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# An investigation of prepregnancy body mass index, ethnicity and health-related quality of life as predictors of breastfeeding exclusivity during early postpartum period: Cross sectional survey

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ABSTRACT

*Background:* Identifying and understanding the determinants of breastfeeding exclusivity during early postpartum period are crucial for sustainable breastfeeding. Few researchers have examined the association among prepregnancy body mass index, ethnicity and exclusive breastfeeding. As a result, whether or not these factors exhibit different relationship patterns across body mass index groups remains unclear.
*Objectives:* This study was performed to: (1) test the relationships among prepregnancy body mass index, ethnicity, health-related quality of life, maternal and obstetric characteristics and exclusive breastfeeding; and (2) compare the relationships among these study variables for two body mass index groups.
*Design:* Exploratory cross-sectional research design.
*Setting:* Two postnatal wards of a university-affiliated hospital.
*Participants:* A total of 715 postpartum multi-ethnic women in Singapore.
*Methods:* We used structural equation modelling with multigroup analysis to examine our hypothetical model, which integrated the concepts of breastfeeding initiation and health-related quality of life conceptual models. A 12-item short form health survey was used to assess the health-related quality of life.
*Results:* The structural equation modelling showed that women with following factors were significantly less likely to initiate exclusive breastfeeding: being Chinese ($\beta$ = -0.10, $p < 0.05$), having high body mass index ($\beta$ = -0.11, $p < 0.01$), living with low household income ($\beta$ = -0.08, $p < 0.05$) and exhibiting poor health-related quality of life scores ($\beta$ = 0.17, $p < 0.001$). Multigroup analysis showed no difference (critical ratio = 0.061) between the parameter estimates of health-related quality of life on exclusive breastfeeding in the two body mass index groups. Health-related quality of life ($\beta$ = 0.17, $p < 0.001$) and monthly household incomes ($\beta$ = -0.11, $p < 0.05$) were the only significant factors in the normal body mass index group. All structural equation modelling values satisfactorily fitted the data (Goodness of Fit Index = 0.937–0.954, Incremental Fit Index = 0.937–0.945, Tucker–Lewis Index = 0.906–0.917, Comparative Fit Index = 0.936–0.942 and Root Means Square Error of Approximation = 0.027–0.040).
*Conclusions:* Enhancing postpartum health-related quality of life and prepregnancy weight management are crucial to initiate exclusive breastfeeding. Our findings can guide the development of promising health promotion strategies among Chinese women with low household income.


## What is already known about the topic?

- A high prepregnancy body mass index is linked to detrimental effects on childhood physical and cognitive development and decreased attitude, confidence, efficacy and duration of breastfeeding among women.
- Postpartum health-related quality of life is critical because it affects the functioning capacity of mothers to take care of themselves and their infant feeding decisions.

## What this paper adds

- Women with high body mass index have low exclusive breastfeeding during early postpartum period.

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- Chinese women with low monthly household income and poor postpartum health-related quality of life are less likely to initiate exclusive breastfeeding.
- Our multigroup analysis showed no difference among the parameter estimates of postpartum health-related quality of life on breastfeeding exclusivity in the two body mass index groups.

## 1. Introduction

With obesity becoming a worldwide epidemic (Ng et al., 2014), high prepregnancy body mass index ($\geq$ 25 kg/m$^2$) (World Health Organization, 2016) has received increasing concern. Approximately 45% of women worldwide have high prepregnancy body mass index (World Health Organization, 2016), and similar trends have emerged in the last decade (Ng et al., 2014). A high prepregnancy body mass index is linked to detrimental effects on childhood physical and cognitive development (Adane et al., 2016) and decreased attitude, confidence, efficacy and duration of breastfeeding among women (Babendure et al., 2015; Lau et al., 2017; Turcksin et al., 2014). Breastfeeding is the best source of nutrition for infants, and the World Health Organization recommends that all mothers should exclusively breastfeed their infants for six months (World Health Organisation, 2011). Given the short- and long-term breastfeeding benefits for mothers, children, family and communities (Victora et al., 2016), identifying and understanding the determinants of breastfeeding exclusivity during early postpartum period are crucial for sustainable breastfeeding (Balogun et al., 2015). Our research team wants to expand previous knowledge (Lau et al., 2017) on different relationship patterns among breastfeeding attitude, health-related quality of life and maternal obesity across different body mass index groups from antenatal to postnatal populations.

### 1.1. Factors relating breastfeeding exclusivity across different body mass index groups

Age, marital status, educational level, employment status, monthly household income, antenatal booking, pregnancy planning and parity are important maternal and obstetric variables related to breastfeeding exclusivity according to systematic reviews (Balogun et al., 2015; Boccolini et al., 2015; Esteves et al., 2014). However, whether or not these factors exhibit different relationship patterns across body mass index groups remains unclear. Different ethnic groups show multifarious cultural beliefs and practices that may influence their breastfeeding pattern (Masho et al., 2015; Pang et al., 2016). Although ethnicity may be a predictor of breastfeeding exclusivity (Jones et al., 2015; Pang et al., 2016), only a few researchers have established the link between prepregnancy body mass index, ethnicity and breastfeeding exclusivity (Masho et al., 2015; Thompson et al., 2013). Researchers in one United States study found different relationships between prepregnancy body mass index and breastfeeding initiation across different ethnic groups (Masho et al., 2015), but another United States research group showed that the relationship between prepregnancy body mass index and breastfeeding initiation do not significantly vary by ethnicity (Thompson et al., 2013). Inconclusive findings (Masho et al., 2015; Thompson et al., 2013) suggested further investigation. If different body mass index groups exhibit different patterns of relationships, then helping priority groups who require additional attention is essential to maximally improve breastfeeding exclusivity.

