

Association Between Pregnant Women's Pre-pregnancy BMI and Their Eating Behavior, General Health Status, as Well as the Infant Birth Weight

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We assessed abnormal eating behaviors using the modified EAT and the general health status using the GHQ28, surveyed the maternal weight gain and infant birth weight data, and evaluated and classified 91 pregnant women according to three pre-pregnant BMI group.

The thin group classified according to the pre-pregnancy BMI was significantly younger than the normal weight or obese group. Maternal weight gain in the thin group was within the recommended range, but was the lowest among the 3 groups. In the normal weight group, the GHQ28 score was significantly higher during the early pregnancy period compared to later period, suggesting improvement in the general health status during the late pregnancy period. The obese group showed a higher modified EAT score than the other two groups, suggesting certain eating behavior problems. The general health status in the obese group was persistently poor during both early and late pregnancy periods, which differed from the results in the thin and healthy weight groups.

key words: pregnancy, eating behavior, General health, pre-pregnancy BMI

Introduction

The infant and pregnant woman mortality rates in Japan have markedly decreased, and Japan is one of the countries showing the most favorable status in terms of maternal and child health indicators at present. On the other hand, the birth weights of both male and female infants reached a peak in 1975, and tended to decrease thereafter. This trend was not observed in other advanced countries (Health, Labour and Welfare Statistics Association, 2011/2012).

A National Health and Nutrition Survey in 2009 showed that 7.2% of females aged 20–29 years are overweight, and 22.3% are underweight. The high percentage of underweight females in this age group is characteristic of Japan (National Health and Nutrition Survey, 2009). This has been suggested to be associated with admiration of “thin” women as a

cultural background and “the desire to be thin” enhanced by the mass media (Okuda & Okamoto, 2005). There have been many studies on “thinness” and eating disorders in young women, reported moderate or severe eating disorders in 20–30% of female college students (Sato, 2004). Eating disorders are psychosomatic disorders frequently observed during puberty and adolescence. Certain physical disorders adversely affect general health, resulting in abnormal eating behaviors such as food refusal and overeating (Hinokuma & Kodama, 2010). Okuda et al. speculated that there are a large number of females who experience deviated eating behaviors such as “overeating” or “food refusal” even though they do not develop eating disorders (Okuda & Okamoto, 2005).

As factors associated with the decrease in birth weight in Japan, increases in young females who smoke, or are thin have been suggested (Takimoto,

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2006). In addition, low birth weight infants were reported to show an increased mortality rate due to cardiovascular disease and an increased risk of developing disorders such as metabolic syndrome, cancer, osteoporosis, and psychoneurological diseases during adulthood (Miyamoto, 2009). Thus, problems associated with women's thinness and pregnancy are important for maternal and child health.

Many studies have shown the lowest infant birth weight to be associated with "thin" pregnant women (Nishii, Ohkawara, Noda, Ushiro, Mochizuki, Taguchi, & Uchino, 2007; Takimoto, Yoshiike, & Kato, 2010), but there have been only a few studies in which both pregnant women's eating behavior and general health status were also investigated. Therefore, we performed a survey to evaluate pregnant women's eating behavior, general health status, and the infant birth weight according to the pre-pregnancy BMI.

Study methods

1. Subjects of survey

Of pregnant women who visited 5 medical institutions in city A, those with a spontaneous single pregnancy without illness requiring treatment who gave consent regarding the study purpose were included as the subjects.

2. Methods of survey

1) Survey period; January–November 2010

2) Survey protocol

(1) Consent for the study: After pregnancy was confirmed (confirmation of fetal heart beats), informed consent was obtained from pregnant women at less than week 10 of pregnancy.

(2) Early pregnancy period survey (weeks 12–16)

A questionnaire survey (general background, presence or absence of a history of smoking/drinking, the short EAT-26, GHQ28)

Transfer of basic information from medical records by physicians (such as the pre-pregnancy BMI and past history).

