（様式５）

乳幼児健康調査（問診票）

（都府県名　　）

母親氏名：
乳幼児氏名：

年　　齢：　　歳　　月（満1歳2ヶ月末満）

採血問診日：　　月　　日（医療機関及び医師名　　）

①採血時よりさかのぼって2週間以内に37．5℃以上の発熱がある。　ある　ない

②採血時よりさかのぼって2週間以内に風邪をひいた。　ある　ない

③採血時よりさかのぼって1ヶ月以内に予防接種を受けた。　ある　ない

母子健康手帳を確認し誕生以来の全ての予防接種を記入	予防接種の種類	接種月日

④過去に重い病気にかかったことがある。　ある　ない
（「ある」の場合の病名：　　）

⑤アレルギー疾患がある。　ある　ない
（「ある」の場合の病名：　　）

⑥採血時の体温　（　　℃）

⑦発育・発達状況
身体発育（生後　　月　　日）
体重　　g　身長　　cm　頭囲　　cm　胸囲　　cm
「乳幼児健康調査票（1歳児用）のⅡ発育発達」について確認をし、必要に応じ身体等のチェックを行う。
所見（　　）

⑧これまでの栄養状況
「乳幼児健康調査票（1歳児用）のⅢこれまでの栄養状況」について確認をし、必要に応じ調査票を訂正する。

⑨その他特記事項（　　）

注：①又は②で「ある」の場合、③において「ある」かつ1ヶ月以内にポリオや麻疹などの生ワクチンか2週間以内に生ワクチン以外の予防接種を受けた場合、⑤において37．5℃以上の体温がある場合は、いずれも当日の採血は中止し、予防接種又は37．5℃以上の発熱若しくは風邪が治ってから２週間以上期間を置いて改めて採血を行うこと。

＊　ただし、予防接種や発熱により、前述のとおりの調査日の設定がどうしても困難な場合には、検査結果は参考値になるが調査等を行うことを保護者に伝え、調査日を設定する。

第2(3)子の母乳採取時の第1(2)子の栄養および健康調査票

都府県名(　　)

母親氏名:　　連絡先:TEL

第1(2)子氏名:　　性別:男・女　　出生体重:　　g
生年月日:　　年　月　日(在胎　週　日または出産予定日　月　日)

第2(3)子氏名:　　性別:男・女　　出生体重:　　g
生年月日:　　年　月　日(在胎　週　日または出産予定日　月　日)

第1(2)子(まえのお子さん)についてお尋ねします:

Ⅰ　これまでに重い病気にかかったことがありますか　　: ある　ない
あった場合の病名:

Ⅱ　アレルギー疾患があるといわれたことがありますか　　: ある　ない
あった場合の病名:

Ⅲ　現在までの発育・発達

1)　身体発育(1歳近くでの測定日の月齢と測定値を記入して下さい):測定日(生後　月　日)
体重　　g　身長　　cm　頭囲　　cm　胸囲　　cm

2)運動発達:
次のことが出来るようになったのはいつですか。

(1)首のすわり　: 生後　月　　(4)つかまり立ち　: 生後　月
(2)寝返り　: 生後　月　　(5)伝い歩き　: 生後　月
(3)お座り　: 生後　月　　(6)一人歩き(2～3歩)　: 生後　月

3)1歳の誕生日までに次の項目が出来ていたら○、出来なければ×、記憶に無ければ△を○で囲んで下さい。

(1)「いけません」というと、ちょっと手をひっこめる。　(○ × △)
(2)「バイバイ」や「さよなら」に反応する。　(○ × △)
(3)「おいで」「ちょうだい」「ねんね」などを1つでも理解できる。(○ × △)
(4)食物のことを「マンマ」という(他の有意義語でも良い)。　(○ × △)
(5)ブラシ、鉛筆などを使うまねをする。　(○ × △)