### 1.2. Health-related quality of life and breastfeeding exclusivity in postpartum period

Health-related quality of life refers to general health perception and functioning capabilities related to changes in health status (Ferrans et al., 2005; Ware et al., 1995) and is a broad multidimensional concept that offers a comprehensive perspective of health (Ferrans et al., 2005). Dramatic physical, psychological and social changes that characterise early postpartum period considerably influence the health-related quality of life (Van der Woude et al., 2015). Postpartum health-related quality of life is critical because it affects the functioning capacity of mothers to take care of themselves and their infant feeding decisions. Evidence about the relationship between health-related quality of life and breastfeeding exclusivity during early postpartum period is scant. Researchers in Taiwan showed that mother's health-related quality of life is significantly related to breastfeeding at six months (Chen et al., 2007). Another study found no significant differences in health-related quality between feeding groups at six-month postpartum in Spain (Triviño-Jua'rez et al., 2016). Owing to the significant changes that occur in the health-related quality of life across the postpartum period (Emmanuel and Sun, 2013), the effects of this parameter on breastfeeding exclusivity during early postpartum period remain unclear. Thus, additional work must be further conducted to contribute to the existing body of knowledge.

According to the aforementioned issues, the extent to which a relationship exists among prepregnancy body mass index, maternal and obstetric characteristics, ethnicity, postpartum health-related quality of life and breastfeeding exclusivity during early postpartum period has not been fully evaluated until now. We aimed to determine any difference among body mass index groups. This study attempted to fill the literature gaps regarding specific relationship patterns in the entire population and across two body mass index subgroups.

### 1.3. Conceptual framework and hypothetical model

A hypothetical model (Fig. 1) was developed by integrating the concepts of the breastfeeding initiation (Dusdieker et al., 1985) and health-related quality of life conceptual models (Ferrans et al., 2005). The breastfeeding initiation model identified that breastfeeding exclusivity is multifactorial (Dusdieker et al., 1985) and health-related quality of life model explained the elements and the causal relationships among them (Ferrans et al., 2005). In addition, we adopted some concepts from a hierarchical theoretical model to postulate the maternal and obstetric factors associated with exclusive breastfeeding from a systematic review (Boccolini et al., 2015). We proposed this hypothetical model because of empirical (Balogun et al., 2015; Boccolini et al., 2015; Esteves et al., 2014) and theoretical (Boccolini et al., 2015; Dusdieker et al., 1985; Ferrans et al., 2005) support for the hypothetical relationships of study variables. Fig. 1 schematically illustrates how health-related quality of life, prepregnancy body mass index, ethnicity (Chinese, Malay and Indian), maternal (age, marital status, educational level, employment status and monthly household income) and obstetric (antenatal booking, planning of pregnancy and parity) characteristics are related to breastfeeding exclusivity during early postpartum period.

To our best knowledge, only a few researchers have examined the health-related quality of life, prepregnancy body mass index, ethnicity, maternal, obstetric characteristics and breastfeeding exclusivity amidst normal weight and high prepregnancy body mass index by using a multi-group structural equation modelling (SEM) approach. The present study is designed to address our hypothetical assumption by providing theoretical and empirical consideration. We selected SEM approach to simultaneously analyse the effects among the constructs in our hypothetical model (Byrne, 2013; Kline, 2015). SEM can assess latent variables at the observation level and test hypothesised relationships among latent variables at the theoretical level (Kline, 2015). A multi-group

