# Dietary changes during pregnancy and the postpartum period in Singaporean Chinese, Malay and Indian women: the GUSTO birth cohort study

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## Abstract

*Objective:* To examine changes in food consumption during pregnancy and the postpartum period in women of major Asian ethnic groups.

*Design:* Using interviewer-administered questionnaires, we assessed changes in food consumption during pregnancy (26–28 weeks' gestation) and the postpartum period (3 weeks after delivery) as compared with the usual pre-pregnancy diet.

*Setting:* Singapore.

*Subjects:* Pregnant women (*n* 1027) of Chinese, Malay and Indian ethnicity (mean age 30·4 (SD 5·2) years) who participated in the Growing Up in Singapore Towards healthy Outcomes (GUSTO) study.

*Results:* During pregnancy, participants tended to increase their consumption of milk, fruit and vegetables and decrease their consumption of tea, coffee, soft drinks and seafood (all $P < 0.001$). Most participants reported adherence to traditional restrictions ('confinement') during the early postpartum period (Chinese: 94·8%, Malay: 91·6%, Indian: 79·6%). During the postpartum period, participants tended to increase their consumption of fish and milk-based drinks and decrease their consumption of noodles, seafood, and chocolates and sweets (all $P < 0.001$). Ethnic differences in food consumption were pronounced during the postpartum period. For example, most Chinese participants (87·2%) increased their ginger consumption during the postpartum period as compared with smaller percentages of Malays (31·8%) and Indians (40·8%; *P* for ethnic difference $< 0.001$). Similar ethnic differences were observed for cooking wine/alcohol, herbs and spices, and herbal tea consumption.

*Conclusions:* Marked changes in food consumption that reflect both modern dietary recommendations and the persistence of traditional beliefs were observed in Singaporean women during pregnancy and the postpartum period. Traditional beliefs should be considered in interventions to improve dietary intakes during these periods.

Multiple lines of evidence indicate that maternal diet during pregnancy and the postpartum period has important effects on the offspring's health[1,2]. It is widely recognized that poor maternal nutritional status is associated with adverse birth outcomes[1]. Moreover, the diet of a lactating mother influences the composition of breast milk[2]. In Asia, the dietary choices of women during pregnancy and the postpartum period may be heavily influenced by traditional medical theories and cultural beliefs surrounding these periods[3–5]. In general, pregnancy is considered

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to be a 'hot' state, but with blood loss after giving birth the woman moves into a state of excess 'cold'[5,6]. It is believed that a 'hot–cold balance' should be maintained in order to stay healthy[5,7,8] and that this can be achieved by following special prescriptive diets during pregnancy and the initial postpartum period, commonly termed 'the confinement period'.

The confinement period is the period immediately after delivery when women are confined to their homes and are expected to observe a broad set of restrictive prescriptions and proscriptions regarding diet and other behaviours[4]. For instance, Chinese women are prohibited to take baths and are advised to stay in bed as much as possible during the confinement period[4]. The confinement period is practised by major Asian ethnic groups in Asia, including Chinese, Malays and Indians in their countries of origin and by migrants of these ethnic groups living in other parts of the world such as the USA[9], Scotland[10], Australia[11], Taiwan[12] and Singapore[13]. The confinement period is usually practised for 30–45 d[7].

Studies in the literature have focused on confinement practices and behaviours but data on the dietary changes in pregnant and postpartum women during confinement are sparse. An understanding of dietary changes during pregnancy and the postpartum period in these Asian groups could allude to the extent of influence traditional beliefs have on their diets. This could aid the development of culturally sensitive antenatal and postpartum dietary interventions necessary to improve maternal nutrition for the health benefits of the mother and child.

Singapore is a multi-ethnic South-East Asian country that includes Chinese, Malay and Indian populations. We assessed the dietary changes of Chinese, Malay and Indian women in Singapore during pregnancy and the confinement period.

## Methods

We used data from the Growing Up in Singapore Towards healthy Outcomes (GUSTO) study. The GUSTO study is a birth cohort study designed to investigate the effect of early-life events on the risk of developing metabolic diseases later in life. The study involves detailed assessments of pregnant women and their children after birth. The study was granted ethical approval by the Institutional Review Board of the KK Women's and Children's Hospital (KKH) and National University Hospital (NUH). Written informed consent was collected from all participants upon recruitment.

