

Optimal Gestational Weight Gain in Chinese Women with Twin Pregnancy

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Objectives: To propose an optimal gestational weight gain (GWG) guideline for Chinese women with twin pregnancy and to assess the neonatal and maternal outcomes based on the proposed guideline.

Methods: Records of women who delivered dichorionic diamniotic twins after 24 weeks of gestation at Tuen Mun Hospital between 2012 and 2016 were retrospectively reviewed. They were classified according to their pre-pregnancy body mass index (BMI) as underweight/normal weight or overweight/obese. An optimal GWG was proposed for each group by deriving the interquartile range of GWG in women who delivered twins with a birthweight of ≥ 2500 g at 37-42 weeks of gestation. Women were categorised as having GWG below, between, or above the proposed standard. Maternal characteristics and neonatal and maternal outcomes of the three GWG categories were compared.

Results: A total of 171 women were identified. Of them, 25 were underweight, 100 normal weight, 18 overweight, and 28 obese, according to the Asian BMI classification. Only 48 of 171 women delivered twins with a mean birthweight of ≥ 2500 g at 37-42 weeks of gestation. Respectively in underweight/normal weight and overweight/obese women with twin pregnancy, a GWG of 15.15 to 23.90 kg (0.41-0.65 kg per week) and 13.10 to 17.30 kg (0.35-0.47 kg per week) was proposed. In underweight/normal weight women, those with GWG below the standard had significantly increased odds of spontaneous preterm labour, one or both twins with a birthweight of < 1500 g, one or both twins with a birthweight of < 2500 g, delivery at ≤ 34 weeks, and any twin requiring neonatal intensive care unit admission.

Conclusion: In underweight/normal weight Chinese women with twin pregnancy, those with a GWG below 15.15 kg had increased risks of giving birth to low or very low birthweight babies, spontaneous preterm labour, and delivery at ≤ 34 weeks.

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Introduction

Gestational weight gain (GWG) is associated with maternal and neonatal outcomes: a low GWG is associated with increased risk of having small-for-gestational-age babies and preterm delivery, whereas an excessive GWG is associated with increased risk of having large-for-gestational-age babies, macrosomia, and caesarean delivery¹. Most such studies have been of singleton pregnancies; evidence for multiple pregnancies is lacking. The 2009 Institute of Medicine (IOM) guideline provisionally recommends specific ranges of GWG for women with twin pregnancy: those of normal weight should gain 17 to 25 kg, overweight 14 to 23 kg, and obese 11 to 19 kg. Information for underweight women with twins is insufficient. Nonetheless, the guideline was based on the interquartile range of GWG of American women who delivered twins weighing ≥ 2500 g at 37 to 42 weeks of gestation. Asian populations in general have less GWG². According to a retrospective study of 8209 singleton pregnancies in Chinese, only 42.7% of

pregnancies achieved the IOM recommended GWG and they were at increased risk of macrosomia³. The World Health Organization suggests a different body mass index (BMI) classification for Asians⁴. The IOM guideline may not be applicable to the Chinese population. This study aimed to propose an optimal GWG guideline for Chinese women with twin pregnancies, and to assess the maternal and neonatal outcomes based on the proposed guideline.

Materials and Methods

This retrospective cohort study was approved by the New Territories West Cluster Research Ethics Committee. Records of dichorionic diamniotic live twin deliveries after 24 weeks of gestation by Chinese women at Tuen Mun Hospital between 2012 and 2016 were retrospectively

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reviewed. The chorionicity and amnionicity were confirmed by histopathological examination of the placentae. Women with monochorionic twins were excluded, as they were at greater risk of poor perinatal outcomes owing to the risk of twin-twin transfusion syndrome and discordant fetal growth restriction⁵. Women with a twin pregnancy that resulted from fetal reduction or miscarriage were also excluded, as were women with intrauterine fetal demise of one or both twins, pregnancies with congenital anomalies, and women with chronic hypertension or pre-existing diabetes, as neonatal and maternal outcomes could be affected.

Maternal characteristics were collected including age, pre-pregnancy BMI, gravidity, parity, and smoking status. Primary neonatal outcomes were gestational age at delivery, birthweight of the larger and smaller twins, spontaneous preterm labour, one or both twins with birthweight of <1500 g or <2500 g, and neonatal intensive care unit (NICU) admission. Secondary maternal outcomes were preeclampsia and gestational diabetes.