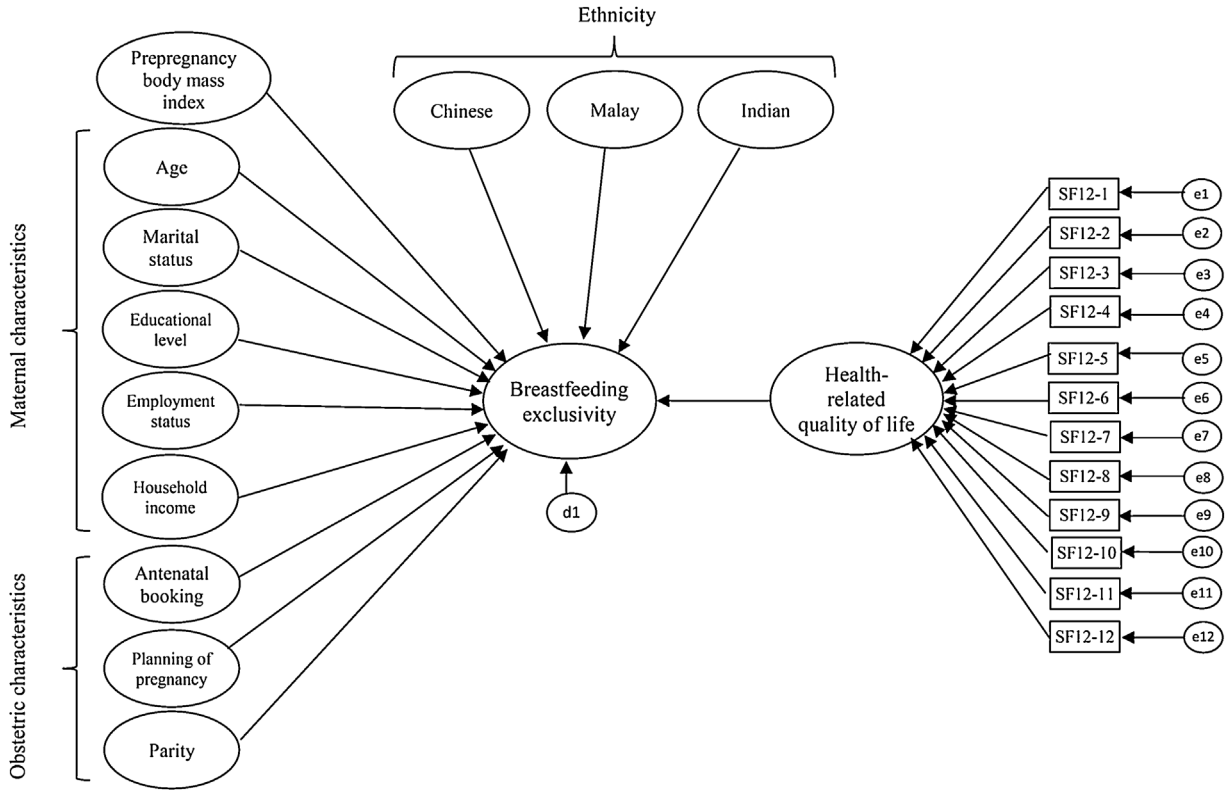


**Fig. 1.** A hypothetical model.
Note: SF12, health-related quality of life; e, error term; d, residue term.

SEM is a robust statistical technique to compare the distinct features of the estimate parameters of subgroups (Deng and Yuan, 2015). Multi-group analysis is adopted to identify the variation across different body mass groups (Bou and Satorra, 2010).

The objectives of this study were as follows: (1) to test the relationships among prepregnancy body mass index, ethnicity, health-related quality of life, maternal and obstetric characteristics, and exclusive breastfeeding; and (2) to compare the relationships among the study variables between two body mass index groups.

## 2. Materials and methods

This study employed an exploratory cross-sectional quantitative design. Multi-ethnic postpartum women in Singapore were our target population. Singapore is a multi-ethnic and multicultural Southeast Asian country with a population of over 5.7 million people. Chinese, Malay, and Indian are the three main ethnic groups (Pang et al., 2016). The sample size was determined by the given latent variables ($n$ = 2) and observable variables ($n$ = 24) to achieve a power of 0.80, an anticipated effect size of 0.25 and a probability level of 0.05 (Soper, 2019). A minimum sample size of 136 for each group was required to detect the structural complexity of the model (MacCallum et al., 1996). A sample size of 715 postpartum women was recruited from private and subsidised postpartum wards of one university-affiliated hospital with a delivery rate of 2935 deliveries/year. Convenience sampling and a 1:1 ratio from these two postpartum wards were adopted because of the different socio-economic characteristics. Postpartum women who can read and understand English were included. Exclusion criteria are as follows: (1) maternal severe psychiatric illness and physical disabilities, (2) women with major breast surgery preventing establishment of effective breast feeding and (3) babies with congenital health problems.

### 2.1. Data collection

Postpartum women were recruited from September 2013 to November 2015 after obtaining approval from the Institutional Review Board. Researchers first used eligibility criteria to screen the obstetric records for all women in two postnatal wards. An experienced research assistant approached eligible women individually and explained the study using the information sheets of patients. Women who agreed to participate were asked to complete the self-administered structured questionnaire in 15–20 min. The completed questionnaires were collected with no identifiers. Thus, the Institutional Review Board waived the required informed consent. Participation in the study was voluntary and anonymous.

### 2.2. Measurements

Prepregnancy body mass index was calculated as the prepregnant weight in kilograms divided by the height in meters squared based on self-reported weight and height. Women were categorised into two body mass index groups, namely, normal body mass index (18.5–24.9 $kg/m^2$) and high body mass index groups ($\geq$ 25.0 $kg/m^2$) (World Health Organization, 2016). Breastfeeding exclusivity during the early postpartum period referred to feeding at the breast or feeding with expressed breast milk within 1 h–72 h postpartum. Maternal and obstetric variables including age, ethnicity, marital status, educational level, employment status, household income, antenatal booking, pregnancy planning and pregnancy number were collected according to previous

systematic reviews (Balogun et al., 2015; Boccolini et al., 2015; Esteves et al., 2014).

Health-related quality of life was measured using the 12-item medical outcome study short form health survey (SF-12) (Ware et al., 1995). This survey is a simplified version of the original 36-item short form health survey (SF-36) and explained more than 90% of the variance of the physical and mental components of the SF-36 (Ware et al., 1995). Physical components include limitation experienced when performing moderate activities and accomplishing less because of bodily pain, whereas mental components include doing activities less carefully than usual, feeling calm, peaceful, downhearted and blue (Ware et al., 1995). This tool evaluates the general health perception that consists of eight dimensions, namely, physical functioning, role physical, bodily pain, general health, vitality, social functioning role and emotional and mental health. The SF-12 generated physical and mental component summary scores ranging from 0 to 100, in which high scores indicated a superior state of health-related quality of life. Construct validity was confirmed across ethnic groups (Jenkinson et al., 2001). The reliability and validity of the SF-12 were satisfactory (Luo, 2003; Ware, 1996). The Cronbach $\alpha$ of the SF-12 was 0.76 in this study, indicating acceptable internal consistency.