### Study population

Pregnant women who were attending their antenatal care (<14 weeks' gestation) in KKH and NUH, which house the major public maternity units in Singapore, were recruited into the GUSTO study from June 2009 to September 2010. The inclusion criteria included age range between 18 and 50 years, intention to finally deliver in KKH and NUH, intention to reside in Singapore for the next 5 years, and willingness to donate cord, cord blood and placenta. Only Chinese, Malay and Indian women whose parents and whose husband's parents were of the same ethnicity were included in the study. Women with significant health conditions such as type 1 diabetes mellitus and psychosis were excluded.

Only GUSTO participants who completed the questionnaires on changes in food consumption during pregnancy and the postpartum period were included in the present dietary study. After excluding those who provided incomplete nutritional information (n 136; for details, see Supplementary Figure 1 in the online supplementary material), the final numbers of participants for the present dietary study were 1019 for diet during pregnancy and 895 for diet during the postpartum period.

### Assessment of covariates

Data on ethnicity, age, education level and monthly household income were assessed during the recruitment of pregnant women attending their antenatal care. To calculate pre-pregnancy body mass indices of the participants, self-reported pre-pregnancy weights of the participants were obtained during the recruitment while heights of the participants were measured during the pregnancy clinic visit, when women were in the 26th to 28th week of pregnancy. Weights were also measured during this clinic visit. Standing heights were measured with a stadiometer (model 213; Seca, Hamburg, Germany) whereas weights were measured using digital scales (model 803; Seca). Both measurements were taken separately two times with bare feet. If the first two measurements differed by ≥1 cm or ≥200 g for height or weight, a third measurement was taken for the average calculation. Weight gains up to 26–28 weeks' gestation were calculated by subtracting self-reported pre-pregnancy weights from weights measured at 26–28 weeks' gestation. Information about cigarette smoking and alcohol consumption habits before and during pregnancy was also gathered during the pregnancy clinic visit at 26–28 weeks' gestation. A 24 h recall was administered during the same visit. From the 24 h recall, daily energy and major nutrient intakes were calculated. Breast-feeding and postpartum practices (whether the participants went through confinement and how so if they did) were assessed during the 3-week postpartum home visit. All questionnaires were administered by trained interviewers.

### Assessment of dietary changes

The questions used to assess dietary changes during pregnancy were part of the interviewer-administered questionnaire used at the pregnancy clinic visit, while those on dietary changes during the postpartum period were included in the interviewer-administered questionnaire used at the 3-week postpartum home visit. Specifically,

participants were asked to rate whether they consumed 'more', 'less', 'same as before' or 'do not usually eat' for a list of foods during pregnancy and the postpartum period, as compared with their usual pre-pregnancy diets. For clarity in describing dietary changes, we subsequently refer to the 'more' category as 'increased' and to the 'less' category as 'decreased'. The food lists contained seventeen items for the pregnancy questionnaire and thirty-two items for the post-partum questionnaire. The food items represent major food groups and different food categories that can provide useful information on dietary changes during these periods.

To obtain more insight into the accuracy of our questionnaire on dietary changes, we compared the mean intakes of selected nutrients (as recorded in 24 h recall) for the 'increased' and 'decreased' groups as defined by the dietary changes questionnaire. For this purpose, we used information on three nutrients for which foods of interest are a major source (i.e. Ca for milk, fibre and vitamin C for fruit and vegetables). We found that the mean Ca intake of participants who increased their intakes of milk was 233·6 (95 % CI 167·2, 300·1) mg/d higher as compared with participants who decreased their milk intakes. Participants who increased their intakes of vegetables had a 4·2 (95 % CI 2·3, 6·2) g/d higher mean dietary fibre intake and a 45·2 (95 % CI 22·3, 68·0) mg/d higher mean vitamin C intake as compared with those who decreased their intakes of vegetables. Similarly, the mean intake of dietary fibre was 5·3 (95 % CI 3·7, 7·0) g/d and the mean intake of vitamin C was 42·8 (95 % CI 24·2, 61·4) mg/d higher for participants who reported increased intakes of fruit as compared with participants who reported a decreased intake of fruit. These results suggest that the dietary changes questionnaire captured important changes in dietary intakes.

### Statistical analysis

Sociodemographic information was summarized for the study population and according to ethnicity. One-way ANOVA, the independent-samples $t$ test and Pearson's $\chi^2$ test of independence were used to assess differences in sociodemographic characteristics across ethnic groups and between participants who did or did not go through confinement. *Post hoc* tests (all possible pairwise comparisons) were conducted if the overall tests were significant.