(3) Late pregnancy period survey (weeks 32–36)

A questionnaire survey (the smoking/drinking status during pregnancy, GHQ28)

(4) Survey at delivery

Transfer of information from medical records by physicians (such as the birth weight and pregnancy/delivery course)

3. Contents of survey

1) Short EAT-26

The original Eating Attitudes Test (EAT) is an eating behavior questionnaire that consists of 40 items to evaluate the eating attitude and behavior problems in patients with eating disorders (Garner, Olmsted, Bohr, & Garfinkel, 1982). At present the short EAT-26, consisting of 26 items, is widely used to evaluate eating behavior in healthy people as well as patients during not only puberty but also adulthood (Mukai, Crago, & Shisslak, 1994). A 6-point scoring system from never (1 point) to always (6 points) is used. There are 3 subscales, "Dieting", "bulimia and food preoccupation", and "oral control". A higher score indicates more serious eating behavior problems. According to the scoring system of the original version proposed by Garner et al. (1984), 0 points are given to "never", "rarely", and "sometimes", and 1, 2, and 3 points are given to "often", "very often", and "always", respectively. However, when those considered to be mostly healthy persons are used as subjects, the score distribution is markedly biased. Therefore, Wells, Coope, Gabb, & Pears (1985) proposed a 1–6 scoring system. In the latter scoring method, the degree of eating behavior abnormality is considered to be a continuous variable. Using this scoring system as well as the scoring system of the original version, a higher score indicates more marked behavioral abnormality (Mukai et al., 1994). Since the subjects of this survey were also expected to be healthy pregnant women, the 1–6 scoring system was selected. Therefore, the consistency of the factor structure of EAT-26 between the study by Garner et al. (1984) and this study was confirmed.

Factor analysis of EAT-26 was performed using varimax rotation of the principal factor method, and 6 items showing low loadings (<0.35) among all items were deleted. As a result, 3 factors and 20 items were extracted, and the validity of the following interpretation was confirmed: Factor 1, 9 items of "Dieting", Factor 2, 7 items of "bulimia and food preoccupation", and factor 3, 4 items of "oral control". The reliability coefficient (α) for each factor was ≥ 0.7 , and the cumulative factor contribution rate was 42.88%. Although 6 items were deleted, consistency of the factor structure was generally confirmed, and we considered that the 20 items can be analyzed in this study (Table 1). Modified EAT.

2) GHQ28

The General Health Questionnaire (GHQ) is a screening test developed by Goldberg & Hillier in England (1979), and be useful for detecting neurosis and evaluating its symptoms. A short 28-item Japanese version of GHQ (GHQ28) was developed by Nakagawa and Daibo (1985), and is widely used. The reliability and validity of GHQ28 have been confirmed, and the total score and scores for 4 subscales (somatic symptoms, anxiety and insomnia, social dysfunction, and depression) can be evaluated. The maximum score is 28, and the minimum score is 0. A higher score indicates more serious mental health problems. The cutoff point for the total score to evaluate the mental health state is 5/6.

4. Ethical considerations

This study was performed with the approval of the Ethical Committee of University of Occupational and Environmental Health (No. 08-91).

5. Statistical analysis

Factor analysis to confirm the factor structure of the questionnaire, the Kruskal–Wallis test, the Scheffe method as a post-hoc test, and multiple regression analysis were performed. $p < 0.05$ was re-

garded as significant. For data analysis, SPSS19.0 J was used.

Results

1. Subjects' background

The subjects consisted of 91 pregnant women who gave consent to this study and fulfilled the survey conditions. There were 31 primiparas and 60 multiparas without a significant difference in the mean age.

The pre-pregnancy Kaup index (a synonym for BMI) criteria proposed by the Nutritional Issues Committee of the Japan Society of Obstetrics and Gynecology (Ichijo & Fukui, 1988) were used. According to the pre-pregnancy BMI, the subjects were classified into thin ($BMI < 18.0$), healthy weight ($HW: 18.0 \leq BMI < 24.0$), and obese ($BMI \geq 24.0$) groups. As a result, 8 subjects (8.6%) were included in the thin group, 68 (73.1%) in the HW group, and 15 (16.1%) in the obese group. The thin group (mean age, 26.1 ± 5 years) was significantly younger ($p < 0.01$) than the HW or obese group (Table 2).