### 2.3. Statistical analysis

Data were analysed using IBM SPSS 25.0 (IBM Corporation, Armonk, New York, USA). Expectation–maximization technique was used to replace missing data. Chi-square ($\chi^2$) and independent sample $t$ tests were used to compare maternal and obstetric characteristics, ethnicity, SF-12 scores and exclusive breastfeeding between two prepregnancy body mass index groups. SEM using maximum likelihood estimation was performed to assess the fit of the hypothetical model with the data and parameter estimates free of the influence of measurement errors in AMOS 25.0 (Byrne, 2013; Kline, 2015). SEM approach was used to test the structural relationships between measured variables and latent constructs of the modelled phenomenon for connecting theoretical concepts to empirical data (Kline, 2015). We used multi-group SEM to test similarity or difference in the parameter estimates in the two body mass index groups (Deng and Yuan, 2015). Normally distributed data are typically required when using full information maximum likelihood in SEM (Kline, 2015). Skewness and kurtosis values within the range of $\pm$ 2 indicate normally distributed variables (Gravetter and Wallnau, 2014).

A three-step approach was used to estimate the proposed model based on our theoretical assumption (Kline, 2015). In the first step, exploratory factor and confirmatory factor analyses were performed to confirm the acceptable fit of SF-12. A factor loading ($\lambda$) > 0.3 of each item is considered relevant for the particular factor (Byrne, 2013; Kline, 2015). Secondly, a hypothetical SEM was performed to test the structural relationship between constructs (Byrne, 2013). Thirdly, a multi-group SEM was used to test the critical ratio for the differences between the pairwise parameters of health-related quality of life on the breastfeeding exclusivity estimates of the two body mass index groups. If the critical ratio for the differences between the two groups is between -1.96 and +1.96 using pairwise parameter comparison (Arbuckle, 2017; Byrne, 2013), then the null hypothesis is accepted ($H_0$). If the critical ratio is beyond $\pm$ 1.96, then $H_0$ is rejected (Arbuckle, 2017; Byrne, 2013). Modification indices were applied to improve the goodness-of-fit of the model with the misspecification evidence associated with pairing error terms (Kline, 2015). The recommended cut-off values for goodness-of-fit are as follows: Goodness of Fit Index > 0.90, Incremental Fit Index > 0.90, Tucker–Lewis index > 0.90, Comparative Fit Index > 0.90 and Root Means Square Error of Approximation < 0.06 (Hu and Bentler, 1999; Kline, 2015; Schermelleh-Engel et al., 2003).

## 3. Results

A total of 831 eligible women were invited from two postnatal wards, and 715 of them completed the questionnaires (response rate 86%). The missing data were less than 4% for all items and were managed by expectation–maximization technique. Table 1 shows the comparison of participant characteristics between the two body mass index groups. The prevalence of women with body mass index $\geq$ 25.0 kg/m$^2$ and < 25.0 kg/m$^2$ were 25.9% and 78.6%, respectively. The ethnic composition of women comprised Chinese (38.7%), Indians (21.7%), Malays (19.4%), Caucasian (7.3%), Eurasian (0.8%) and other ethnic groups (12.0%). The majority (78.6%) of women initiated exclusive breastfeeding. The mean and standard deviation of physical and mental components of health-related quality of life were 42.00 $\pm$ 8.65 and 52.17 $\pm$ 8.22, respectively. Ethnicity, household income $\leq$ S$5000 and exclusive breastfeeding were significantly different between the two body mass index groups according to the chi-square test ($p <$ 0.01).

The skewness and kurtosis results of SF-12 ranged from -1.641 to 0.287 and from

-1.933 to 0.864, respectively. These results indicated that the variables were normally distributed and thus fulfilled the use of complete information maximum likelihood in SEM (Kline, 2015). A series of exploratory factor and confirmatory factor analyses was conducted to confirm the acceptable fit of SF-12 in the initial step. Exploratory factor analyses showed a one-factor structure for SF-12 in this study, and 12 items were fitted for the original eight dimensions. Factor loadings ($\lambda$) ranged from 0.32 to 0.59, indicating acceptable values (Kline, 2015). Confirmatory factor analyses showed satisfactory fit indices for SF-12 (Goodness of Fit Index = 0.962, Incremental Fit Index = 0.953, Tucker–Lewis index = 0.938, Comparative Fit Index = 0.953 and Root Means Square Error of Approximation = 0.057) after the model re-specification by correlating error terms according to empirical rationales (Byrne, 2013).

In the second step, SEM was used to test the entire sample as hypothesised. Prepregnancy body mass index ($\beta$ = -0.11, $p <$ 0.01), monthly household income $\leq$ S$ 5000 ($\beta$ = -0.08, $p <$ 0.05), Chinese ($\beta$ = -0.10, $p <$ 0.05) and health-related quality of life ($\beta$ = 0.17, $p <$ 0.001) were significantly related to breastfeeding exclusivity as shown in Fig. 2. In the third step, we compared the differences between the pairwise parameters of health-related quality of life estimates on breastfeeding exclusivity of the two body mass index groups by using a multi-group SEM. Fig. 3 reveals that health-related quality of life ($\beta$ = 0.17, $p <$ 0.001) and monthly household income ($\beta$ = -0.11, $p <$ 0.05) were significantly associated with breastfeeding exclusivity among women with normal weight but not among women with high prepregnancy body mass index as shown in Fig. 4. The critical ratio result was 0.061, indicating no differences between health-related quality of life estimates on the breastfeeding exclusivity of the two body mass index groups. The models fitted the data satisfactorily (Goodness of Fit Index = 0.937–0.954, Incremental Fit Index = 0.937–0.945, Tucker–Lewis index = 0.906–0.917, Comparative Fit Index = 0.936–0.942 and Root Means Square Error of Approximation = 0.027–0.040). However, age, marital status, educational level, employment status, antenatal booking, pregnancy planning and parity showed no significant impact ($p >$ 0.05) on the breastfeeding exclusivity in this study.