The percentages of the four categories – 'increased', 'decreased', 'same as before' and 'do not usually eat' – were summarized for all food items according to ethnicity. For each food item, Pearson's $\chi^2$ test of goodness-of-fit was used to test whether the percentages in the 'increased' and 'decreased' categories varied significantly from the expected proportion of 50 % in each category. Pearson's $\chi^2$ test of independence was used to assess if there were significant ethnic differences in changes in food consumption. For these tests, only the 'increased' and 'decreased' categories were considered as they reflected dietary changes.

We also conducted several sensitivity analyses. For both pregnancy and the postpartum period, we conducted analyses stratified for pre-pregnancy BMI ($<25\cdot0\,kg/m^2$ or $\geq25\cdot0\,kg/m^2$) and weight gain up to 26–28 weeks' gestation (weight gain less than the mean value or weight gain greater than or equal to the mean value) to examine if results differed substantially. For the postpartum period only, we stratified by breast-feeding practice at 3 weeks postpartum (yes/no). Furthermore, we restricted the analysis to participants who reported going through confinement. In these sensitivity analyses, a $\geq10\%$ difference in the percentage of participants in the 'increased' and 'decreased' categories was considered substantial.

All tests were two-sided. $P$ values smaller than 0·001 were considered to be statistically significant to account for the number of tests that were performed (there were forty-nine food items in total). *Post hoc* tests were conducted with Bonferroni adjustment. All statistical analyses were performed using the statistical software package STATA 10·0.

## Results

### Sociodemographic characteristics

Table 1 shows the characteristics of study participants. The mean age of the study population was 30·4 (sd 5·2) years. The ethnic background of the study population was 56·5 % Chinese, 25·5 % Malay and 18·0 % Indian. More than half of the participants received at least a pre-university education. Chinese participants were less likely to be overweight ($\geq25\cdot0\,kg/m^2$) as compared with the other participants. Overall, the percentage of cigarette smokers reduced from 14·0 % before pregnancy to 2·5 % during pregnancy and the percentage of alcohol consumers reduced from 35·9 % before pregnancy to 2·0 % during pregnancy. The percentage of participants who reported going through confinement was lower in Indian (79·6 %) as compared with Chinese (94·8 %) and Malay (91·6 %) participants. Except for ethnicity, characteristics of participants who went through confinement were not significantly different from those of participants who did not.

### Dietary changes

We found that in five out of seventeen foods taken during pregnancy and twenty-one out of thirty-two foods taken during the postpartum period, changes in amount consumed were significantly associated with ethnicity (see Supplementary Tables 1 and 2, respectively, in the online supplementary material). Changes in food consumption are therefore presented separately for each ethnic group, listing the five food items with the greatest percentages of participants in the 'increased' or 'decreased' categories.

Changes in food consumption of the participants during pregnancy as compared with the pre-pregnancy period are

**Table 1** Sociodemographic information of participants: pregnant women (n 1027) of Chinese, Malay and Indian ethnicity, Growing Up in Singapore Towards healthy Outcomes (GUSTO) study, recruited June 2009 to September 2010