Ⅲ　1歳までの栄養状態を教えて下さい。
ほ乳方法はどうでしたか。次の番号をカッコ内に入れて下さい。

1. 母乳のみ　2. 混合(母乳が主)　3. 混合(母乳とミルクがほぼ等量)
4. 混合(人工が主)　5. 人工栄養のみ

生後1ヶ月未満	(ほ乳方法　)	6～7ヶ月未満	(ほ乳方法　)
1～2ヶ月 〃	(ほ乳方法　)	7～8ヶ月 〃	(ほ乳方法　)
2～3ヶ月 〃	(ほ乳方法　)	8～9ヶ月 〃	(ほ乳方法　)
3～4ヶ月 〃	(ほ乳方法　)	9～10ヶ月 〃	(ほ乳方法　)
4～5ヶ月 〃	(ほ乳方法　)	10～11ヶ月 〃	(ほ乳方法　)
5～6ヶ月 〃	(ほ乳方法　)	11～12ヶ月 〃	(ほ乳方法　)

(第2子以降の母乳採取に協力が得られた場合で前児が当研究班の1歳時乳幼児健康診査を受診しなかった場合に記入して下さい)

Ⅳ．研究成果の刊行に関する一覧表

研究成果の刊行に関する一覧表

(2010年4月1日～2011年3月31日迄)

書籍

著者氏名	論文タイトル名	書籍全体の編集者名	書籍名	出版社名	出版地	出版年	ページ
	脳室周囲白質軟化症	五十嵐隆	総合小児科診療のための小児科レビュー2010	総合医学社	東京	2010	277-283
岡明	脳の発達と疾患	渡辺とよ子	新生児医療	中山書店	東京	2010	92-95
岡明	脳室内出血、脳室周囲白質軟化症	山口徹、北原光夫、福井次矢	今日の治療指針	今日の治療指針	東京	2010	1147-1148

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Takahashi K, Oka A, Mizuguchi M, Saitoh M, Takita J, Sato A, Mimaki M, Kato M, Ogawa S, Igarashi T	Interstitial deletion of 13q14.13-q32.3 presenting with Arima syndrome and bilateral retinoblastoma	Brain Dev	In press		
Chihara I, Uehara R, Kotani K, Sadakane A, Aoyama Y, Tsuboi S, Ae R, Enkh-Oyun T, Nakamura Y.	The effect of prepregnancy body mass index on singleton cesarean delivery among term nulliparous women in Japanese population.	Arch Gynecol Obstet.	In press (Early release)		
岡明	早産児の神経発達	周産期医学	40	619-623	2010
岡明	意識障害を起こす疾患の鑑別診断	小児内科	43	471-475	2011

Ⅴ．研究成果の刊行物・別冊

Arch Gynecol Obstet
DOI 10.1007/s00404-010-1812-7

MATERNO-FETAL MEDICINE

The effect of prepregnancy body mass index on singleton cesarean delivery among term nulliparous women in Japanese population

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Abstract
Purpose Overweight or obesity is a known risk factor for cesarean delivery although there is minimal data among Japanese women. The aim of the study was to examine the effect of prepregnancy body mass index (BMI) on singleton cesarean delivery among term nulliparous women using a national sample from the Human Milk Survey.
Methods Data from the Human Milk Survey between 1998 and 2008 were used for the secondary analysis. Women were categorized as underweight (BMI < 18.5 kg/m^2), normal weight ($18.5 \leq$ BMI < 25.0), or overweight (BMI ≥ 25.0) based on their prepregnancy BMI. The association between maternal prepregnancy BMI and cesarean delivery was assessed using logistic regression models.
Results A total of 915 women were included in the analysis. The proportion of cesarean section was 10.1%. Overall, 17.1% of the women were underweight while 6.0% were overweight. After adjusting for maternal age, smoking status, pregnancy complications, and infant birthweight, overweight women were 2.7 times more likely to have a cesarean delivery compared to normal weight women (adjusted odds ratio [adjusted OR] = 2.7, 95% confidence interval [CI] = 1.4–5.4), and underweight women were half as likely to have a cesarean delivery compared to normal weight women (adjusted OR = 0.5, 95% CI = 0.2–1.1).
Conclusions Being overweight before pregnancy more than doubled the risk of cesarean delivery independent of age, smoking, pregnancy complications, and infant birthweight among term nulliparous women. Overweight Japanese women should be advised to achieve normal prepregnancy BMI in their preconception period to prevent cesarean delivery.

