



## A diet and physical activity intervention for preventing weight retention among Taiwanese childbearing women: a randomised controlled trial

Tzu-ting Huang, PhD (RN)<sup>a,\*</sup>, Chieh-Ying Yeh, MSN (RN)<sup>b</sup>, Yc-Chen Tsai, MSN (RN)<sup>c</sup>

<sup>a</sup> School of Nursing, Chang-Gung University, 259, Wen-Hwa 1st Road, Kwei-Shan, Taoyuan, Taiwan

<sup>b</sup> Health Station of Taoyuan City, Taiwan

<sup>c</sup> Tainan Municipal Hospital, Tainan, Taiwan

### ARTICLE INFO

#### Article history:

Received 26 May 2008

Received in revised form

18 December 2008

Accepted 7 June 2009

#### Keywords:

Weight retention

Intervention

Pregnancy

Post partum

### ABSTRACT

**Objective:** to examine the effect of individual counselling on diet and physical activity from pregnancy to six months post partum, or from birth to six months post partum, on weight retention among Taiwanese women.

**Design:** a randomised controlled trial assigned participants to two experimental groups [from pregnancy to six months post partum (EP) and from birth to six months post partum (EPP)] and one comparison group.

**Setting:** a 3900-bed medical centre in northern Taiwan with around 3000 births annually.

**Participants:** a sample of 189 women who had regular check-ups during pregnancy and gave birth at the medical centre.

**Interventions:** the comparison group received the routine outpatient department obstetric educational programme. The EP group attended regularly scheduled clinic visits with individualised dietary and physical activity education plans from 16 gestational weeks to six months post partum, and received on brochure. The EPP group received the same educational intervention as the EP group from 24–48 hours after birth to six months post partum.

**Measurements:** body weight, body mass index, health-promoting behaviour and psycho-social variables (self-efficacy, body image, depression and social support).

**Findings:** average gestational weight gain was 14.02, 15.27 and 16.22 kg in the three EP, EPP and comparison groups respectively, and average weight retention at six months post partum was 2.34, 4.06 and 5.08 kg in the three groups, respectively.

**Key conclusions:** a diet and physical activity intervention from pregnancy is effective for reducing post-pregnancy weight retention.

**Implications for practice:** the findings of the present study should be taken into consideration when incorporating significant others and weight-loss maintenance strategies with interventions for a healthier family lifestyle.

© 2009 Elsevier Ltd. All rights reserved.

### Introduction

The increasing prevalence of overweight and obese individuals in the general population is a significant health concern in Taiwan (Department of Health, 2006). However, the National Nutritional Survey in Taiwan (Department of Health, 2002) reports that women are more likely than men to be overweight and obese (for those  $\geq 19$  years, 42.0% vs 37.7%; for those  $\geq 45$  years, 62.2% vs 43.0%, respectively). Furthermore, the prevalence of overweight and obese women of childbearing age is rising, with a large proportion of Taiwanese women gaining more than the recom-

mended weight during pregnancy (Kac et al., 2004a, b; Walker et al., 2005; Huang and Dai, 2007).

Recommended gestational weight gain (GWG) is associated with optimal fetal and maternal outcomes, whereas excessive weight gain increases the risk of pregnancy complications, infant macrosomia and caesarean birth (Abrams et al., 2000). Excessive GWG is also one of the main factors explaining high postpartum weight retention (Gunderson and Abrams, 2000; Siega-Riz et al., 2004; Huang and Dai, 2007; Kinnunen et al., 2007a, b; Huang et al., 2010). The GWG recommended by the Department of Health in Taiwan is 10–14 kg regardless of body size.

The transition to motherhood offers an opportunity to study weight concerns and weight management strategies during a period of weight fluctuation that is part of a life transition for many women. Pregnancy marks the beginning of a life stage in

\* Corresponding author.

E-mail address: [thuag@mail.cgu.edu.tw](mailto:thuag@mail.cgu.edu.tw) (T.-t. Huang).

which women think not only of their nutritional needs and weight goals, but also of the needs of their child. During pregnancy, women were found to decrease their exercise and be more liberal with their diet, and during the postpartum period, they delayed returning to their pre-pregnancy diet and exercise practices (Devine et al., 2000).