| Variable | Total study population (n 1027)* | | Chinese (n 580) | | Malay (n 262) | | Indian (n 185) | | P value† |
|---|---|---|---|---|---|---|---|---|---|
| | Mean or n | sd or % | Mean or n | SD or % | Mean or n | SD or % | Mean or n | SD or % | |
| Age (years) | 30·4 | 5·2 | 31·4[a] | 4·9 | 28·5[b] | 5·3 | 30·0[a,b] | 5·0 | <0·001 |
| Went through confinement | 817 | 91·4 | 496 | 94·8[a] | 196 | 91·6[a,b] | 125 | 79·6[b] | <0·001 |
| Highest education level | | | | a | | b | | a,c | <0·001 |
|   Primary or less | 43 | 4·3 | 22 | 3·9 | 16 | 6·3 | 5 | 2·8 | |
|   Secondary or vocational training | 372 | 37·1 | 160 | 28·1 | 164 | 64·1 | 48 | 27·1 | |
|   Pre-university | 250 | 24·9 | 143 | 25·1 | 63 | 24·6 | 44 | 24·9 | |
|   University | 338 | 33·7 | 245 | 43·0 | 13 | 5·1 | 80 | 45·2 | |
| Monthly household income ($S) | | | | a | | b | | c | <0·001 |
|   0–1999 | 151 | 15·8 | 60 | 11·2 | 62 | 24·8 | 29 | 17·2 | |
|   2000–3999 | 291 | 30·5 | 121 | 22·6 | 111 | 44·4 | 59 | 34·9 | |
|   4000–5999 | 238 | 25·0 | 140 | 26·2 | 61 | 24·4 | 37 | 21·9 | |
|   ≥6000 | 274 | 28·7 | 214 | 40·0 | 16 | 6·4 | 44 | 26·0 | |
| Smoking regularly before pregnancy | 142 | 14·0 | 59 | 10·2[a] | 73 | 28·3[b] | 10 | 5·4[a,c] | <0·001 |
| Smoking during pregnancy | 25 | 2·5 | 13 | 2·3 | 11 | 4·3 | 1 | 0·5 | 0·040 |
| Alcohol consumption before pregnancy | 365 | 35·9 | 284 | 49·4[a] | 48 | 18·5[b] | 33 | 17·9[b] | <0·001 |
| Alcohol consumption during pregnancy | 20 | 2·0 | 18 | 3·2 | 1 | 0·4 | 1 | 0·6 | 0·009 |
| Pre-pregnancy BMI (kg/m²) | | | | a | | b | | b | <0·001 |
|   <18·5 | 120 | 12·7 | 78 | 14·6 | 26 | 10·9 | 16 | 9·3 | |
|   18·5–24·9 | 599 | 63·5 | 379 | 71·1 | 130 | 54·6 | 90 | 52·3 | |
|   25·0–29·9 | 159 | 16·9 | 60 | 11·3 | 49 | 20·6 | 50 | 29·1 | |
|   ≥30·0 | 65 | 6·9 | 16 | 3·0 | 33 | 13·9 | 16 | 9·3 | |
| Weight gain up to 26–28 weeks' gestation (kg) | 8·5 | 4·6 | 8·4 | 3·8 | 9·1 | 5·8 | 8·1 | 4·8 | 0·069 |
| Daily energy intake at 26–28 weeks' gestation (kJ) | 7803 | 2481 | 8109[a] | 2364 | 7456[a,b] | 2778 | 7335[b] | 2264 | <0·001 |
| Daily energy intake at 26–28 weeks' gestation (kcal) | 1865 | 593 | 1938[a] | 565 | 1782[a,b] | 664 | 1753[b] | 541 | <0·001 |
| Breast-feeding at 3 weeks postpartum | 740 | 82·7 | 441 | 84·0 | 164 | 77·0 | 135 | 86·0 | 0·036 |

Values are presented as mean and standard deviation for 'age', 'weight gain up to 26–28 weeks' gestation' and 'daily energy intake at 26–28 weeks' gestation'; all other variables as numbers and percentages. Percentages may not add up to 100% due to rounding.

[a,b,c]Values within a row with unlike superscript letters were significantly different (P < 0·00033).

*Number of missing data: n 11 for 'age', n 133 for 'went through confinement', n 24 for 'highest education level', n 73 for 'monthly household income', n 9 for 'smoking regularly before pregnancy', n 8 for 'smoking during pregnancy', n 9 for 'alcohol consumption before pregnancy', n 31 for 'alcohol consumption during pregnancy', n 84 for 'pre-pregnancy BMI', n 92 for 'weight gain up to 26–28 weeks' gestation', n 20 for 'daily energy intake at 26–28 weeks' gestation' and n 132 for 'breast-feeding at 3 weeks postpartum'.

†Tests were meant to assess differences in sociodemographic characteristics across ethnic groups; one-way ANOVA was used for 'age', 'weight gain up to 26–28 weeks' gestation' and 'daily energy intake at 26–28 weeks' gestation' and Pearson's $\chi^2$ test of independence was used for other variables.