Pre-pregnancy BMI was calculated at the first antenatal visit using the self-reported pre-pregnancy weight and height. Asian BMI classification was used to stratify the pre-pregnancy BMI: underweight (<18.5 kg/m²), normal weight (18.5-22.9 kg/m²), overweight (23-24.9 kg/m²), or obese (≥25 kg/m²)⁴.

GWG was the weight at delivery minus the pre-pregnancy weight. GWG per week was calculated by dividing GWG with the gestational age at delivery in weeks. Our proposed GWG was derived from the interquartile range of GWG in our women who delivered twins with a birthweight of ≥2500 g at 37-42 weeks of gestation, as in the 2009 IOM guideline¹.

Women were categorised as having GWG below, between, or above the proposed standard. Maternal characteristics and neonatal and maternal outcomes of the three GWG categories were compared using the ANOVA for continuous variables and the Chi squared test or Fisher's exact test for categorical variables. Univariate analysis and logistic regression analysis of the neonatal and maternal outcomes were performed. A p value of <0.05 was considered statistically significant. Statistical analysis was performed with SPSS (version 22; IBM Corp, Armonk [NY], US).

Results

A total of 171 women were identified. Of them, 25 were underweight, 100 normal weight, 18 overweight, and 28 obese, according to the Asian BMI classification (Table 1). Only 48 of 171 women delivered twins with a birthweight of ≥2500 g at 37-42 weeks of gestation (Table 1). Respectively in underweight/normal weight and overweight/obese women with twin pregnancy, a GWG of 15.15 to 23.90 kg (0.41-0.65 kg per week) and 13.10 to 17.30 kg (0.35-0.47 kg per week) was proposed. The two groups of women were further categorised as having GWG below, between, or above our proposed standard. Women of the three categories were comparable in terms of age, nulliparity, and smoking status (Table 2).

In univariate analysis, in underweight/normal weight women, birthweight of the larger and smaller twins increased with increasing GWG (p=0.001 and p=0.002, respectively). In women with GWG below the standard, 24.4% and 14.6% had one or both twins with a birthweight of <1500 g, respectively. In women with GWG above the standard, 0% had one or both twins with a birthweight of <1500 g. In overweight/obese women, those with GWG

Table 1. Calculation of proposed gestational weight gain (GWG) for Chinese women with twin pregnancy

Classification of Asian pre-pregnancy body mass index, kg/m ²	Gestation at delivery, w*	GWG, kg*	GWG per week, kg*	No. of women who delivered twins with a birthweight of ≥2500 g at 37-42 weeks of gestation	Proposed GWG per week, kg*	Proposed GWG at 37 weeks, kg*
Underweight (<18.5) [n=25]	34.8±2.2	19.2±6.0	0.55±0.16 (0.41-0.71)	2	0.41-0.65	15.15-23.90
Normal (18.5-22.9) [n=100]	35.4±2.6	17.0±5.4	0.48±0.16 (0.37-0.59)	35		
Overweight (23-24.9) [n=18]	34.7±2.6	15.2±4.3	0.44±0.12 (0.33-0.54)	5	0.35-0.47	13.10-17.30
Obese (≥25.0) [n=28]	35.1±2.5	10.4±6.0	0.29±0.17 (0.19-0.39)	6		

* Data are presented as mean±standard deviation, mean±standard deviation (interquartile range), or interquartile range

Table 2. Univariate analysis of maternal characteristics and neonatal and maternal outcomes by comparing women with gestational weight gain (GWG) below, between, or above the proposed standard