In the postpartum period, weight retention has been associated with disappointment, surprise, symptoms of eating disorders, reduced self-esteem and depressive symptoms (Devine et al., 2000; Huang and Dai, 2007). Dissatisfaction with weight following childbirth has been positively associated with pre-pregnancy body mass index (BMI), GWG and postpartum BMI (Walker, 1998; Huang and Dai, 2007), as well as with greater long-term weight gain (Harris et al., 1997). Lifestyle factors related to excessive weight gain, eating behaviours and physical activity have played a major role in preventing and treating the overweight and obese (Wing et al., 2001). However, the role of diet and physical activity as determinants of GWG is still unclear (Siega-Riz et al., 2004; Kinnunen et al., 2007a, b). Nonetheless, behavioural interventions are needed to advise pregnant women on the recommended ranges of GWG, and to promote healthy diet and regular physical activity to prevent subsequent obesity and associated health problems (Siega-Riz et al., 2004; Huang and Dai, 2007; Kinnunen et al., 2007a, b; Huang et al., 2010). To reduce excessive weight gain in pregnancy and during the postpartum period, 15 intervention studies have been conducted in the past decade (Leermakers et al., 1998; Gray-Donald et al., 2000; Rae et al., 2000; Peterson et al., 2002; Polley et al., 2002; O'Toole et al., 2003; Olson et al., 2004; Stotland et al., 2005; Althuisen et al., 2006; Hui et al., 2006; Artal et al., 2007; Kinnunen et al., 2007a, b; Claesson et al., 2008; Onwude, 2008; Wolff et al., 2008). Of these studies, three provided postpartum interventions (Leermakers et al., 1998; Peterson et al., 2002; O'Toole et al., 2003), and only one study targeted all women (not only overweight/obese women) (Hui et al., 2006). Evidence to date does not clearly illustrate the most appropriate time to prevent weight retention. Furthermore, clinicians face the dilemma of whether to target women who are already overweight or obese, or those who are normal weight. The authors' previous findings indicated that women who were underweight before pregnancy were at risk of excessive GWG and weight retention (Huang and Dai, 2007). Therefore, GWG within the recommended range should be for all women, not just for those who are overweight or obese.

The aim of this study was to examine and compare the effect of individual counselling about diet and physical activity on child-bearing women during two periods: from pregnancy through to six months post partum, and from birth through to six months post partum.

## Methods

### Design

This study had a three-group randomised intervention design. In this design, subjects were randomly assigned to three groups: (1) experimental group EP (from 16 gestational weeks to six months post partum), (2) experimental group EPP (from birth through to six months post partum), and (3) a comparison group (usual care).

### Participants

To determine the sample size for this study, a power analysis was conducted. This analysis determined that to have a medium-level effect ( $q^2 = 0.28$ ) using a three-group MANOVA test with an

$\alpha$  level = 0.05, the total sample should be at least 132–174 subjects (power of 0.80–0.90) (Stevens, 1996). Considering the possible attrition of some subjects during the study period, at least 80 subjects were selected for each group.

Before subjects were recruited, the study was approved for human subject research by the institutional review board of the study site, a 3900-bed medical centre in northern Taiwan with an annual birth rate of around 3000. Each participant was assured of confidentiality and had the opportunity to decline to participate or to withdraw from the study at any time.

From January to June 2006, pregnant women were recruited from the obstetric clinics of the study site. A nurse research assistant (RA) explained the trial and recruited the participants before 16 weeks of gestation. The inclusion criteria were: age 18 years or older, no cognitive impairment or psychiatric illness, ability to speak and read Chinese, not participating in another study, and intention to give birth at the study site. The RA obtained written informed consent from each participant.

### Procedures for data collection

After obtaining informed consent, the RA collected baseline data from women in the three groups. Using a randomised table, the researcher assigned pregnant women to the comparison group or to one of the two experimental groups [the interventions differed in two ways: (1) different baselines and (2) different durations]. All subjects were interviewed at baseline (16 gestational weeks) and again six months post partum. At each interview, the RA, who was blind to the group assignments, evaluated participants regarding the outcomes (body weight, lifestyle behaviours, self-efficacy, body image, depression and social support).

### Interventions

#### Comparison group

Participants in the comparison group received the routine outpatient department obstetric educational programme for pregnant women, provided once each trimester. They also participated in face-to-face discussions in the health education room with nurse educators about individual concerns, e.g. sexual life during pregnancy, preparation for breast feeding, birth and first signs of labour. They also received leaflets on various topics: e.g. how your baby grows and develops each month, common disorders during pregnancy, information on medical problems during pregnancy and ways to deal with them, nutrition for baby and you, and exercise during pregnancy.

#### EP group

The first educational intervention began at 16 gestational weeks (baseline) and extended 12 months beyond baseline (to six months post partum). The intervention was delivered at regularly scheduled clinic visits by a master's-prepared nurse with training in nutrition and physical fitness.

The nurse discussed with each participant how to design an individualised dietary and physical activity education plan based on the participant's baseline information. The plan consisted of six one-to-one counselling sessions: one primary session (about 30–40 minutes) at the 16-week gestation visit, and five one-to-one booster sessions (at 28 gestational weeks, 36–38 gestational weeks, before hospital discharge after a three–seven-day stay, six weeks post partum and three months post partum). At the first session, the nurse and participant discussed the participant's diet and physical activity based on their baseline data (body weight, height and BMI). Goals were set for personal GWG (within

10–14-kg range) and weight retention, and examples were provided of a healthy diet and appropriate physical activity plan. After each clinic visit, women in the experimental groups were sent a personalised graph of their weight changes. At each booster session, participants submitted three-day records of their diet and self-monitored physical activity. Women were informed if their weight changes were within the appropriate ranges and were encouraged to maintain this healthy lifestyle. Those whose weight exceeded the recommended levels were given an additional assessment of current diet and physical activity (based on self-monitored records), problem solving and goal setting for diet and physical activity behaviours.