All subjects delivered a full-term child (gestational age: 37 weeks and 2 days–41 weeks and 5 days).

Table 1 Results of factor analysis of EAT-26 scores (principle factor method/varimax rotation)

Item No.	Item	Factor 1	Factor 2	Factor 3	Communality
Factor 1	Dieting ($\alpha=0.811$)				
23	Engage in dieting behavior.	.793	.055	.221	.682
11	Am preoccupied with a desire to be thinner.	.706	.376	.217	.687
17	Eat diet foods.	.694	.057	-.112	.497
1	Am terrified about being overweight.	.549	.400	.089	.470
19	Display self-control around food.	.513	-.021	.187	.299
12	Think about burning up calories when I exercise.	.477	.122	.144	.263
2	Avoid eating when I am hungry.	.451	.068	-.083	.215
16	Avoids food with sugar in them.	.445	.213	-.073	.248
5	Cut my food into small pieces.	.443	-.072	.251	.255
Factor 2	Bulimia and food preoccupation ($\alpha=0.726$)				
18	Feel that food controls my life.	.152	.718	-.048	.541
10	Feel extremely guilty after eating.	.178	.710	.138	.555
21	Give too much time and thought to food.	.124	.562	.087	.339
22	Feel uncomfortable after eating sweets.	.008	.534	.265	.355
14	Am preoccupied with the thought of having fat on my body.	.520	.526	.153	.571
4	Have gone on eating binges where I feel that I may not be able to stop.	-.015	.477	.059	.231
3	Find myself preoccupied with food.	.212	.376	.248	.248
Factor 3	Oral control ($\alpha=0.753$)				
26	Have the impulse to vomit after meals.	.019	.276	.889	.867
20	Feel that others pressure me to eat.	.122	-.102	.651	.449
9	Vomit after I have eaten.	.040	.333	.610	.484
25	Enjoy trying new rich foods.	.118	.222	.508	.321
	Factor contribution	3.41	2.89	2.28	
	Contribution ratio	17.03	14.45	11.40	
	Cumulative contribution ratio	17.03	31.49	42.88	

Table 2 Subjects' background

n=91

		Number (%)	Mean age
Pre-pregnancy BMI	Thin group (BMI<18.0)	8 (8.6%)	26.1±5.0
	HW group (18.0≤BMI<24.0)	68 (73.1%)	31.7±4.6
	Obese group (24.0≤BMI)	15 (16.1%)	32.2±4.6

Kruskal-Wallis test, after Scheffe ***p*<0.01**Table 3** EAT-26 scores in the 3 pre-pregnancy BMI groups

Modified EAT	Total scores	Factor 1 Dieting	Factor 2 Bulimia and food preoccupation	Factor 3 Oral control
Thin group	25.4±5.2	12.5±4.3	8.5±1.6	4.4±0.5
HW group	32.3±9.5	17.5±6.4	9.8±3.0	5.1±2.3
Obese group	40.1±9.7	22.6±6.4	12.7±4.4	4.9±1.5

Kruskal-Wallis test, after Scheffe ***p*<0.01, **p*<0.05**Table 4** GHQ28 scores in the 3 pre-pregnancy BMI groups

	Thin group	HW group	Obese group
Early pregnancy period, total GHQ28 score	6.5±3.4	7.4±4.9	6.3±4.7
Somatic symptoms	2.5±1.6	3.0±1.9	2.3±1.9
Anxiety	2.4±1.1	2.8±1.8	2.3±2.1
Social dysfunction	1.4±1.2	1.5±1.9	1.6±2.2
Depression	0.3±0.5	0.2±0.7	0
Late pregnancy period, total GHQ28 score	5.8±5.1	5.3±4.5	6.6±3.8
Somatic symptoms	1.9±1.8	1.8±1.7	2.1±1.4
Anxiety	2.4±1.9	2.1±1.7	2.7±1.6
Social dysfunction	1.3±1.3	1.4±1.6	1.5±1.8
Depression	0.3±0.7	0.1±0.4	0.3±0.5

t-test ***p*<0.01

No severe gestational complications were observed in any subject.