**Table 2** Foods with substantial increased or decreased consumption during pregnancy as compared with the pre-pregnancy period for each ethnic group (only top five listed): pregnant women (*n* 1019) of Chinese, Malay and Indian ethnicity, Growing Up in Singapore Towards healthy Outcomes (GUSTO) study, recruited June 2009 to September 2010

| Foods with increased consumption | | | Foods with decreased consumption | | |
|---|---|---|---|---|---|
| | % increased | % decreased | | % increased | % decreased |
| Chinese (*n* 576) | | | Chinese (*n* 576) | | |
|   Milk | 63·7 | 9·7 |   Seafood | 10·6 | 44·8 |
|   Fruit | 60·8 | 5·7 |   Tea | 3·7 | 41·3 |
|   Vegetables | 49·1 | 5·4 |   Soft drinks | 11·8 | 41·1 |
|   Fish | 44·3 | 17·7 |   Coffee | 3·0 | 33·3 |
|   Rice, noodles & bread | 39·2 | 8·9 |   Confectionery* | 25·7 | 30·6 |
| Malay (*n* 259) | | | Malay (*n* 259) | | |
|   Milk | 58·7 | 12·7 |   Seafood | 9·7 | 42·1 |
|   Fruit | 52·9 | 12·7 |   Soft drinks | 17·0 | 40·9 |
|   Rice, noodles & bread | 47·1 | 12·4 |   Tea | 17·0 | 33·6 |
|   Vegetables | 45·6 | 12·4 |   Coffee | 4·6 | 32·1 |
|   Fish | 37·5 | 24·3 |   Eggs | 12·0 | 28·6 |
| Indian (*n* 184) | | | Indian (*n* 184) | | |
|   Fruit | 66·9 | 11·4 |   Soft drinks | 9·8 | 36·4 |
|   Milk | 66·3 | 10·9 |   Tea | 8·2 | 36·4 |
|   Vegetables | 64·7 | 3·8 |   Coffee | 6·0 | 35·9 |
|   Rice, noodles & bread | 42·4 | 10·3 |   Confectionery | 20·1 | 35·3 |
|   Cheese & yoghurt | 33·2 | 16·3 |   Meat | 8·1 | 33·7 |

Pearson's $\chi^2$ test of goodness-of-fit was used to test if the percentages in the 'increased' and 'decreased' categories varied significantly from the expected proportion of 50 % in each category. *P* values were all <0·001 for food items shown in the table except for confectionery (*P* = 0·120 and 0·006 for Chinese and Indian, respectively), fish for Malay (*P* = 0·007) and cheese and yoghurt for Indian (*P* = 0·001). Other food items that were assessed but not listed in the table are chicken, organ meats, chocolate drinks and wine/alcohol; for percentages of other columns ('same as before' and 'do not usually eat'), please refer to Supplementary Table 1.
*Confectionery includes chocolates, sweets, biscuits and cakes.

presented in Table 2. For all three ethnic groups, 39·2 % to 66·9 % of the participants increased their consumption of milk, fruit, vegetables, and rice, noodles and bread (*P* < 0·001 for all items). More participants also increased rather than decreased their fish intakes. In contrast, for all three ethnic groups, more participants decreased rather than increased their consumption of tea, coffee, soft drinks and seafood (*P* < 0·001 for all items). Moreover, confectionery consumption was decreased in about a third of all participants. Ethnic differences in dietary changes during pregnancy were modest. The largest ethnic difference observed was that of eggs consumption, which was decreased in 28·6 % of the Malay participants as compared with 11·1 % for Chinese and 16·9 % for Indians (*P* for ethnic difference < 0·001). For other foods, the percentages of participants reporting increased or decreased consumption during pregnancy were smaller (see Supplementary Table 1).

Table 3 shows the changes in food consumption of the participants during the postpartum period as compared with the pre-pregnancy period. In all three ethnic groups, consumption of fish, leafy vegetables and milk-based drinks was increased in a large percentage of the participants (47·1 % to 73·4 %; *P* < 0·001 for all items). In contrast, chocolates and sweets and noodle consumption during the postpartum period was decreased in approximately half of the participants (*P* < 0·001 for all items). Furthermore, substantially more participants decreased rather than increased their intakes of seafood, cheese and yoghurt, fruit juice and soft drinks in all three ethnic groups (*P* < 0·001 for all items).