## 4. Discussion

The authors investigated the different patterns of relationships affecting breastfeeding exclusivity across body mass index groups using a multi-group SEM. This study contributed to the literature in several ways. Firstly, women with high prepregnancy body mass

**Table 1**
Comparison of participants' characteristics among two prepregnancy body mass index groups ($N = 715$).

| | Entire sample N = 715 N (%) | Normal prepregnancy body mass index group n = 530 n (%) | High prepregnancy body mass index group n = 185 n (%) | *p*-value |
|---|---|---|---|---|
| Maternal characteristics | | | | |
| Age (M ± SD) | 30.73 ± 3.89 | 30.78 ± 3.87 | 30.60 ± 3.94 | 0.597[a] |
| Ethnicity | | | | |
| Chinese | 277 (38.7) | 238 (44.9) | 39 (21.1) | 0.00[b,**] |
| Malay | 139 (19.4) | 79 (14.9) | 60 (32.4) | |
| Indian | 155 (21.7) | 104(19.6) | 51 (27.6) | |
| Caucasian | 52 (7.3) | 40 (7.5) | 12 (6.5) | |
| Eurasian | 6 (0.8) | 4 (0.8) | 2 (1.1) | |
| Others | 86 (12.0) | 65 (12.3) | 21(11.4) | |
| Marital status | | | | |
| Married | 697 (97.5) | 515 (97.2) | 182 (98.4) | 0.585[b] |
| Single/divorced/separated | 18 (2.5) | 15 (2.8) | 3 (1.6) | |
| Educational level | | | | |
| ≥Secondary | 691 (96.6) | 512 (96.6) | 179 (96.8) | 0.92[b] |
| <Secondary | 24 (3.4) | 18 (3.4) | 6 (3.2) | |
| Employment status | | | | |
| Part-timer or homemaker | 270 (37.8) | 206 (38.9) | 64 (34.6) | 0.302[b] |
| Full-timer | 445 (62.2) | 324 (61.1) | 121 (65.4) | |
| Household income | | | | |
| ≤S$5000 | 328 (45.9) | 231 (43.6) | 97 (52.4) | 0.038[b,*] |
| >S$5000 | 387 (54.1) | 299 (56.4) | 88 (47.6) | |
| Obstetric characteristics | | | | |
| Antenatal booking | | | | |
| <12 weeks | 465 (65.0) | 344 (64.9) | 121(65.4) | 0.902[b] |
| ≥ 12 weeks | 250 (35.0) | 186 (35.1) | 64 (34.6) | |
| Planning of pregnancy | | | | |
| Planned | 363 (50.8) | 276 (52.1) | 87 (47.0) | 0.237[b] |
| Unplanned | 352 (49.2) | 254 (47.9) | 98 (53.0) | |
| Parity | | | | |
| Primiparous | 379 (53.0) | 283 (53.4) | 96 (51.9) | 0.724[b] |
| Multiparous | 336 (47.0) | 247 (46.6) | 89 (48.1) | |
| Health related quality of life (M ± SD) | | | | |
| Physical health (PCS) | 42.00 ± 8.65 | 42.28 ± 8.81 | 41.20 ± 8.13 | 0.144[a] |
| Mental health (MCS) | 52.17 ± 8.22 | 52.08 ± 8.58 | 52.42 ± 7.11 | 0.594[a] |
| Breastfeeding exclusivity | | | | |
| Yes | 562 (78.6) | 430 (81.1) | 132 (71.4) | 0.01[**,b] |
| No | 153 (21.4) | 100 (18.9) | 53 (28.6) | |

*Note*: BMI, Body Mass Index; PCS, Physical component summary; MCS, Medical component summary; M(SD), mean (standard deviation); S, Singapore dollar (S$1 = £0.55 GBP).
[a] Independent *t* test.
[b] $\chi^2$ = chi-square test.
[*] $p < 0.05$.
[**] $p < 0.01$.

index had a low exclusive breastfeeding rate. Malay and Indian women showed a higher body mass index compared with Chinese and other ethnic groups. Chinese women with low monthly household income and poor postpartum health-related quality of life were less likely to initiate exclusive breastfeeding during early postpartum period.

### 4.1. Postpartum women with high body mass index in Singapore

The prevalence of high prepregnancy body mass index among postpartum women was 25.9% in the current study. This figure was similar to our previous study on antenatal women (Lau et al., 2017), and this prevalence was lower than the 45% worldwide (World Health Organization, 2016); such discrepancies may be related to different compositions of ethnic groups and inconsistent age ranges between Singapore and other countries. The Ministry of Health estimates that trends are increasing at 1% per year in Singapore, especially among Indian and Malay women. This pattern was consistent with our results, wherein the proportion of high prepregnancy body mass index was higher among Indian and Malay women than among Chinese women. This result may be due to the increased saturated fat and high-density food in Indian and Malay diets (Neelakantan et al., 2016). Indian and Malay women were more likely to have increased sedentary behaviour and were physically inactive during pregnancy compared with Chinese women (Padmapriya et al., 2015).