2. Modified EAT in the 3 pre-pregnancy BMI groups

The total Modified EAT score was significantly higher in the obese group than in the thin group (*p*<0.01). The score for Factor 1 "dieting" was significantly higher in the obese group than in the thin (*p*<0.01) or HW group (*p*<0.05). The score for Factor 2 "bulimia and food preoccupation" was also significantly higher in the obese group than in the thin (*p*<0.01) or HW group (*p*<0.05). The score for Factor 3 "oral control" did not significantly differ among the 3 groups.

In this study, the score for each item of Factors 1-2 of Modified EAT was the highest in the obese group, followed in order by the HW and thin groups. These results showed that there was no rela-

tionship between the thin group and eating behavior problems (Table 3).

When a 0-3 scoring system is used for the short EAT-26, a total score ≥ indicates eating disorder (anorexia nervosa) (Kawano, Ozaki, Kozaki, Takaba, Tsuchimoto, Makino, Ito, Kajii, Saigo, Terawaki, Muto, Muto, & Kambe, 2005). In this survey, evaluation using a 0-3 scoring system showed a total score ≥20 in only 1 of the 91 pregnant subjects, and the subject belonged to the obese group.

3. GHQ28 scores in the 3 pre-pregnancy BMI groups

Both early and late pregnancy period surveys showed no significant difference among the 3 groups in the total GHQ28 score or the score for any item in "somatic symptoms", "anxiety", "social dysfunction", and "depression" (Table 4).

Comparison between the early and late period

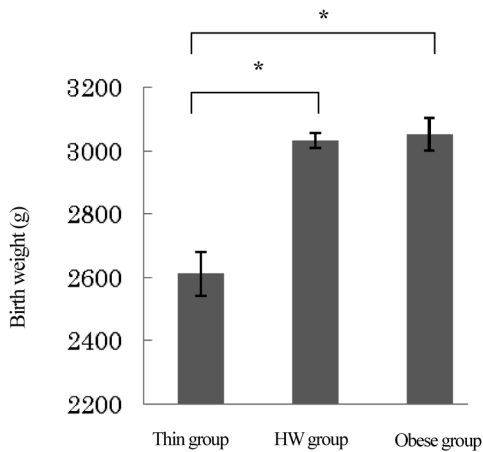


Figure 1 Infant birth weights in 3 pre-pregnancy BMI groups
Kruskal–Wallis test, after Scheffe * $p < 0.05$

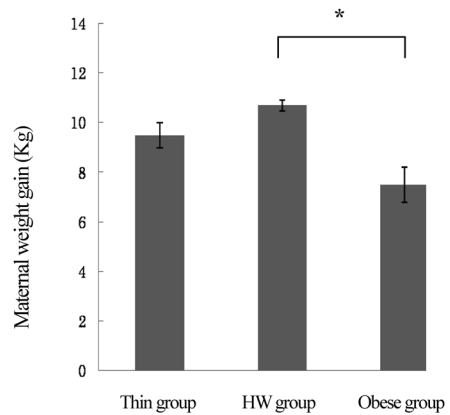


Figure 2 Maternal weight gains in 3 pre-pregnancy BMI groups
Kruskal–Wallis test, after Scheffe * $p < 0.05$

surveys showed significant decreases in the total score and the score for “somatic symptoms” ($p < 0.01$ for both) and slight decreases in the scores for all items in “anxiety”, “social dysfunction”, and “depression” in the late survey in the HW group. The thin group also showed slight decreases in the scores for “somatic symptoms” and “social dysfunction”. Based on these results, the general health status was poorer during the early pregnancy period than during the late pregnancy period in the healthy weight and thin groups. On the other hand, the obese group showed slight increases in the total score and the scores for “anxiety” and “depression” in the late pregnancy period. The cutoff point of the total GHQ28 score is 5/6, and a score ≥ 6 indicates certain problems. These results suggest a persistently poor general health status during both early and late pregnancy periods in the obese group. There was no association between EAT-26 and GHQ28 in the early pregnancy period in any group.