At the first session, the experimental groups also received a researcher-prepared brochure that provided detailed information on weight management goals during pregnancy and post partum, ideal body weight, diet (food categories, nutritional components, calorie calculations, balanced diet and personal diet plan) and physical activities (exercise categories and purpose, list of energy expenditure on various exercises).

#### *EPP group*

The second educational intervention began 24–48 hours after birth (baseline) and extended to six months post partum. The intervention was delivered at bedside in the obstetric units and during regularly scheduled clinic visits by the same nurse as for the EP group. Participants of this group and the EP group received the same intervention, but starting from the postpartum session (one primary counselling session, one brochure and two booster sessions at six weeks post partum and three months post partum).

#### *Measurements*

A researcher-developed demographic information form was used to collect information on age, marital status, education, employment and parity.

Health-promoting behaviour was measured by the Health-Promoting Lifestyle Profile (Walker et al., 1987), Chinese version (Huang and Chiou, 1996). This 50-item scale uses a four-point response format (range = 50–200) to measure the frequency of engaging in activities related to self-actualisation, nutrition, physical activity, interpersonal support, health responsibility and stress management. Cronbach's alpha reported for the total scale was 0.94 (Huang and Chiou, 1996); in the present study, Cronbach's alphas for the subscales ranged from 0.74 to 0.90.

Perceived self-efficacy for weight management was measured by the Self-Rated Abilities for Health Practices Scale (Becker et al., 1993), modified Chinese version (Huang, 1995). This scale measures beliefs about one's abilities to engage in health-promoting practices in the areas of nutrition, physical activity and/or exercise, psychological well-being and responsibility for health practices. Ratings for the 28 items are summed to yield a total score (range = 0–112). Responses are rated on a five-point scale from zero (not at all) to four (completely). Internal consistency of the total scale was 0.92, and the two-week test–retest reliability was 0.78 in this study.

Participants' feelings about their bodies (body image) were assessed by the Attitude toward Body Image Scale (ABIS) (Strang and Sullivan, 1985). The ABIS measures attitudes about 10 aspects of the body: body weight, chest, waist, buttocks, legs, feet, facial appearance, shoulder width, abdomen and hair. Responses were rated on a seven-point Likert scale from one (very positive feeling) to seven (very negative feeling). The face validity of ABIS was examined by five experts in midwifery and nursing, psychology and obstetrics who recommended adding items on three bodily aspects: skin, arms and figure. The maximum ABIS score is 91 points, with higher scores indicating a more negative body image.

In this study, Cronbach's alpha was 0.94 and two-week test–retest reliability was 0.83.

Depression was measured by the Beck Depression Inventory (BDI) (Beck and Steer, 1993), Chinese version (Ko et al., 1996). The BDI has 21 items, with responses rated on a four-point Likert scale; its reliability and validity have been assessed in a variety of samples. The BDI cutoff scores for determining depression in a Chinese population (Ko et al., 1996) have been suggested as nine or less for normal, 10 to 18 for minor depression, 19 to 29 for moderate depression, and 30 to 63 for severe depression. In this study, Cronbach's alpha was 0.85 and two-week test–retest reliability was 0.91.

Perceived social support was measured by the brief Chinese version (Chen et al., 1994) of the Interpersonal Support Evaluation List (ISEL) (Cohen and Hoberman, 1983), a multi-dimensional inventory that evaluates the impact of perceived availability of social support resources on health and well-being (Cohen and Hoberman, 1983; Cohen et al., 1985). The 16-item ISEL has four subscales with four questions in each of the following categories: (1) belonging (companionship support), (2) appraisal (emotional support or someone to talk to about problems), (3) self-esteem maintenance (positive statements when comparing oneself to others) and (4) instrumental support (availability of tangible material aid) (Cohen et al., 1985). Responses to the ISEL are rated on a four-point Likert scale from zero (definitely false) to three (definitely true). High ISEL scores indicate a more positive perception of social support. In this study, Cronbach's alpha was 0.86 and two-week test–retest reliability was 0.78.

#### *Data analysis*

Statistical analyses were conducted using Statistical Package for the Social Sciences Version 13.0 (SPSS Inc., Chicago, IL, USA). Baseline data for the experimental and control groups were compared using  $\chi^2$  tests for categorical variables, and one-way analysis of variance (ANOVA) for continuous variables. Repeated-measures ANOVA were used to compare changes in body weight, lifestyle, body image, social support, locus of control, depression and self-efficacy. The Scheffe method was used for post hoc comparisons. The reporting conforms to the CONSORT statement (Altman et al., 2001; Moher et al., 2001).

#### *Findings*

Of 240 women recruited for this trial, 51 withdrew during the 12 months of study follow-up. Therefore, the final sample used for analysis was 189 women (Fig. 1). The 189 participants and 51 women who dropped out were not statistically different in age, parity, employment, education or BMI.