Keywords Epidemiology · Cesarean delivery · Prepregnancy BMI · Maternal overweight · Pregnancy · Japanese

Introduction

In Japan, cesarean rate has doubled over the last two decades, from 8.5% in 1987 to 18.4% in 2008, while the total number of deliveries has decreased [1]. Although cesarean section is regarded to be a low-risk procedure both by health professionals and patients in developed countries, maternal intraoperative and postoperative complication rates have been reported to be high [2, 3]. Some may claim that the increase in cesarean section rates was necessary to improve perinatal outcomes. However, recent WHO surveys conducted in Latin America and Asia suggested that increasing rates of cesarean section do not necessarily lead to improved perinatal outcomes but may be associated with maternal mortality and morbidity [4, 5]. In addition, cesarean delivery costs more than a vaginal birth, contributing to rising health costs [6].

Overweight or obesity is a known risk factor for cesarean delivery [7–11]. While increasing numbers of women of childbearing age in western countries are overweight or obese [12, 13], a similar trend has not been observed in Japan. According to a national survey of non-pregnant women in Japan, in 2007, the prevalence of overweight (defined as body mass index [BMI] of ≥ 25.0 kg/m^2) women in their twenties and thirties were 5.9 and 11.1%,

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respectively, and the prevalence has not changed over the last 20 years [14]. In Japan, the government does not monitor the prevalence of obesity (defined as BMI of $\geq$30.0 kg/m^2) for non-pregnant women. In pregnant women in Japan, there is no national prevalence data of overweight or obesity. National data indicate that Japanese women are having their babies at older age compared to a few decades ago. According to vital statistics, the average maternal age at delivery rose from 27.4 years in 1975 to 31.0 years in 2009 [15]. Because the prevalence of overweight increases as women age [14], it is likely that the overall prevalence of overweight among pregnant women have increased over the years. This may have contributed to the rise in cesarean section rate in Japan, to some degree.

The association between overweight and cesarean delivery has not been well documented among Japanese women. To our knowledge, in Japan, there is only one published study investigating the association between overweight women and cesarean delivery in the English language and it is a single institution study [16]. Therefore, our aim of the study was to examine the effect of prepregnancy body mass index on singleton cesarean delivery among term nulliparous women using a national sample from the Human Milk Survey.

Methods

Data from the Human Milk Survey between 1998 and 2008 were extracted for secondary analysis. The primary purpose of the survey was to investigate the dioxin levels in human breast milk and their effects on child development. The details of the survey methodology are described elsewhere [17]. In brief, healthy nulliparous women carrying singleton babies in their twenties and thirties were recruited and interviewed by public health nurses in 19 prefectures and one city. Women were first interviewed during the third trimester of pregnancy, and they provided maternal information including prepregnancy BMI and smoking status. Women were again interviewed approximately 1 month post-delivery, at which time, delivery and infant information were obtained. The information was self-reported and confirmed by the public health nurses from each mothers' maternal and child health handbook, a document issued by municipal governments in Japan. By law, health providers in charge of prenatal visits and/or delivery are responsible for documenting information such as maternal weight, pregnancy complications, and mode of delivery in the handbooks.

Between 1998 and 2008, there were 1,021 participants in the Human Milk Survey. Women with non-cephalic fetuses and post-term delivery were excluded from the analyses since malpresentation and post-term delivery are both associated with cesarean delivery, and we wanted to separate those effects. After excluding those missing mode of delivery ($n = 5$), those missing gestational age at delivery ($n = 2$), preterm delivery defined as less than 37 weeks gestation ($n = 26$), post-term delivery defined as 42 weeks gestation or more ($n = 16$), those missing information on prepregnancy BMI ($n = 2$), and those with non-cephalic fetuses ($n = 48$) or missing information on fetal presentation ($n = 7$), a total of 915 women and their infants were included in the analysis.

The exposure variable of interest was prepregnancy BMI, calculated using prepregnancy weight and height as self-reported by the mother during the 3rd trimester of pregnancy. Prepregnancy BMI was categorized into underweight (BMI $<$ 18.5 kg/m^2), normal weight (18.5 kg/m^2 $\leq$ BMI $<$ 25.0 kg/m^2), and overweight (BMI $\geq$ 25.0 kg/m^2) according to the definition by the Japan Society for the Study of Obesity [18]. The outcome variable was a dichotomous variable of whether or not the mother had a cesarean delivery, as self-reported by mother 1 month post-delivery. Bivariate analyses were conducted using a contingency table approach to assess the association between prepregnancy BMI and demographic and clinical characteristics of the mothers and infants. The association between three-category prepregnancy BMI variable and cesarean delivery variable was assessed using logistic regression models. Covariates and potential effect modifiers considered were maternal age, smoking status, region of residence (Japan is officially divided into 8 regions, including Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Kyushu, and Okinawa), pregnancy complications (presence of either one of the following: preeclampsia/hypertension, uterine anatomic abnormality, gestational diabetes, and threatened labor), gestational age, and infant birthweight (in 100 g). A p value of less than 0.05 was considered statistically significant. All statistical analyses were conducted using the Statistical Analysis System® (SAS, version 9.1; SAS Institute, Cary, NC).

Results

Table 1 demonstrates the demographic and clinical characteristics of women and infants in the study. Proportion of cesarean delivery was 10.1%. Women were aged between 24 and 36 years (mean 29.3 years, median 29 years). The study participates were from six regions (19 prefectures and 1 city) out of eight regions (47 prefectures) of Japan. Prepregnancy BMI ranged from 16.0 to 36.2 kg/m^2, and the mean (SD) and median were 20.7 (2.7) kg/m^2 and 20.2 kg/m^2, respectively. Overall, 17.1% of the women were underweight while 6.0% were overweight. Pregnancy complications (preeclampsia or hypertensive disorder

Table 1 Characteristics of term nulliparous women and infants in cephalic position, the human milk survey, 1998–2008 ($n = 915$)

Characteristic	n (%)[a]
Maternal age (years)	
24–27	276 (30.2)
28–31	440 (48.1)
32–36	199 (21.8)
Region of residence	
Tohoku	133 (14.5)
Kanto	225 (24.6)
Chubu	261 (28.5)
Kinki	145 (15.9)
Chugoku	101 (11.0)
Kyushu	50 (5.5)
Smoking status	
Current smoker (3rd trimester)	33 (3.6)
Quit smoking during pregnancy	162 (17.8)
Non-smoker	716 (78.6)
Missing $n = 4$	
Prepregnancy BMI status	
Underweight (BMI < 18.5 kg/m^2)	156 (17.1)
Normal (18.5 kg/m^2 ≤ BMI < 25.0 kg/m^2)	704 (76.9)
Overweight (BMI ≥ 25.0 kg/m^2)	55 (6.0)
Pregnancy complications	
Present	36 (4.0)
Absent	873 (96.0)
Missing $n = 6$	
Sex of the infant	
Male	468 (51.4)
Female	443 (48.6)
Missing $n = 4$	
Birth weight	
Low birthweight (<2,500 g)	54 (5.9)
Normal birthweight (2,500 g ≤ BW < 4,000 g)	855 (93.4)
High birthweight (≥4,000 g)	6 (0.7)
Mode of delivery	
Cesarean	92 (10.1)
Vaginal	823 (90.0)

[a] Pecentages may not add up to 100% because of rounding

during pregnancy, uterine anatomic abnormality, gestational diabetes, and threatened labor) were reported in 4.0% of women.