Substantial ethnic differences in dietary changes were observed during the postpartum period. A larger proportion of the Chinese participants (87·2 %) increased their ginger consumption, as compared with smaller percentages of Indian (40·8 %) and Malay (31·8 %) participants (*P* for ethnic difference < 0·001). Similar ethnic differences were observed for wine/alcohol used in cooking, herbs and spices, and herbal tea consumption (see Supplementary Table 2). In contrast, more than half of the Malay (73·8 %) and Indian (56·7 %) participants increased their plain water consumption, while more than half of the Chinese participants (53·2 %) decreased their water consumption (*P* for ethnic difference < 0·001). More than half of the Indian participants increased their milk and garlic consumption, as compared with smaller percentages of the Chinese and Malay participants (*P* for ethnic difference < 0·001). About half of the Malay participants decreased their eggs and beef consumption, as compared with less than a third of the Chinese and Indian participants. For other assessed foods, the percentages of participants reporting increased or decreased consumption during the postpartum period were smaller (see Supplementary Table 2). Restricting the analysis to participants who went through confinement did not change the results substantially.

We also conducted analyses stratified by pre-pregnancy overweight status (BMI < 25·0 kg/m² or ≥25·0 kg/m²), weight gain during pregnancy (less than the mean or greater than or equal to the mean) and breast-feeding practice (yes/no). Overweight women were more likely to reduce their intakes of meat and eggs during pregnancy

**Table 3** Foods with substantial increased or decreased consumption during postpartum as compared with the pre-pregnancy period for each ethnic group (only top five listed): pregnant women (*n* 895) of Chinese, Malay and Indian ethnicity, Growing Up in Singapore Towards healthy Outcomes (GUSTO) study, recruited June 2009 to September 2010

| Foods with increased consumption | | | Foods with decreased consumption | | |
|---|---|---|---|---|---|
| | % increased | % decreased | | % increased | % decreased |
| Chinese (*n* 524) | | | Chinese (*n* 524) | | |
| Ginger | 87·2 | 4·8 | Chocolates & sweets | 8·2 | 56·3 |
| Wine/alcohol used in cooking | 71·8 | 9·0 | Plain water | 26·7 | 53·2 |
| Herbs & spices | 70·4 | 9·7 | Fruit juice | 3·6 | 53·1 |
| Fish | 65·7 | 12·6 | Seafood | 1·9 | 50·6 |
| Pork | 57·8 | 11·1 | Cheese & yoghurt | 4·2 | 46·6 |
| Malay (*n* 214) | | | Malay (*n* 214) | | |
| Plain water | 73·8 | 9·8 | Noodles | 7·0 | 53·3 |
| Leafy vegetables | 73·4 | 3·7 | Chicken | 7·9 | 49·1 |
| Milk-based drinks | 58·4 | 14·0 | Chocolates & sweets | 9·8 | 47·7 |
| Fish | 55·6 | 16·4 | Eggs | 6·5 | 47·7 |
| Non-leafy vegetables | 47·7 | 15·9 | Beef | 8·9 | 46·3 |
| Indian (*n* 157) | | | Indian (*n* 157) | | |
| Leafy vegetables | 58·0 | 11·5 | Seafood | 2·6 | 44·6 |
| Plain water | 56·7 | 18·5 | Noodles | 2·6 | 43·3 |
| Milk | 55·4 | 13·4 | Chocolates & sweets | 7·6 | 40·8 |
| Garlic | 53·5 | 6·4 | Soft drinks | 1·9 | 38·2 |
| Fish | 51·6 | 10·2 | Fruit juice | 12·7 | 37·6 |

Pearson's $\chi^2$ test of goodness-of-fit was used to test if the percentages in the 'increased' and 'decreased' categories varied significantly from the expected proportion of 50 % in each category. *P* values were all <0·001 for food items shown in the table. Other food items that were assessed but not listed in the table are mutton, pork trotters, organ meats, nuts, fruit, rice, bread, oil, herbal tea, tea, coffee and wine/alcohol; for percentages of other columns ('same as before' and 'do not usually eat'), please refer to Supplementary Table 2.

and to increase their intakes of garlic and plain water during the postpartum period. In contrast, non-overweight women were more likely to increase their intakes of chicken, eggs and oil in the postpartum period. Women who gained more weight were more likely to decrease their intakes of rice and chocolates and sweets during the postpartum period. Finally, breast-feeding women were more likely to increase their intakes of fish and milk during the postpartum period.

## Discussion

A large majority of the Singaporean women of Chinese, Malay and Indian ethnicity in the present study indicated that they observed the confinement period. Moreover, consumption of many foods changed during pregnancy and the postpartum period. Changes in food consumption during pregnancy were generally similar for Chinese, Malay and Indian women. For example, milk, fruit and vegetables consumption was increased while tea, coffee and soft drinks consumption was decreased. During the postpartum period, many increased their consumption of fish, leafy vegetables and milk-based drinks while substantially more participants decreased rather than increased their consumption of chocolates and sweets, noodles, seafood, cheese and yoghurt, fruit juice and soft drinks. Large ethnic differences in dietary practice were observed during the postpartum period e.g. for increases in ginger, milk and garlic consumption.

The baseline dietary information (pre-pregnancy) of the study participants was not collected. However, according to the National Nutrition Survey[14] in Singapore, on average, women aged 18–39 years meet national dietary recommendations of 5–7 servings of rice and alternatives (e.g. bread, noodles), ≥2 servings of vegetables and 2–3 servings of meat and alternatives (e.g. prawns, milk) daily. However, they do not meet the recommended servings for fruit (≥2 servings/d). The survey also indicated dietary differences among the ethnic races. For example, Chinese in Singapore consume more rice, porridge, noodles, red meat and poultry as compared with the Malays and Indians in Singapore.

Physiological changes during pregnancy can impact on dietary needs. Not only is higher energy intake recommended during the second half of the pregnancy, a higher increment in intakes of various nutrients including protein, Ca, folate, vitamin C and vitamin D is recommended during pregnancy[15]. Increasing the consumption of nutrient-dense fruit and vegetables and lowering the intake of foods with low nutrient density are thus advised during pregnancy[15]. It is possible that participants might have increased their fruit and vegetables intakes due to modern medical and nutritional advice which usually promotes fruit and vegetables consumption during pregnancy[16]. At the same time, in traditional Asian belief, pregnancy is generally considered to be a 'hot' state and thus women need to consume more 'cold' foods to maintain the 'hot–cold balance'[8]. As most vegetables and fruit are considered 'cold'[4,5], it is also possible that a large proportion of the participants from all ethnic groups is following these cultural practices and thus increased their intakes of this food group. The increased milk consumption during pregnancy in all three ethnic groups

in the study could be due to modern dietary advice that promotes milk products as good sources of Ca and other nutrients[15]. Insufficient Ca intake during pregnancy may lead to lower Ca content in the fetus' skeleton[15]. Tea and coffee intakes were decreased in all three ethnic groups, likely as a consequence of the reported negative effects of caffeine on pregnancy outcomes[17,18].

Similar to pregnancy, mothers also need to meet higher nutritional requirements during the postpartum period[19]. This is especially true for breast-feeding women as nutritional factors can influence the quality and quantity of breast milk[19]. It is recommended that a lactating mother increases her energy intake by 2092 kJ/d (500 kcal/d) as compared with the pre-pregnancy period and includes an adequate amount of protein in her diet[19]. In traditional Asian belief, the body of a woman is believed to be in a state of 'cold' during the postpartum period and thus 'hot' foods are recommended[4]. Ginger, wine and herbs are frequently used in preparation of the Chinese confinement diet due to their warming properties[7,20]. Fruit juice is generally perceived as 'cold' and seafood is usually regarded as 'poisonous' during this period[7]. Thus, it was not surprising that fruit juice and seafood consumption was decreased in more than half of the Chinese participants in the present study. Furthermore, seafood is prone to Hg contamination that may be harmful to the central nervous system of the fetus or infant[21]. For Malays, decreased consumption of beef and eggs in a large percentage of the participants is consistent with the belief that these foods inhibit a woman's general recovery[5]. However, a large percentage of the Malay participants in our study increased their consumption of leafy and non-leafy vegetables, which are traditionally proscribed, probably due to the influence of modern medical advice[19]. Classification of garlic and fish as 'hot' foods in Indian belief may be the reason for increased consumption of these foods in more than half of the Indian participants in our study[3,8]. Milk consumption was also increased as it is prescribed in the Indian confinement diet[3,8]. The decreased intake of fruit juice in a large percentage of our Indian participants may be due to Indian perception that most fruit are 'cold'[3].

We compared our results with those from earlier studies that examined the dietary changes of Chinese, Malay and Indian women during pregnancy and the postpartum period. In a study conducted in Malaysia, the dietary beliefs of 100 Chinese women (mean age 28·7 (SD 5·0) years) during the postpartum period were assessed and they were generally in agreement with our results[7]. In that study, the participants were asked about their acceptance ('prohibited', 'not encouraged', 'neutral', 'encouraged' and 'must eat a lot') and perceived properties ('cold', 'hot', 'poison', 'windy' and 'do not know') of a list of foods during the postpartum period. Ginger and white pepper consumption was thought to be 'encouraged' or 'must eat a lot' by more than half of that study's participants. Furthermore, consumption of most seafood other than fish (e.g. prawns

and crab) and fruit juice was considered to be 'prohibited' and 'not encouraged' by most of the participants in that study. In contrast with our findings, most fish was perceived to be 'poison' during the postpartum period by more than half of that study's participants and the consumption of fish was thought to be 'prohibited' or 'not encouraged'. However, the consumption of *ikan haruan*, a type of fish believed to enhance dermal wound healing, was thought to be 'encouraged' or 'must eat a lot' by a quarter of the participants. In a study conducted in China, dietary behaviours of about 2000 women during the postpartum period were assessed using an interviewer-administered questionnaire and an FFQ. In that study, fish and rice wine were frequently consumed by the Chinese participants during the postpartum period[22]. Furthermore, 78·8% of the participants never ate fruit during this period[22]. In another study conducted in Malaysia (information gathered through interviews with informants), Malay women indicated that eggs and beef were generally avoided during the postpartum period[5] as was observed in our study. However, plain water and most vegetables were proscribed in that population[5], whereas consumption of these foods was increased during the postpartum period in our study. In general, dietary changes in our study that appear to be based on traditional belief (e.g. regarding ginger, wine used in cooking during the postpartum period) were also observed in earlier studies. However, the increased consumption of fruit, vegetables and fish during the postpartum period indicated that our study population may have been more affected by modern dietary advice than the participants of the earlier studies.

Our study had several strengths. Its sample size was reasonably large with a representation of three major ethnic groups in Asia. In addition, the questionnaires used to assess changes in food consumption were interviewer-administered which may have improved the completeness of the data. However, our study also had several limitations. First, our questionnaire only assessed relative changes of food consumption as compared with the pre-pregnancy period and did not allow estimation of absolute changes in food consumption. Second, participants were recruited only from public hospitals in Singapore and women with the highest incomes may have been under-represented as they may have chosen private hospitals. However, KKH alone delivers approximately 30% of the babies born in Singapore annually[23]. Therefore, the study population can be expected to be reasonably representative of the overall population of pregnant women in Singapore.

Our results may have several implications for dietary intervention during pregnancy and the postpartum period. Because traditional beliefs appear to have important influences on the dietary choices of various Asian groups, dietary intervention targeting Asian pregnant and lactating women should take these traditional beliefs into consideration. For instance, most vegetables and fruit are considered 'cold' and

are not usually consumed during the postpartum period[7]. This not only poses a risk to the mother's health due to the lack of dietary fibre, vitamins, minerals and phytochemicals, but may also influence the infant's acceptance of fruit and vegetables later in life if the mother is breast-feeding[24]. Dietary intervention involving an increase in fruit and vegetables consumption during the postpartum period can focus on promoting more acceptable fruit and vegetables such as apple, black fungus and red dates for Chinese[7,25], tamarind and turmeric root (usually used to make juice or concoction) for Malays[5], and ginger, beans and tomato for Indians[3,8]. Chicken soup prepared with sesame seed oil and rice wine is commonly consumed by Chinese during the postpartum period for its warming effect[26]. However, recent research has shown that the consumption of this alcoholic soup significantly lengthens milk ejection time and lowers milk yield of lactating mothers[26]. Furthermore, alcohol can be detected in breast milk for several hours after consumption of the alcoholic soup[27]. Results from some studies suggest that alcohol in breast milk can be detrimental for the sleep pattern and psychomotor development of infants[27]. Therefore, consumption of traditional foods such as alcoholic soups should be targeted in dietary advice or intervention for Asian lactating women.

## Conclusion

The practice of confinement is still very common in Chinese, Malay and Indian women in Singapore, a high-income country where Western medicine is widely accepted. Furthermore, consumption of many foods was altered during pregnancy and the postpartum period in a large number of Chinese, Malay and Indian women. These changes appear to reflect a mix of traditional beliefs and modern dietary advice. As such, to improve dietary compliance and ultimately the health of women and their children, it is important to assess an individual's traditional beliefs before conducting any dietary intervention involving Asian pregnant and lactating women.

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## Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980013001730

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