#### *Comparison of three groups at baseline*

The majority of participants were aged 26–35 years, primiparae, employed with at least 14 years education. BMI ranged from 16.60 to 36.90. No notable baseline differences were found between groups in demographic data and bodyweight status (Table 1). The groups were well balanced for baseline health-promoting behaviours, as well as for psycho-social factors (self-efficacy, body image, depression and social support).

#### *Impact of education on outcomes*

All outcome indicators were significantly better for patients in the EP group than for those in the comparison group.

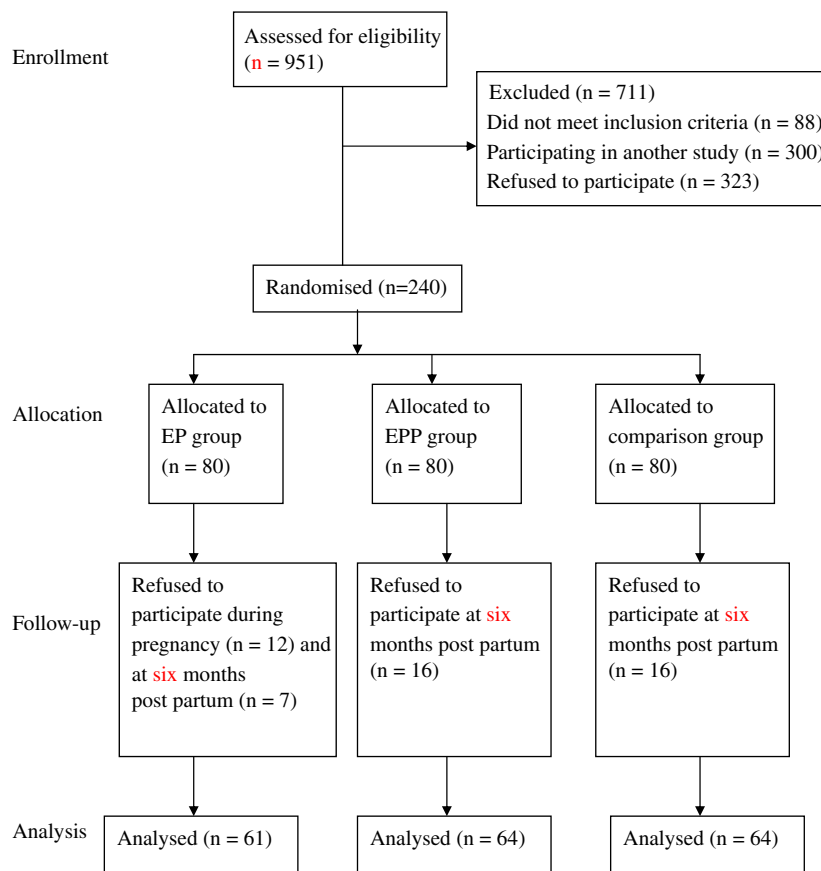


Fig. 1. Participant enrolment and flow for this randomised trial.

**Table 1**  
Baseline characteristics of participants by group.

Variable	Group						p-Value
	EP (n = 61)		EPP (n = 64)		Comparison (n = 64)		
	n	%	n	%	n	%	
Age							0.141 <sup>a</sup>
≤25 years	2	3.13	5	8.19	2	3.13	
26–35 years	54	84.38	45	73.77	46	71.88	
≥36 years	5	7.81	14	22.95	16	25	
Mean (SD)	32.13	(4.50)	30.67	(3.70)	31.91	(4.85)	
Pre-pregnant body weight (kg)							0.80 <sup>a</sup>
Mean (SD)	52.80	(8.44)	52.61	(6.57)	53.53	(9.38)	
Range	43–78		44–70		39–98		
Pre-pregnant body mass index							0.948 <sup>a</sup>
Mean (SD)	20.98	(2.34)	20.96	(3.22)	21.12	(3.13)	
Range	17.15–28.40		16.16–36.90		16.80–36.90		
Para							0.250 <sup>b</sup>
0	30	49.18	28	43.75	32	50.00	
1	26	42.62	22	34.38	20	31.25	
≥2	5	8.20	14	21.88	12	18.75	
Employee status							0.640 <sup>b</sup>
No	12	19.67	16	25	17	26.56	
Yes	49	80.33	48	75	47	73.44	
Education							0.123 <sup>b</sup>
High school	20	32.79	29	45.31	15	23.44	
Junior college	26	42.62	20	31.25	31	48.44	
College and above	15	24.59	15	23.43	18	28.13	

n = 189.

p-value: a = ANOVA, b =  $\chi^2$  test.

#### Body weight changes

Participants' average pre-pregnancy body weight rose from 52.80 kg (SD = 8.44) for the EP group, 52.61 kg (SD = 6.57) for the EPP group and 53.53 kg (SD = 9.38) for the comparison group to 55.15 kg (SD = 8.63), 56.67 kg (SD = 6.12) and 58.61 kg (SD = 10.23), respectively, at six months post partum. Repeated-measures ANOVA showed that the group by time interaction was significant ( $p < 0.001$ ), and the main time effects were significant ( $p < 0.001$ ) (Table 2).