Bivariate analyses that looked at the association between prepregnancy BMI categories and characteristics of women and infants using contingency table approach showed that, in general, increasing maternal age and greater birthweight were associated with greater maternal prepregnancy BMI categories (Table 2). Maternal smoking status and pregnancy complications were not significantly associated with prepregnancy BMI status. In addition, there was no regional difference in prepregnancy BMI status (data not shown).

The results of logistic regression analyses to test the association between maternal and infant characteristics and mode of delivery (cesarean vs. vaginal) are presented in Table 3. The crude logistic regression models showed that prepregnancy BMI, maternal age, the presence of pregnancy complications, and infant birthweight were associated with cesarean delivery. After adjusting for maternal age, smoking status, pregnancy complications, and infant birthweight, overweight women were 2.7 times more likely to have a cesarean delivery compared to normal weight women (adjusted odds ratio [OR] = 2.7, 95% confidence interval [CI] = 1.4–5.4). On the other hand, underweight women were half as likely to have a cesarean delivery compared to normal weight women (adjusted OR = 0.5, 95% CI = 0.2–1.1) although the association was marginally significant ($p = 0.076$). Adding gestational age to the final model did not alter the results.

Discussion

Overweight women were 2.7 times more likely to have a cesarean delivery compared to normal weight women even after controlling for pregnancy complications, maternal age, smoking status, and birthweight. This result indicates that overweight women are likely to deliver cesarean not only because of pregnancy complications such as preeclampsia and diabetes but also because they may have difficulty delivering vaginally for anatomical reasons: dystocia due to increases in pelvic soft tissues [9, 19]. Although overweight women are likely to have high birthweight infants [20], our result also suggests that infant birthweight was not the only reason for the overweight women to have a cesarean delivery. It is likely that abnormal labor (i.e., protraction and arrest disorders) resulted in cesarean delivery. In addition, obstetricians may tend to recommend a cesarean delivery to overweight women once the labor is prolonged because they may fear that vaginal delivery may not be possible for those women. Further research is needed to reveal whether the perception and practice patterns of obstetricians in Japan differ by prepregnancy BMI status.

To our knowledge, this is the first national multicenter study in Japan that investigated the association between prepregnancy BMI categories and cesarean delivery. A previous study of 633 women by Murakami et al. involving one hospital showed that the odds of a cesarean delivery were 2.42 times (95% CI = 1.05–5.58) higher among overweight women (prepregnancy BMI ≥ 25 kg/m^2) compared with normal weight women after adjusting for

Table 2 Characteristics of the study population and mode of delivery by prepregnancy BMI categories, the human milk survey, 1998–2008 ($n = 915$)

Characteristic	Underweight ($n = 156$)	Normal weight ($n = 704$)	Overweight ($n = 55$)	p Value[a]
Mean maternal age (in years) (SD)	28.8 (2.5)	29.3 (2.7)	30.0 (2.5)	0.008
Smoking status				0.278
Current smoker (%)	5.8	3.3	1.8	
Quit smoking during pregnancy (%)	19.9	16.9	23.6	
Non-smoker (%)	74.4	79.9	74.6	
Sex of the infant				0.578
Male (%)	51.3	50.9	58.2	
Birth weight (g) (SD)	2974.7 (358.3)	3073.1 (358.5)	3198.7 (429.6)	<0.001
Birth weight (3 category)				<0.001
Low birthweight (<2,500 g) (%)	9.6	5.4	1.8	
Normal birthweight (2,500 g ≤ BW < 4,000 g) (%)	89.7	94.3	92.7	
High birth weight (≥4,000 g) (%)	0.6	0.3	5.5	
Pregnancy complications				0.861
Present (%)	3.2	4.2	3.6	
Mode of delivery				<0.001
Cesarean delivery (%)	4.5	10.1	25.5	

SD standard deviation

[a] p Values were calculated using the Chi-square test, Fisher's exact test, and one-way analysis of variance test as appropriate

Table 3 Results from logistic regression models to test the association between maternal and infant characteristics and mode of delivery (cesarean vs. vaginal), the human milk survey, 1998–2008 ($n = 915$)

	Crude		Adjusted[a]	
	OR (95% CI)	p Value	OR (95% CI)	p Value
Prepregnancy BMI				
Underweight (BMI < 18.5 kg/m^2)	0.4 (0.2–0.9)	0.032	0.5 (0.2–1.1)	0.076
Normal (18.5 kg/m^2 ≤ BMI < 25.0 kg/m^2)	Reference		Reference	
Overweight (BMI ≥ 25.0 kg/m^2)	3.0 (1.6–5.9)	0.001	2.7 (1.4–5.4)	0.003
Maternal age (years)	1.1 (1.1–1.2)	0.002	1.1 (1.0–1.2)	0.011
Smoking status				
Current smoker	0.6 (0.1–2.5)	0.470	0.7 (0.2–3.2)	0.672
Non-smoker	Reference		Reference	
Quit during pregnancy	1.1 (0.7–2.0)	0.649	1.1 (0.6–2.0)	0.664
Pregnancy complications				
Present	3.2 (1.4–7.0)	0.004	3.0 (1.3–6.7)	0.009
Absent	Reference		Reference	
Birth weight (in 100 g)	1.1 (1.0–1.1)	0.036	1.0 (1.0–1.1)	0.121

OR odds ratio, *CI* confidence interval

[a] The multivariable model is adjusted for all the other variables listed in the table

maternal age, parity, smoking, weight gain during pregnancy, and gestational age [16]. The study was conducted at a tertiary hospital, and included women of multiparity, teenagers, those over 40 years of age, as well as deliveries between 24 and 42 weeks gestation. The women in our study were low-risk because the survey targeted healthy pregnant women in their twenties and thirties who were planning to breastfeed. Nonetheless, our study involving low-risk women from the general population showed that being overweight is a significant risk factor for cesarean delivery, consistent with the previous hospital-based study.

Japan has lower rates of cesarean delivery compared to western countries: The overall cesarean rate in Japan was 18.4% in 2008 while the rate was 32% in the United States

in 2007 [21]. Even though our study involved low-risk, term nulliparous women with cephalic fetuses, overweight women in our sample had a high cesarean delivery rate of 25.5%. This is comparable to a US cesarean delivery rate of 26.5% among nulliparous overweight women with term live births from the Pregnancy Risk Assessment Monitoring System between 1998 and 2000 [22] although overweight was defined slightly different (26.1 kg/m^2 $\leq$ BMI $\leq$ 29.0 kg/m^2) in the US.

The results of the current study and the previous study by Murakami et al. suggest that overweight Japanese women may have higher risk of cesarean delivery compared with women from western countries, in terms of the magnitude of risk of overweight women compared to normal weight women. A meta-analysis of studies conducted in western countries by Chu et al. showed that the OR of a cesarean delivery were 1.46 (95% CI = 1.34–1.60), 2.05 (95% CI = 1.86–2.27), and 2.89 (95% CI = 2.28–3.79) among overweight, obese, and severely obese women, respectively, compared with normal weight pregnant women [23]. Although our study and the study by Murakami et al. combined the overweight and obese categories into one category of overweight (prepregnancy BMI $\geq$ 25.0 kg/m^2) as suggested by the Japan Society for the Study of Obesity [18], the majority of these women are between the prepregnancy BMI of 25.0 and 29.9 kg/m^2 (78% in our sample). Therefore, the OR of 2.7 in our study and OR of 2.42 in the previous study most likely represent the odds ratios of women with prepregnancy BMI between 25.0 and 29.9 kg/m^2. These magnitudes of risk are comparable to the risk among obese women in western countries.