4. Association between pre-pregnancy BMI and infant birth weight or maternal weight gain

The mean infant birth weight was lower ($p < 0.05$) in the thin group ($2,612 \pm 373$ g) than in the HW or obese group (Figure 1).

The maternal weight gain calculated by subtracting the pre-pregnancy weight from the weight immediately before delivery was 9.5 ± 0.1 kg in the thin group, 10.7 ± 0.5 kg in the healthy weight group, and 7.6 ± 1.5 kg in the obese group, being significantly smaller ($p < 0.05$) in the obese group

than in the healthy weight group (Figure 2).

Discussion

1. “Thinness” and pregnancy in young females in Japan

When females are classified as a thin group according to the pre-pregnancy BMI, the risk of pregnancy complications such as delivery of a low birth weight infant, intrauterine growth retardation, and imminent premature delivery has been shown to increase. In addition, an association between birth weight and metabolic syndrome during adulthood has also been suggested. Concrete mechanisms should be clarified in the future for the association between thinness in young females as a social problem in Japan and low infant birth weight and the development of lifestyle-related diseases during adulthood.

2. Comparison among the 3 pre-pregnancy BMI groups

1) Thin group

Of the 91 pregnant women in this survey, only 8 (8.6%) were included in the thin group. However, the thin group was significantly younger than the HW or obese group, showing that young females were often classified as the thin group as in previous surveys. In Japan in 2009, the mean maternal age at the birth of the first child was 29.7 years, and that at the birth of the second child was 31.7 years. Therefore, the subjects of this study were regarded as an average population in Japan (Health, Labour and

Welfare Statistics Association, 2011/2012).

Modified EAT for the evaluation of eating behavior was the lowest in the thin group among the 3 groups, showing no abnormal eating behavior in this group in this study. EAT is widely used as an index for evaluating the mentality characteristic of patients with eating disorder and particularly for the severity of the desire to be thin, fear of obesity, and eating restrictions. However, EAT is a questionnaire developed to evaluate the symptoms of anorexia nervosa, and, therefore, includes only a few question items regarding overeating characteristic of bulimia nervosa. To compensate for this, EAT-26 should be used in combination with other scales such as the Eating Disorder Inventory for the detection of a borderline eating disorder group among healthy persons in future surveys (Okuda & Okada, 2005).

The GHQ28 score as an index of the general health status was poorer during the early pregnancy period in the thin group as well as the healthy weight group. Since the early pregnancy survey in this study was performed during the period (weeks 12–16) showing decreased but persistent symptoms of hyperemesis gravidarum, these results may markedly reflect the physical symptoms of hyperemesis gravidarum.

The infant birth weight was significantly lower in the thin group than in the other 2 groups, which was consistent with previous studies. The maternal weight gain during the entire pregnancy period according to the physique recommended by the Ministry of Health, Labour and Welfare is 9–12 kg in the thin group, 7–12 kg in the HW group, and individually decided in the obese group. In this study, the maternal weight gain in the thin group was 9.5 ± 0.1 kg, which was within the above recommended range, but was significantly smaller than the weight gain in the other 2 groups. A survey by the Ministry of Health, Labour and Welfare in 2010 showed that the median birth weight of infants born at 40 weeks of pregnancy was 3,000 g in male infants and 2,940 g in female infants. In this study, the infant birth weight was standard in the healthy weight and obese groups, but significantly lower in the thin group. In the thin group, although the maternal weight gain was appropriate, the infant birth weight was the lowest. These results suggest that the infant birth weight is affected by not only nutritional intake during pregnancy, but also other factors such as

the health and nutritional statuses before pregnancy. In the thin group in this study, no abnormal eating behavior was observed, and the maternal weight gain during pregnancy was appropriate, whereas the infant birth weight was the lowest. These results suggest that interventions to correct wrong body image perceptions are necessary in young females before pregnancy.

2) HW group

Using the modified EAT, the total score and scores for two items in “Factor 1: dieting”, “Factor 2: bulimia and food preoccupation” in the healthy weight group were between those in the thin and obese groups. No abnormal eating behavior was observed in the healthy weight group as well as the thin group. In addition, the healthy weight group showed an appropriate maternal weight gain (10.7 ± 0.5 kg) and a standard infant birth weight.

Comparison of the GHQ28 score for the evaluation of the general health state between the early and late pregnancy periods showed significant decreases in the total score and the score for somatic symptoms in the HW group. Since pregnant women in the HW group account for 73.1% (68 of 91) in this survey, these results suggest that general health state of the early pregnant women were poorer and suggesting improvement in the general health status during the late pregnancy period. A survey by Anan, Shiiba, Sibata, Tanaka, & Kawamoto (2012) reported that urinary 8OH-dG as an excellent oxidation stress marker for the measurement of physical stress was higher in the early pregnancy period and decreased in the late pregnancy period. The general health status was poorer during the early pregnancy period, which may have been most closely associated with the symptoms of hyperemesis gravidarum in this group as well as the thin group. Psychological care and health guidance are important during the early pregnancy period.

3) Obese group

The total score of the modified EAT as an indicator of eating behavior was significantly higher in the obese group than in the thin group. As subscales, the scores for “dieting” and “bulimia and food preoccupation” were significantly higher in the obese group than in the healthy or thin group. The maternal weight gain obtained by subtracting the pre-pregnancy weight from the weight immediately before delivery was 9.5 ± 0.1 kg in the thin group, 10.7

± 0.5 kg in the healthy weight group, and 7.6 ± 1.5 kg in the obese group. The maternal weight gain in the obese group was significantly smaller than that in the healthy weight group and the smallest among the 3 groups. Since pre-pregnant obesity increases the risks of gestational diabetes mellitus, fetal macrosomia, and pregnancy-induced hypertension, strict weight control interventions are performed in obese pregnant women. In the subjects of this survey, educational weight control interventions by physicians and nurses in each medical institution may have markedly affected eating behavior in the obese group, inhibiting weight gain. However, the modified EAT score in the obese group was higher than that in the other groups, suggesting the presence of certain eating behavior problems. Concerning the GHQ28 as an index of the general health status, the obese group showed a persistently high total score and scores for anxiety and depression even during the late pregnancy period, suggesting a persistently poor general health status during both early and late pregnancy periods. Whether or not the poor general health status was due to the diet was unclear, but appropriate dietary interventions and psychological care are necessary in obese pregnant women.

Conclusions

This survey showed no eating behavior problems in the thin group. However, the infant birth weight was significantly lower in the thin group than in the HW or obese group, which was consistent with the results of previous surveys. In the thin group, although the maternal weight gain was appropriate during the entire pregnancy period, the infant birth weight was the lowest among the 3 groups. The concrete scientific mechanism for the influences of women's "thinness" and nutritional intake during pregnancy on the infant birth weight or outcome has been not adequately clarified. In the future, early educational dietary interventions are necessary so that young females can improve their diet, and will not have the wrong body image before pregnancy.

The general health status according to the pregnancy period was poorer during the early pregnancy period, and improved during the late pregnancy period in the healthy weight and thin groups. In this study, since the early pregnancy survey was performed during the period showing persistent symp-

toms of hyperemesis gravidarum, these results may have markedly reflected the physical symptoms of hyperemesis gravidarum. This poor general health status during the early pregnancy period in many pregnant women supports the necessity of health support during the early pregnancy period in all pregnant women.

In the obese group, the general health status was persistently poor during the late as well as early pregnancy period. The modified EAT score in this group was higher than that in the other two groups. Appropriate weight control interventions and psychological care such as adequate listening to worries and problems are necessary in obese pregnant women. Dietary and body image interventions in young women before pregnancy should be performed in not only thin but also obese women.

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