### 4.2. High prepregnancy body mass index and breastfeeding exclusivity

We found that women with high prepregnancy body mass index were significantly less likely to initiate exclusive breastfeeding during early postpartum period. This finding was similar to the breastfeeding pattern at three months in Brazil (Castillo et al., 2016). This phenomenon may be linked to the large breasts of women with high prepregnancy body mass index that increases the likelihood of breastfeeding practicality and mechanical difficulties (Babendure et al., 2015; Turcksin et al., 2014) and negatively affects milk production and secretion. Psychosocial factors that decrease breastfeeding exclusivity among high prepregnancy body mass index women (Hauff et al., 2014; Lyons et al., 2018), such as reduced confidence in their breastfeeding goals, decreased social support, and dissatisfactory body image, could also explain this finding. Another possible reason is the delay in the onset of copious milk production and less prolactin

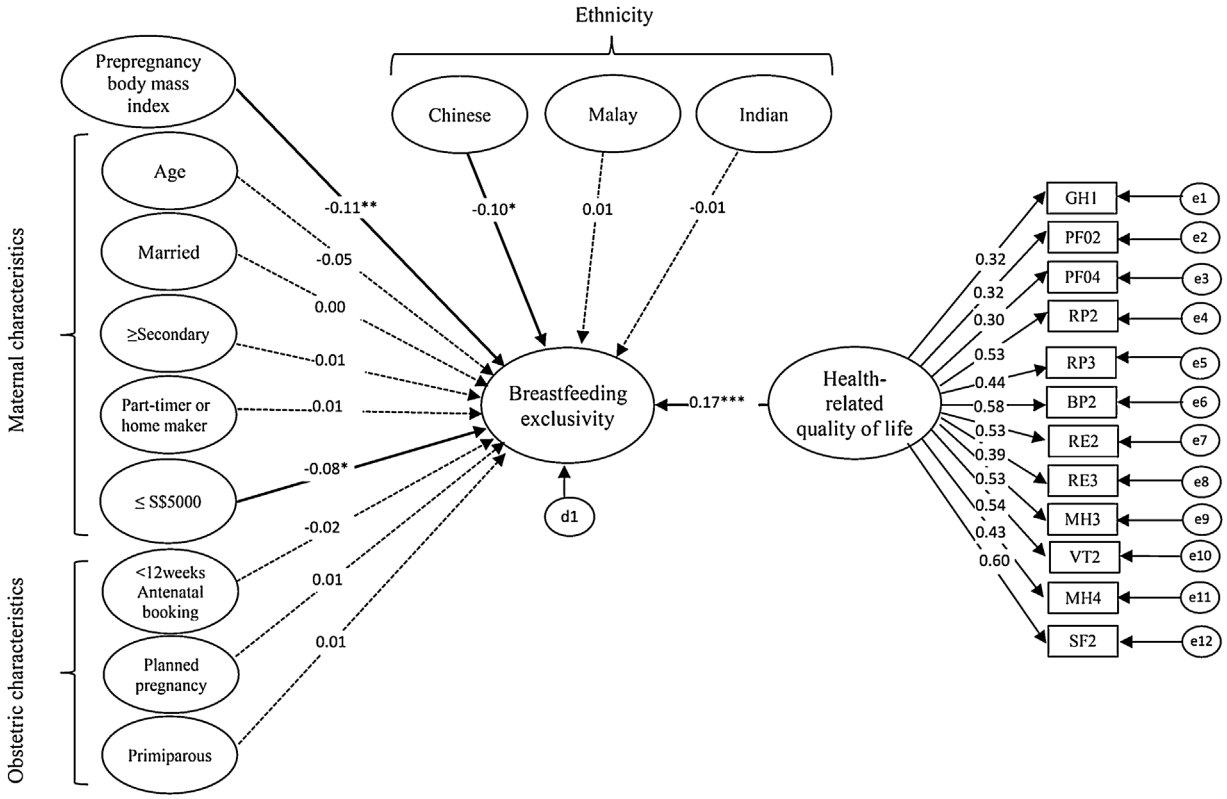


**Fig. 2.** Structural equation model analysis among entire group (N=715).
Note. GH, general health; PF, physical functioning; RP, role physical; BP, bodily pain; RE, role emotional; MH, mental health; VT, vitality; SF, social functioning; e, error term; d, residue term; solid line, significant; dash line, non-significant.

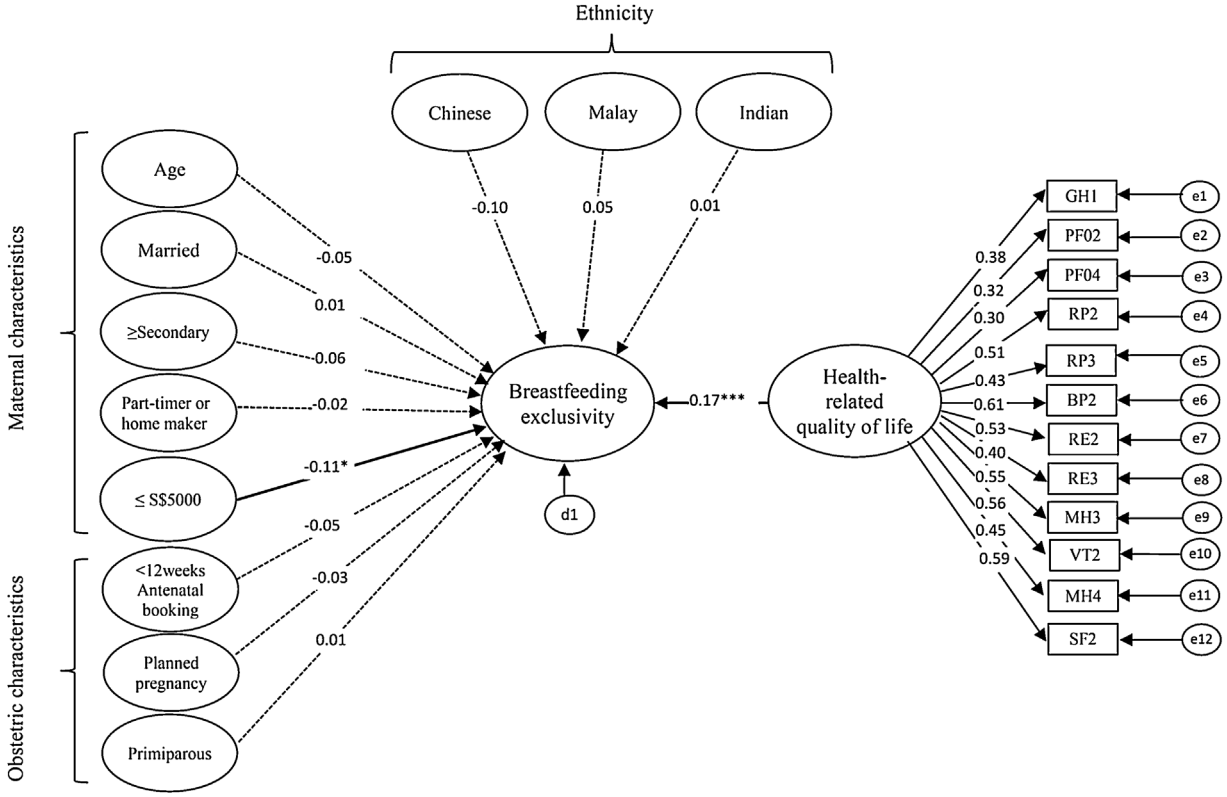


**Fig. 3.** Multi-group analysis among normal BMI group (n = 530).
Note. GH, general health; PF, physical functioning; RP, role physical; BP, bodily pain; RE, role emotional; MH, mental health; VT, vitality; SF, social functioning; e, error term; d, residue term; solid line, significant; dash line, non-significant.

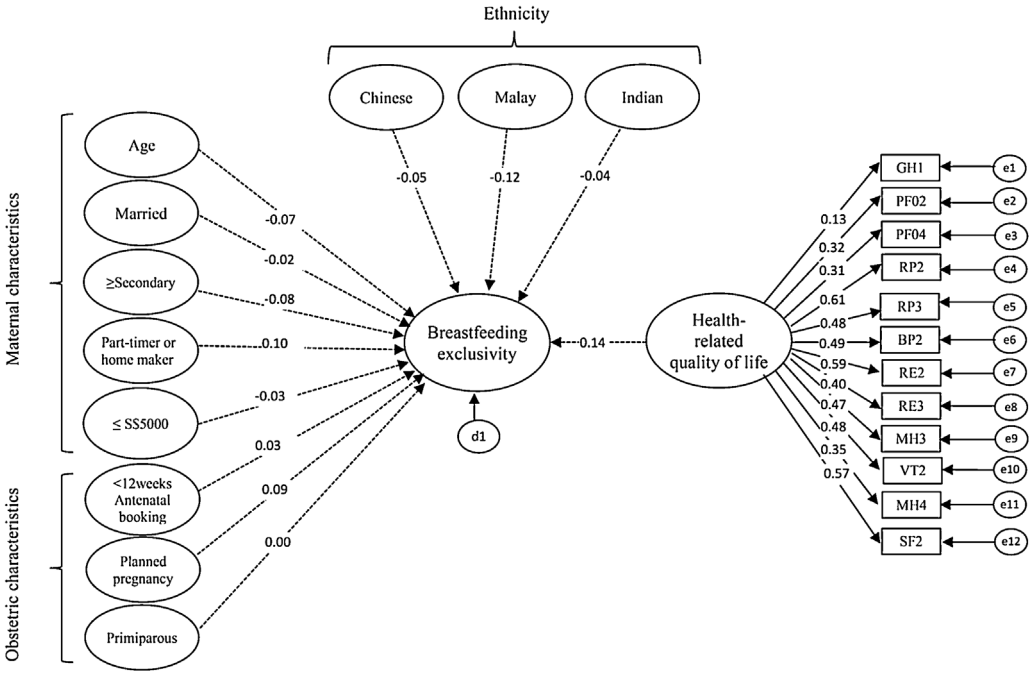


**Fig. 4.** Multi-group analysis among high BMI group (n = 185).
Note. GH, general health; PF, physical functioning; RP, role physical; BP, bodily pain; RE, role emotional; MH, mental health; VT, vitality; SF, social functioning; e, error term; d, residue term; solid line, significant; dash line, non-significant.

responses to suckling among women with high body mass index (Babendure et al., 2015).

### 4.3. Health-related quality of life and exclusive breastfeeding

We found that women with low postpartum health-related quality of life were less likely to initiate exclusive breastfeeding among the entire sample population and normal body mass index group. This finding added to the scant evidence on the relationship between postpartum health-related quality of life and breastfeeding exclusivity during the early postpartum period. This result was also consistent with our previous study among antenatal population (Lau et al., 2017) indicating that women with low health-related quality of life are significantly likely to have negative breastfeeding attitude. Given that health-related quality of life of women might worsen after delivery during early postpartum period (Emmanuel and Sun, 2013), poor breastfeeding attitude negatively affects breastfeeding exclusivity (Linares et al., 2015; Lyons et al., 2018). Women with low health-related quality of life experience breastfeeding difficulties in early postpartum period (Mortazavi et al., 2014). Breastfeeding difficulties, including insufficient milk supply, nipple/breast pain and cracked nipples or mastitis, were associated with decreased breastfeeding exclusivity (Mortazavi et al., 2014). Conversely, women with good health-related quality of life are more likely share their feelings with others and seek additional social and family support (Chen et al., 2007; Triviño-Jua'rez et al., 2016), which are crucial determinants of breastfeeding exclusivity. Another possible explanation related to women with high health-related quality of life to having increased breastfeeding self-efficacy (Zubaran and Foresti, 2013) is that women with high breastfeeding self-efficacy tend to initiate exclusive breastfeeding.

Our multi-group SEM showed no difference among the parameter estimates of postpartum health-related quality of life on breastfeeding exclusivity in the two body mass index groups. The summary scores of physical and mental components were similar in both groups, which can explain the non-significant relationship. The physical component of health-related quality of life was below average (41.2–42.28) among all postpartum women, and these results were consistent with those observed in a previous systematic review (Van der Woude et al., 2015). Our findings indicated that postpartum women exhibited impaired physical health during early postpartum period, which may be related to sleeping disturbance, tiredness, wound pain and fatigue after birth (Van der Woude et al., 2015). However, we need to speculate underlying reasons in further investigation. No significant factors were related to breastfeeding exclusivity in the high prepregnancy body mass index group. Although the cause is unknown, exclusive breastfeeding in the high body mass index group may be influenced by other factors. Further studies are necessary to derive additional evidence-based knowledge on postnatal women with high prepregnancy body mass index.

### 4.4. Ethnicity and breastfeeding exclusivity

This result was in congruence with those of previous studies (Masho et al., 2015; Pang et al., 2016). Ethnicity was a significant predictor of breastfeeding exclusivity in the current study. In this multi-ethnic population, Chinese women were less likely to initiate exclusive breastfeeding but more likely to feed their children with a combination of direct and expressed breastfeeding compared with Malay and Indian mothers (Pang et al., 2016). A high portion of Chinese mothers reported breastfeeding pain, suggesting their breastfeeding difficulties (Pang et al., 2016). Another possibility is that many Chinese women (46.7%) were working mothers compared with Malays (18.0%) and Indians (16.9%) in the current sample. Working Chinese women may perceive lack of support from their employment after their return to work and embarrassment about breastfeeding status, which might be related to their low breastfeeding exclusivity (Desmond and Meaney, 2016).

### 4.5. Family household income and breastfeeding exclusivity

Consistent with our previous study among antenatal women (Lau et al., 2017), low household income was a consistent barrier to initiate exclusive breastfeeding among entire postpartum women and normal body mass index group. Women with low household income were deficient in socioeconomic resources, especially insufficient social support and poor nutritional quality (Gazso and McDaniel, 2015), which may serve as a reason for relatively lower breastfeeding exclusivity. Additional financial restraint may be caused by a stressful family situation considering a new infant was added into a low income family. Stressed women have inhibited secretion of prolactin and oxytocin (Zhu et al., 2013), and this biological mechanism may suppress the initiation of lactation (Zhu et al., 2013). Women with low household income are less likely to initiate exclusive breastfeeding.

## 5. Implications for practice

Despite the aforementioned limitations, our study provided new evidence on the relationships among prepregnancy body mass index, maternal and obstetric characteristics, ethnicity, health-related quality of life and breastfeeding exclusivity during early postpartum period across body mass index groups. Our findings included important clinical implications for culturally appropriate breastfeeding promotion program among Chinese women. Considering that this study involved more than 25% of women with high prepregnancy body mass index, we noted that health professionals needed focus on women with high body mass index regarding their infant feeding decisions. We recommend providing a clinical checklist for screening this high-risk group during pregnancy and designing a body mass index-specific discharge plan to sustain exclusive breastfeeding on discharge from hospital. Poor physical health-related quality of life was identified as a factor influencing breastfeeding exclusivity. Thus, we must consider creating effective interventions to enhance the physical health-related quality of life of mothers during the vulnerable period following childbirth.

## 6. Limitations

Firstly, self-reported prepregnancy body mass index and health-related quality of life may be subjected to recall and social desirability biases. Secondly, a cross-sectional design cannot determine a causal relationship between study variables, and a convenient sample in a single setting limits the generalisability of findings. To expand the depth and scope of the design, we need to conduct a longitudinal design among a randomised sample in multiple settings to understand the mechanisms in the relationships. Thirdly, we investigated variables in this study but failed to address several other potential factors that may influence breastfeeding exclusivity, such as mode of delivery, obstetric complications, social support, sleeping and fatigue. Thus, further studies are warranted.

## 7. Conclusion

We considered our findings to add evidence on the relationship among high prepregnancy body mass index, ethnicity, postpartum health-related quality of life and exclusive breastfeeding. Chinese women with high prepregnancy body mass index, low monthly household income and poor health-related quality of life are less likely to initiate exclusive breastfeeding. Further investigation would benefit from examining the possible factors affecting breastfeeding exclusivity in high prepregnancy body mass index groups. Enhancing the health-related quality of life and a culturally-sensitive intervention for Chinese women with low household income can improve their breastfeeding exclusivity during the early postpartum period.

## Conflict of interest

The authors declare that they have no competing interests.

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## Ethical approval

Institution Review Board of University – Affiliated Hospital reviewed and approved this study (NHG DSRB: 2013/00513).

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