There are some limitations in our study. The study used prepregnancy weight and height to calculate prepregnancy BMI, which were self-reported during the third trimester of pregnancy and may have been inaccurate. Although self-reported weight and height are reported to be generally reliable among middle-aged Japanese women [24], no validation study has been conducted among Japanese pregnant women. Another limitation is that other important variables associated with cesarean delivery such as weight gain during pregnancy [25, 26] and socioeconomic status [27, 28] were not available. Future studies should investigate the association between prepregnancy BMI and cesarean delivery in relation to these variables in Japan.

Furthermore, the generalizability of the study is limited. The study population was low-risk since the survey targeted healthy pregnant women in their twenties and thirties who were planning to breastfeed. The cesarean rate among term nulliparous women in our study was 10.1% while the overall cesarean rate for Japan was between 14.7 and 18.4% during the same period [1]. Nonetheless, the study was a multicenter study, had a large sample size of 915, and provided useful insight on this subject. Further research is needed among adolescents, older women, and high-risk women in Japan.

In conclusion, our study showed that being overweight more than double the risk of cesarean delivery even among low-risk nulliparous women in Japan, where women are leaner compared to women in the western countries. Overweight Japanese women should be advised to achieve normal prepregnancy BMI through dietary and life-style modifications in their preconception period to prevent primary cesarean delivery.

Acknowledgments This study was conducted as a part of the study on dioxins in human milk and child development supported by Health and Labour Science Research Grants (Principal investigator: Professor Hiroshi Tada).

Conflict of interest We declare that we have no conflict of interest.

References

1. Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare. Survey of Medical Institutions. http://www.mhlw.go.jp/english/database/db-hss/mi.html. Accessed 1 July 2010
2. Hager RM, Daltveit AK, Hofoss D, Nilsen ST, Kolaas T, Oian P, Henriksen T (2004) Complications of cesarean deliveries: Rates and risk factors. Am J Obstet Gynecol 190(2):428–434
3. van Ham MA, van Dongen PW, Mulder J (1997) Maternal consequences of caesarean section. A retrospective study of intraoperative and postoperative maternal complications of caesarean section during a 10-year period. Eur J Obstet Gynecol Reprod Biol 74(1):1–6
4. Lumbiganon P, Laopaiboon M, Gulmezoglu AM, Souza JP, Taneepanichskul S, Ruyan P, Attygalle DE, Shrestha N, Mori R, Nguyen DH, Hoang TB, Rathavy T, Chuyun K, Cheang K, Festin M, Udomprasertgul V, Germar MJ, Yanqiu G, Roy M, Carroli G, Ba-Thike K, Filatova E, Villar J (2010) Method of delivery and pregnancy outcomes in Asia: the WHO global survey on maternal and perinatal health 2007–08. Lancet 375(9713):490–499
5. Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A, Shah A, Campodonico L, Bataglia V, Faundes A, Langer A, Narvaez A, Donner A, Romero M, Reynoso S, de Padua KS, Giordano D, Kublickas M, Acosta A (2006) Caesarean delivery rates and pregnancy outcomes: The 2005 WHO global survey on maternal and perinatal health in Latin America. Lancet 367(9525):1819–1829
6. The National Collaborating Centre for Women's, Children's Health (2004) Caesarean section clinical guideline. RCOG Press, London
7. Ehrenberg HM, Durnwald CP, Catalano P, Mercer BM (2004) The influence of obesity and diabetes on the risk of cesarean delivery. Am J Obstet Gynecol 191(3):969–974
8. Kaiser PS, Kirby RS (2001) Obesity as a risk factor for cesarean in a low-risk population. Obstet Gynecol 97(1):39–43
9. Young TK, Woodmansee B (2002) Factors that are associated with cesarean delivery in a large private practice: the importance of prepregnancy body mass index and weight gain. Am J Obstet Gynecol 187(2):312–318 (discussion 318–320)
10. Kumari AS (2001) Pregnancy outcome in women with morbid obesity. Int J Gynaecol Obstet 73(2):101–107

11. Ramos GA, Caughey AB (2005) The interrelationship between ethnicity and obesity on obstetric outcomes. Am J Obstet Gynecol 193(3 Pt 2):1089–1093
12. Marriot H, Buttriss J (2004) Key points from the findings of volume 4 of the national diet and nutrition survey (NDNS) of adults aged 19–64 years. Nutr Bull 29:249–253
13. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM (2006) Prevalence of overweight and obesity in the United States, 1999–2004. JAMA 295(13):1549–1555
14. National Institute of Health and Nutrition (2007) Project for the national health and nutrition survey. http://www.nih.go.jp/eiken/english/research/project_nhns.html. Accessed 1 July 2010
15. Ministry of Health, Labour and Welfare (2010) Vital Statistics. http://www.mhlw.go.jp/english/database/db-hw/vs01.html. Accessed 1 Nov 2010
16. Murakami M, Ohmichi M, Takahashi T, Shibata A, Fukao A, Morisaki N, Kurachi H (2005) Prepregnancy body mass index as an important predictor of perinatal outcomes in Japanese. Arch Gynecol Obstet 271(4):311–315
17. Uehara R, Peng G, Nakamura Y, Matsuura N, Kondo N, Tada H (2006) Human milk survey for dioxins in the general population in Japan. Chemosphere 62(7):1135–1141
18. Editorial Board of the Japan Society for the Study of Obesity (ed) (2001) Manual for controlling obesity, 2nd edn. Ishiyaku Shuppan Publishing, Tokyo. [in Japanese]
19. Crane SS, Wojtowycz MA, Dye TD, Aubry RH, Artal R (1997) Association between pre-pregnancy obesity and the risk of cesarean delivery. Obstet Gynecol 89(2):213–216
20. Khashan AS, Kenny LC (2009) The effects of maternal body mass index on pregnancy outcome. Eur J Epidemiol 24(11): 697–705
21. Martin JA, Hamilton BE, Sutton PD, Ventura MA, Mathews MS, Kirmeyer S, Osterman MJK (2010) Births: final data for 2007. National vital statistics reports, vol 58, Number 24. National Center for Health Statistics, Hyattsville
22. Diez PM, Callaghan WM, Morrow B, Cogswell ME (2005) Population-based assessment of the risk of primary cesarean delivery due to excess prepregnancy weight among nulliparous women delivering term infants. Matern Child Health J 9(3): 237–244
23. Chu SY, Kim SY, Schmid CH, Dietz PM, Callaghan WM, Lau J, Curtis KM (2007) Maternal obesity and risk of cesarean delivery: a meta-analysis. Obes Rev 8(5):385–394
24. Wada K, Tamakoshi K, Tsunekawa T, Otsuka R, Zhang H, Murata C, Nagasawa N, Matsushita K, Sugiura K, Yatsuya H, Toyoshima H (2005) Validity of self-reported height and weight in a Japanese workplace population. Int J Obes (Lond) 29(9):1093–1099
25. Ekblad U, Grenman S (1992) Maternal weight, weight gain during pregnancy and pregnancy outcome. Int J Gynaecol Obstet 39(4):277–283
26. Johnson JW, Longmate JA, Frentzen B (1992) Excessive maternal weight and pregnancy outcome. Am J Obstet Gynecol 167(2):353–370 (discussion 370–352)
27. Gould JB, Davey B, Stafford RS (1989) Socioeconomic differences in rates of cesarean section. N Engl J Med 321(4):233–239
28. Joseph KS, Dodds L, Allen AC, Jones DV, Monterrosa L, Robinson H, Liston RM, Young DC (2006) Socioeconomic status and receipt of obstetric services in Canada. Obstet Gynecol 107(3): 641–650