Average GWG was 14.02, 15.27 and 16.22 kg in the EP, EPP and comparison groups, respectively. ANOVA showed significant differences; the post hoc test showed that GWG in the EP group was significantly lower than that in the EPP and comparison groups (Table 3). Average weight retention at six months post partum was 2.34, 4.06 and 5.08 kg in the EP, EPP and comparison groups, respectively. ANOVA showed significant differences, and the post hoc test showed that weight retention in the EP group was significantly less than that in the EPP and comparison groups (Table 3). A weight reduction of at least 5 kg at six months post partum was significantly different ( $\chi^2 = 15.85$ ,  $p = 0.000$ ) among the three groups (18.0%, 42.2% and 51.6%), respectively (Table 4).

#### Lifestyle and psycho-social factors

Weight changes from baseline to six months post partum are compared between groups by related factors (health-promoting behaviour, self-efficacy for health behaviour, body image, depression and social support) (Table 5).

**Health-promoting behaviours.** Repeated-measures ANOVA showed that the group by time interaction was significant ( $F = 3.48$ ,



**Table 2**

Body weight before pregnancy and at six months post partum by group.

Group Variable	EP (n = 61) Mean (SD)	EPP (n = 64) Mean (SD)	Comparison (n = 64) Mean (SD)	F1	F2	F3
Body weight changes				10.82**	1.61	288.01**
Pre-pregnant	52.80 (8.44)	52.61 (6.57)	53.53 (9.38)			
Six months post partum	55.15 (8.63)	56.67 (6.12)	58.61 (10.23)			

n = 189.

F1, interaction effect; F2, group main effect; F3, time main effect.

\*\* p &lt; 0.001.

**Table 3**

Body weight changes during pregnancy and post partum by group.

Group Variable	EP (n = 61) Mean (SD)	EPP (n = 64) Mean (SD)	Comparison (n = 64) Mean (SD)	F	Post hoc
Gestational weight gain	14.02 (2.38)	15.27 (2.35)	16.22 (3.26)	10.40**	1 < 2, 3
Weight retention at six months post partum	2.34 (2.66)	4.06 (3.60)	5.08 (3.32)	11.43**	1 < 2, 3

n = 189.

1, experimental pregnancy group (EP); 2, experimental postpartum group (EPP); 3, comparison group.

\*\* p &lt; 0.001.

p < 0.05) for scores of health-promoting behaviour. Post hoc tests demonstrated that women who received the EP intervention reported higher lifestyle behaviour scores at six months post partum than those in the EPP and comparison groups (Table 5). Moreover, both the nutrition and physical activity subscales showed significant group by time interaction ( $F = 9.64$  and  $13.29$ ,  $p < 0.001$ ), group ( $F = 9.13$ ,  $p < 0.001$ ;  $F = 3.10$ ,  $p < 0.05$ ) and time ( $F = 14.57$  and  $71.83$ ,  $p < 0.001$ ) main effects. Post hoc tests demonstrated that women who received both interventions reported higher lifestyle behaviour scores at six months post partum than the comparison group (Table 5).

**Self-efficacy.** Mean total self-efficacy scores for women in the EP group rose from 65.41 (SD = 11.77) at baseline to 80.16 (SD = 11.49) at six months post partum, while scores for patients in the EPP and comparison groups rose from 64.73 (SD = 10.45) and 63.91 (SD = 13.49) to 69.91 (SD = 13.02) and 67.50 (SD = 9.96), respectively. Repeated-measures ANOVA demonstrated a significant group by time interaction ( $F = 11.72$ ;  $p < 0.001$ ) (Table 5). Post hoc tests showed that improvements in self-efficacy scores were significantly greater in the EP group than in the EPP and comparison groups.

**Body image.** The average body image scores for the study groups are shown in Table 5. Repeated-measures ANOVA showed significant differences among the three groups ( $F = 3.61$ ;  $p < 0.05$ ). Post hoc tests showed that the average body image score for women in the EP group was better than scores for women in the EPP and comparison groups. All three groups perceived their body image more negatively post partum than at 16 weeks of pregnancy ( $F = 22.55$ ,  $p < 0.001$ ) (Table 5).

**Depression.** Mean total depression scores for women in the EP group rose from 17.51 (SD = 8.11) at baseline to 17.59 (SD = 8.44) at six months post partum, while scores for patients in the EPP and comparison groups over the same period rose from 16.94 (SD = 6.84) and 15.80 (SD = 7.42) to 19.95 (SD = 9.23) and 20.30 (SD = 8.20), respectively. Repeated-measures ANOVA showed a significant difference between the three groups (interaction effect,  $F = 6.48$ ,  $p < 0.001$ ). The post hoc test showed that the depression

**Table 4**Weight retention  $\geq 5$  kg among the study groups.

Group	Weight retention < 5kg	Weight retention $\geq 5$ kg	Total	p-value
	n (%)	n (%)		
EP	50 (82.0)	11 (18.0)	61	0.000
EPP	37 (57.8)	27 (42.2)	64	
Comparison	31 (48.4)	33 (51.6)	64	

n = 189.

 $\chi^2$  test.

score for women in the EP group was better than scores for women in the EPP and comparison groups ( $F = 6.48$ ;  $p < 0.001$ ) (Table 5).

**Social support.** Mean total social support scores for women in the EP group rose from 51.97 (SD = 3.80) at baseline to 53.15 (SD = 6.47) at six months post partum, while scores for patients in the EPP and comparison groups over the same period rose from 51.94 (SD = 4.53) and 50.30 (SD = 4.83) to 52.67 (SD = 5.42) and 48.98 (SD = 6.11), respectively. Repeated-measures ANOVA showed a significant difference between the three groups (group main effect). The post hoc test showed that the social support score for women in the EP group was better than the score for women in the EPP group, and the score for women in the EPP group was better than the score for women in the comparison group ( $F = 10.41$ ,  $p < 0.001$ ) (Table 5).

## Discussion

Pregnancy appears to be a risk period for women to become overweight (Kac et al., 2004a, b; Siega-Riz et al., 2004; Huang and Dai, 2007). The results of this study suggested that the diet and physical activity intervention was effective in preventing Taiwanese women's weight retention, especially if implemented during pregnancy. However, the average GWG of all groups exceeded the range recommended by the Department of Health in Taiwan. This less-than-expected effectiveness of the intervention could have

**Table 5**  
Health-promoting behaviour, self-efficacy, body image, depression and social support among the three groups of women.

Group	EP (n = 61) Mean (SD)		EPP (n = 64) Mean (SD)		Comparison (n = 64) Mean (SD)		F1	F2	F3	Post hoc
	Pre	Post	Pre	Post	Pre	Post				
<b>Health-promoting behaviour</b>	128.46 (15.62)	134.52 (17.59)	133.98 (16.65)	133.91 (17.78)	130.52 (17.61)	129.98 (16.07)	3.48*	1.00	2.58	1 > 3
Nutrition	26.28 (4.30)	29.07 (3.94)	26.25 (4.40)	28.77 (4.09)	25.89 (4.47)	24.98 (4.03)	9.64**	9.13**	14.57**	1,2 > 3
Physical activity	8.52 (2.31)	10.97 (1.92)	9.16 (2.22)	10.84 (2.00)	9.06 (2.17)	9.34 (2.51)	13.29**	3.10*	71.83**	1,2 > 3
<b>Self-efficacy</b>	65.41 (11.77)	80.16 (11.49)	64.73 (10.45)	69.91 (13.02)	63.91 (13.49)	67.50 (9.96)	11.72**	9.48**	60.14**	1 > 2,3
Nutrition	9.46 (2.34)	12.11 (2.18)	9.42 (2.72)	10.33 (2.02)	9.50 (2.77)	10.66 (2.21)	7.06**	3.78*	59.46**	1 > 2,3
Physical activity	15.05 (5.77)	22.08 (3.57)	14.53 (5.58)	19.20 (3.89)	14.22 (5.96)	18.31 (2.91)	3.59*	7.21**	125.16**	1,2 > 3
<b>Body image</b>	56.75 (11.06)	57.67 (11.13)	54.48 (10.10)	59.95 (11.43)	55.56 (12.31)	62.27 (12.38)	3.61*	0.67	22.55**	1 < 2,3
<b>BDI-II</b>	17.51 (8.11)	17.59 (8.44)	16.94 (6.84)	19.95 (9.23)	15.80 (7.42)	20.30 (8.20)	6.48**	0.24	24.97**	1 < 2,3
<b>Social support</b>	51.97 (3.80)	53.15 (6.47)	51.94 (4.53)	52.67 (5.42)	50.30 (4.83)	48.98 (6.11)	2.34	10.41**	0.16	1 > 2 > 3

n = 189.

F1, interaction effect; F2, group main effect; F3, time main effect.

\*  $p < 0.001$ .

\*\*  $p < 0.001$ .

several explanations. First, women might have decreased their exercise and become more liberal with their diet during pregnancy, because they were thinking not only of their own nutritional needs and weight goals, but also of the needs of their child (Devine et al., 2000). Second, weight gain during pregnancy might be valued in the community due to the influence of older women who experienced food shortages during World War II (Gray-Donald et al., 2000). However, high GWG does not improve birth weight (Nielsen et al., 2006). In the absence of medical contraindications, women should be encouraged to maintain their pre-pregnancy activity level (Clapp, 2000). Maternal benefits of physical activity include: improved cardiovascular function, limited weight gain and fat retention, improved attitude and mental state, easier and less-complicated labour, quick recovery and improved fitness. Fetal benefits may include: improved stress tolerance and advanced neurobehavioural maturation (Clapp, 2000). Therefore, for optimal maternal and fetal health in Taiwan, this information (ideal GWG is 10–14 kg) needs to be promoted by health-care workers via the media.

Becoming a mother is accompanied by changes in expectations for lifestyle behaviours, self-efficacy, body image and social support. The present study found that women in both experimental groups had higher scores for health-promoting behaviours, especially for the nutrition and physical activity subscales, compared with those in the comparison group. These results are consistent with a previous report (Devine et al., 2000) that without personal advice, women decreased their exercise and liberalised their diet during pregnancy, and they delayed returning to their pre-pregnancy diet and exercise practices in the postpartum period.

The self-efficacy scores for health behaviours and for the subscales of nutrition and physical activity were better for both experimental groups than for the comparison group. These results support Bandura (1994) by demonstrating that self-efficacy can be promoted through performance accomplishment, vicarious experience, verbal persuasion and emotional arousal.

The body image score for the EP group was better than that for the EPP and comparison groups. The body image results for women in all three groups showed less satisfaction post partum than during pregnancy. The BDI-II score for the EP group was better than that in the EPP and comparison groups. The depressive inclination for women in all three groups increased post partum compared with during pregnancy. In the postpartum period, weight retention has been associated with disappointment, surprise, symptoms of eating disorders, reduced self-esteem and depressive symptoms (Devine et al., 2000). Similarly, women with

higher postpartum weight gain were found to exercise less, to have higher fat intake habits, and to be more dissatisfied with body image than women with lower weight gains (Walker and Freeland-Graves, 1998). Moreover, body image was found to be strongly associated with overall depression, even after controlling for body mass (Himelein and Thatcher, 2006). Walker and Freeland-Graves (1998) suggested that these women would potentially benefit from lifestyle-focused programmes for weight management.

The social support score for the EP group was better than that for the EPP group, and the score for the EPP group was better than that for the comparison group. It is worth noting that women in the comparison group perceived that they had less social support at six months post partum. This result may be due to the sense of belonging, which can be regarded as a source of support, when clinicians provide an intervention and keep in touch with participants (Huang, 2007). Husbands and some female relatives of pregnant and postpartum Latino women were found to be their primary sources of emotional, instrumental and informational support for weight, diet and physical-activity-related beliefs and behaviours (Thornton et al., 2006). When women perceive more social support, they are likely to be healthier, both mentally and physically (Chen and Chen, 2006).

A one-to-one education programme was used in this study. One size does not fit all; therefore, the best results for weight management during pregnancy and the postpartum period may be achieved by providing this individually oriented and comprehensive form of education. Similarly, a review of the literature found that the main role for nurses caring for obesity patients in the UK has been in providing one-to-one, clinic-based consultations (Brown and Psarou, 2008). The authors also suggested the importance of following a structured programme with an evidence-based protocol to support patients' weight loss within a holistic assessment of their needs.

## Limitations

This study has several limitations. First, participants were recruited from a single medical centre and studied over a relatively short period. To generalise findings to the entire postpartum population and to examine the long-term effectiveness of the intervention, future research should involve a nationally representative sample and use a longer longitudinal design (such as 10 years). Second, participants were recruited at around 16 gestational weeks, which may make participants in the

control and postpartum experimental groups aware of the need to control body weight. Third, 51 women withdrew from this study because of the 12-month follow-up period (19 from the EP group, 16 from the EPP group and 16 from the comparison group). Fourth, the average GWG of the three groups in this study was more than 14 kg, which is beyond the upper recommended limit. Fifth, body composition was not measured, which would have allowed quantification of the extent to which observed changes in BMI reflected changes in adiposity relative to lean body mass (Hoffman et al., 2006). Finally, the intervention targeted diet and physical activity behaviour alone. Interventions to reduce weight retention have been suggested to incorporate family-centred approaches and strategies to maintain weight loss (Setse et al., 2008). For more successful results in living a healthier family lifestyle, it may be necessary to involve significant others.

## Conclusion

The implementation of a diet and physical activity intervention during pregnancy and post partum was effective in helping women in this study to reduce excessive weight retention. Health-care providers should base weight gain goals on women's body size, and monitor GWG and postpartum weight retention between follow-up visits.

To the authors' knowledge, this is the first study to intervene with women from 16 gestational weeks to six months post partum, and to target women of all body sizes during this particular high-risk period for weight gain. Further research is required to be confident that this intervention and its timing are appropriate. The effectiveness of the intervention was measured not only by changes in body weight, but also by other outcome indicators such as health-promoting behaviours and psycho-social variables.

Although the success of this intervention suggests that pregnancy and the postpartum period may be a good time to intervene, it remains to be seen whether such a programme can influence long-term weight. This is also only one study with one group of women, thus needing further exploration. As obesity is not modifiable after a given pregnancy begins (Wells et al., 2006), a sustained approach will be required to maintain and promote women's health, education and well-being across the life span.

## Acknowledgements

The authors thank all of the participants for sharing their experiences. Grant supported by National Science Council, Taiwan (NSC 93-2314-B-182-079)

## References

Abrams, B., Altman, S.L., Pickett, K.E., 2000. Pregnancy weight gain: still controversial. *American Journal of Clinical Nutrition* 71, 1233S–1241S.

Althuisen, E., van Poppel, M.N., Seidell, J.C. Design of the New Life (style) study: a randomised controlled trial to optimise maternal weight development during pregnancy. *BMC Public Health* 6, 168.

Altman, D.G., Schulz, K.F., Moher, D. The revised CONSORT statement for reporting randomized trials: explanation and elaboration. *Annals of Internal Medicine* 134, 663–694.

Artal, R., Catanzaro, R.B., Gavard, J.A. A lifestyle intervention of weight-gain restriction: diet and exercise in obese women with gestational diabetes mellitus. *Applied Physiology, Nutrition, & Metabolism = Physiologie Appliquee, Nutrition et Metabolisme* 32, 596–601.

Bandura, A., 1994. Self-efficacy. In: Ramachandran, V.S. (Ed.), *Encyclopedia of Human Behavior*. Academic Press, New York, pp. 71–81.

Becker, H., Stuijbergen, A., Oh, H.S. The self-rated abilities for health practices scale: a health self-efficacy measure. *Health Value* 17, 42–50.

Beck, A.T., Steer, R.A., 1993. *Manual for the Beck Depression Inventory*. Psychological Corporation, San Antonio, TX.

Brown, I., Psarou, A., 2008. Literature review of nursing practice in managing obesity in primary care: developments in the UK. *Journal of Clinical Nursing* 17, 17–28.

Chen, C.H., Tseng, Y.F., Wang, S.Y. The prevalence and predictors of postpartum depression. *Journal of Nursing Research* 2, 263–274.

Chen, Y., Chen, C., 2006. Body image, social support and depression in gynecologic cancer patients. *Journal of Evidence-Based Nursing* 2, 293–300.

Clapp, J.F., 2000. Exercise during pregnancy. A clinical update. *Clinics in Sports Medicine* 19, 273–286.

Claesson, I.M., Sydsjo, G., Brynhildsen, J. Weight gain restriction for obese pregnant women: a case-control intervention study. *BJOG: an International Journal of Obstetrics & Gynaecology* 115, 44–50.

Cohen, S., Hoberman, H.M., 1983. Positive events and social supports as buffers of life change stress. *Journal of Applied Social Psychology* 13, 99–125.

Cohen, S., Mermelstein, R., Kamarch, T. Measuring the functional components of social support. In: Sarason, I.G., Sarason, B.R. (Eds.), *Social Support: Theory, research and application*. M. Nijhoff Publishers, Boston, pp. 73–94.

Department of Health, 2002. The Body Mass Index and Obesity in Taiwan. Available at: <<http://www.doh.gov.tw/newdoh/90-org/org-3/nutrition/2.html>> (last accessed 21 April 2008).

Department of Health, 2006. The Definition of Adult's Overweight and Obesity. Available at: <[http://www.doh.gov.tw/ufile/doc/95/e6%96%b0%e8%81%9e%7a%8%bf\(%e8%82%a5%e8%83%96%e5%ae%9a%e7%be%a9\)-950327.doc](http://www.doh.gov.tw/ufile/doc/95/e6%96%b0%e8%81%9e%7a%8%bf(%e8%82%a5%e8%83%96%e5%ae%9a%e7%be%a9)-950327.doc)> (last accessed 21 April 2008).

Devine, C.M., Bove, C.F., Olson, C.M., 2000. Continuity and change in women's weight orientations and lifestyle practices through pregnancy and the postpartum period: the influence of life course trajectories and transitional events. *Social Science and Medicine* 50, 567–582.

Gray-Donald, K., Robinson, E., Collier, A. Intervening to reduce weight gain in pregnancy and gestational diabetes mellitus in Cree communities: an evaluation. *Canadian Medical Association Journal* 163, 1247–1251.

Gunderson, E.P., Abrams, B., 2000. Epidemiology of gestational weight gain and body-weight changes after pregnancy. *Epidemiologic Reviews* 22, 261–274.

Harris, H.E., Ellison, G.T., Holliday, M. The impact of pregnancy on the long-term weight gain of primiparous women in England. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 21, 747–755.

Himelein, M.J., Thatcher, S.S., 2006. Depression and body image among women with polycystic ovary syndrome. *Journal of Health Psychology* 11, 613–625.

Hoffman, D.J., Policastro, P., Quick, V. Changes in body weight and fat mass of men and women in the first year of college: a study of the "freshman 15". *Journal of American College Health* 55, 41–45.

Huang, T.T., 2007. Self-care behavior of adult asthma patients. *Journal of Asthma* 44, 613–619.

Huang, T.T., Dai, F.T., 2007. Weight retention predictors for Taiwanese women at six-month post partum. *Journal of Nursing Research* 15, 11–20.

Huang, T.T., Wang, H.S., Dai, F.T., 2010. Effect of pre-pregnancy body size on postpartum weight retention. *Midwifery* (unpublished).

Huang, Y.H., 1995. Predictors of Health-promoting Lifestyles Among College Students. