based studies.^{4,7,13,21,23,24} The prevalence of breastfeeding at 3 and 6 months in our study (56% and 21%, respectively) is higher than that reported in Hong Kong (4.2% at 5 months).⁹ It is similar to that seen in Taiwan (12.9% to 39.7% at 6 months),⁷ the US (19% to 32.5% at 6 months),^{4,25} and in the control group of a randomised controlled trial in Singapore (49% and 34% at 3 and 6 months, respectively).²⁶ It is lower than that of developed countries with predominantly Caucasian populations, including European countries (42% to 71% at 3 months, 19% to 52% at 6 months),^{5,12} Australia (44% to 68% at 3 months, 50% to 52% at 6 months),^{6,27-29} and Canada (38% to 59% at 3 months, 31% to 41% at 6 months).^{3,30} It is also lower than the mean prevalence of 94 developing countries in UN regions worldwide (86% at 6 months), and specifically in the Asian region (87.5% at 6 months).³¹

Thus breastfeeding duration exhibits not only Asia-West differences, but also socioeconomic variation within the Asian region. Specifically, duration is lower in Singapore compared to developing Asian countries, despite the higher educational status of Singaporean women; within Singapore, however, duration increases with maternal education. This supports the idea that higher maternal education (and presumably higher employment and out-of-home activities) in developed countries makes it more difficult for mothers to continue breastfeeding; within a given developed country, however, educated mothers are more aware of breastfeeding benefits and thus breastfeed longer than their less-educated counterparts.

Emerging Patterns

Interestingly, the increase in initiation and duration of breastfeeding, as well as Expressed, Combination and Complementary feeding, was not accompanied by an increase in Exclusive or Direct breastfeeding. Instead, Exclusive and Direct breastfeeding prevalence in Singapore remains low, consistent with the 2001 National Breastfeeding Survey¹³ and the prevalence in the US.²⁶ Exclusive breastfeeding prevalence in Singapore and the US is lower than in Europe, Africa, Australia and the Western Pacific.^{10-12,28,32,33}

The fact that breast milk Expression and Combination/Complementary feeding account for the increased breastfeeding initiation in STARS suggests that a cultural or logistic shift may be occurring in Singapore. Increasingly educated Singaporean mothers may be aware of the health benefits of breast milk, but also may have higher employment status and more out-of-home activities, making direct feeding difficult. A practical compromise, and the trend seen in our data, is to practice Expression and Complementary or Combination feeding. This view is supported by the association of Expressed and Combination feeding with

a more recent birth year and higher maternal education in our study.

Next Steps for Research

The causes underlying breastfeeding patterns are multifactorial, and likely involve interplay between social, economic, cultural and professional factors, in addition to the temporal and educational factors identified in this study. For example, breastfeeding patterns may be influenced by mothers' work practices and workplace support structures, by male-female gender roles, and by social perceptions of breastfeeding. Thus, future studies could investigate the specific effect of maternal leave, part- versus full-time employment, and workplace support on breastfeeding practices, the impact of different male and female roles on breastfeeding and the effect of societal approval on mothers' willingness to breastfeed. In addition, it would be informative to complete a nationalised breastfeeding assessment in the entire Singapore population (including Chinese, Malay, and Indian mothers) in order to comprehensively document breastfeeding practices in Singapore.

Strengths and Limitations

There are several important strengths to this study. Firstly, it is population-based, undertaken on a large representative sample of Singaporean Chinese children in Southwestern Singapore. Secondly, the clinical questionnaire gathered data on feeding method in addition to content, allowing us to holistically assess overall feeding trends. Thirdly, the children were born from 2000 to 2008, making this the most recent data available on Singapore breastfeeding patterns.

However, the STARS study is not without limitations. Most notable is the cross-sectional nature of data collection; thus, allowing for recall bias in mothers' recollection of pregnancy and feeding practices that occurred months to years earlier. Some variables of interest are unavailable from our data, such as psychosocial factors like job strain and family duties. Although participants and non-participants were similar in age and gender, there may be unmeasured differences which yield slightly different results than would be attained with 100% participation. Lastly, certain neighbourhoods are more heavily represented in our sample due to proximity to the examination sites.

Concluding Thoughts and Potential Interventions

Our study provides valuable documentation of recent breastfeeding patterns in Singaporean women. The disparity in practices between women of different educational levels suggests that even in populations with good access to medical care, such as in Singapore, additional programmes may be needed to reach mothers of lower educational status. For example, antenatal breastfeeding education and

postnatal lactation support both have been shown to improve initiation, duration, and rates of exclusive breastfeeding in Singaporean women.²⁶ Such programmes could be instituted on a national level in Singapore's many community centres, which already offer social and educational programmes, and which are widely used by people of all age groups, and are located conveniently near residents' HDB apartments. In addition, workplace initiatives may be helpful to support breastfeeding, such as paid maternity leave, temporary transitions from full-time to part-time positions, lactation support groups, and work-based prenatal education sessions. Such initiatives could prevent work from being a primary obstacle to breastfeeding, as has been reported previously in Singaporean women.³⁴ Thus, knowledge of breastfeeding patterns can shape health policies among a new generation of mothers who face logistic, educational and professional barriers to breastfeeding.

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