Variable	Underweight/normal weight women				Overweight/Obese women			
	GWG below the standard (n=41)	GWG between the standard (n=62)	GWG above the standard (n=22)	p Value	GWG below the standard (n=21)	GWG between the standard (n=14)	GWG above the standard (n=11)	p Value
Maternal age, y	33.2±5.1	33.3±4.0	31.3±5.5	0.2	32.8±4.5	35.4±3.0	32.2±2.4	0.07
Nullipara	30 (73.2)	50 (80.6)	18 (81.8)	0.6	12 (57.1)	8 (57.1)	6 (54.5)	0.99
Smoker	0 (0)	1 (1.6)	2 (9.1)	0.07	0 (0)	0 (0)	0 (0)	-
Pre-pregnancy BMI, kg/m ²	20.8±1.8	20.2±1.7	19.2±2.3	0.005	26.5±2.3	25.9±1.5	24.8±1.4	0.09
Birthweight, g								
Larger twin	2196±600	2539±409	2588±459	0.001	2182±475	2585±323	2393±476	0.034
Smaller twin	1946±573	2263±422	2321±419	0.002	1944±451	2308±272	2170±493	0.044
Gestation at delivery, w	34.3±3.5	35.9±1.7	35.6±2.0	0.007	34.4±3.0	36±1.5	34.7±2.4	0.18
Spontaneous preterm labour	18 (43.9)	13 (21)	7 (31.8)	0.046	4 (19)	3 (21.4)	6 (54.4)	0.08
Delivery at ≤34 weeks	12 (29.3)	7 (11.3)	2 (9.1)	0.033	8 (38.1)	1 (7.1)	4 (36.4)	0.12
Any twin <1500 g	10 (24.4)	3 (4.8)	0 (0)	0.01	6 (27.3)	1 (5.9)	1 (14.3)	0.21
Both twins <1500 g	6 (14.6)	1 (1.6)	0 (0)	0.009	2 (9.1)	0 (0)	1 (14.3)	0.35
Any twin <2500 g	35 (85.4)	42 (67.7)	15 (68.2)	0.11	18 (85.7)	12 (85.7)	8 (72.7)	0.61
Both twins <2500 g	24 (58.5)	25 (40.3)	10 (45.5)	0.19	14 (66.7)	3 (21.4)	5 (45.5)	0.031
Any twin neonatal intensive care unit admission	33 (76.7)	54 (90)	19 (86.4)	0.18	7 (33.3)	3 (21.4)	4 (36.4)	0.67
Preeclampsia	4 (9.8)	7 (11.3)	3 (13.6)	0.90	0 (0)	1 (7.1)	0 (0)	0.31
Gestational diabetes	18 (43.9)	29 (46.78)	5 (22.7)	0.14	10 (47.6)	4 (28.6)	4 (36.4)	0.52

* Data are presented as No. (%) or mean±standard deviation

above or below the standard had comparable neonatal and maternal outcomes (Table 2).

In logistic regression analysis, in underweight/normal weight women, those with GWG below the standard had significantly increased odds of spontaneous preterm labour, one or both twins with a birthweight of <1500 g, one or both twins with a birthweight of <2500 g, delivery at ≤34 weeks, and any twin requiring NICU admission (Table 3). In women with GWG above the standard, none of the twins had a birthweight of <1500 g. Women with GWG above or below the standard were comparable in terms of spontaneous preterm labour, one or both twins with a birthweight of <2500 g, delivery at ≤34 weeks, preeclampsia, and gestational diabetes.

When classified according to the 2009 IOM guideline, 25 women were underweight, 118 normal

weight, 26 overweight, and 2 obese. 52.5% of normal weight women, 73.1% of overweight women, and 100% of obese women had a GWG below the IOM recommendation (Table 4). The 2009 IOM guideline may not be applicable to Chinese women with twin pregnancy.

Discussion

The optimal GWG for Chinese, Korean, and Singaporean populations with a singleton pregnancy has been reported to be lower than that recommended by the IOM^{3,6-9}. Asian populations that adhered to the IOM guideline have been reported to be at increased risk of macrosomia and caesarean delivery^{3,8}. An ethnic-specific GWG standard for twin pregnancies is required.

In our study, respectively in underweight/normal weight and overweight/obese women with twin pregnancy, a GWG of 15.15 to 23.90 kg (0.41-0.65 kg per week) and

Table 3. Logistic regression of maternal and neonatal outcomes by comparing women with gestational weight gain (GWG) below or above the proposed standard

Variable	Adjusted odds ratio (95% confidence interval)			
	Underweight/normal weight women		Overweight/obese women	
	GWG below the standard	GWG above the standard	GWG below the standard	GWG above the standard
Preeclampsia	1.11 (0.29-4.18)	0.84 (0.18-3.86)	-	-
Gestational diabetes	1.18 (0.51-2.69)	2.37 (0.73-7.65)	0.38 (0.08-1.92)	0.87 (0.13-6.07)
Delivery at ≤34 weeks	3.31 (1.15-9.55)	0.72 (0.13-3.92)	7.34 (0.66-81.24)	14.09 (0.69-223.17)
Spontaneous preterm labour	3.56 (1.40-9.06)	1.35 (0.418-4.33)	0.92 (0.16-5.41)	10.1 (0.98-93.4)
Any twin <1500 g	8.78 (1.99-38.63)	-	-	-
Both twins <1500 g	9.34 (1.06-82.60)	-	-	-
Any twin <2500 g	3.62 (1.23-10.65)	0.56 (0.17-1.85)	0.48 (0.05-4.56)	0.17 (0.15-1.98)
Both twins <2500 g	2.76 (1.15-6.63)	0.67 (0.21-2.11)	5.82 (1.00-33.71)	2.33 (0.31-17.3)
Any twin neonatal intensive care unit admission	3.27 (1.05-10.15)	1.31 (0.29-5.93)	1.31 (0.22-7.71)	2.85 (0.33-24.82)

Table 4. Percentage of women with gestational weight gain (GWG) below the Institute of Medicine (IOM) recommendation

Classification of IOM pre-pregnancy body mass index, kg/m ²	IOM recommended GWG, kg	Mean±SD (interquartile range) GWG, kg	No. (%) of women with GWG below the IOM recommendation
Underweight (<18.5) [n=25]	-	19.2±6.0 (13.5-24.6)	-
Normal (18.5-24.9) [n=118]	17-25	16.7±5.3 (13.0-20.5)	62 (52.5)
Overweight (25.0-29.9) [n=26]	14-23	10.8±6.0 (6.6-14.2)	19 (73.1)
Obese (≥30.0) [n=2]	11-19	5.8±3.2 (3.5-8)	2 (100)

13.10 to 17.30 kg (0.35-0.47 kg per week) was proposed. This proposed standard was lower than the IOM GWG recommendation of 17-25 kg (0.46-0.68 kg per week) for normal weight women, 14-23 kg (0.38-0.62 kg per week) for overweight women, and 11-19 kg (0.3-0.51 kg per week) for obese women¹.

In our study, underweight/normal weight women with a GWG below the proposed standard had increased odds for spontaneous preterm labour, one or both twins with a birthweight of <1500 g and <2500 g, and preterm delivery at ≤34 weeks. In women with a GWG above the standard, neither of the twins had a birthweight of <1500 g. Birthweight of both the larger and smaller twins increased with increasing GWG. Studies that used the IOM standard for twin pregnancies have also reported similar neonatal outcomes^{10,11}. Compared with women with GWG below the IOM standard, women with normal GWG had a reduced

rate of preterm delivery before 34 weeks (odds ratio=4.97, 95% confidence interval=1.76-14.02)¹². Women carrying twins who had normal BMI-specific GWG had an improved preterm birth rate, neonatal birthweight, and composite neonatal outcomes¹³. In a systematic review, GWG was positively associated with fetal size¹⁴. Nonetheless, the effect of GWG on hypertensive disorders and gestational diabetes in women with twin gestations was inconsistent, because maternal complications may also affect GWG¹⁴. According to the IOM guideline, GWG at the time of diagnosis of preeclampsia and gestational diabetes should be used instead of GWG at delivery¹.

In our study, GWG per week rather than total GWG was used to avoid the problem of prematurity, as >50% of twins were born before 37 weeks of gestation¹⁵. In addition, GWG is not linear throughout pregnancy. Women gain less weight in the first trimester than in the second and third

trimesters¹⁶. The proposed GWG should be interpreted with caution, especially during the first trimester, to avoid anxiety about inadequate weight gain. Trimester-specific GWG goals can provide better monitoring. To eliminate a potential error in self-reporting, body weight at first visit (if early enough) can be used although the time of the first visit may vary. In our study, the number of overweight/obese women was too small to determine the effect of GWG on neonatal and maternal outcomes. A territory-wide sample over a longer period is needed.

Conclusion

In underweight/normal weight Chinese women with twin pregnancy, those with a GWG below 15.15 kg had increased risks of giving birth to low or very low birthweight babies, spontaneous preterm labour, and delivery at ≤ 34 weeks.

Declaration

All authors have no conflicts of interest to disclose.

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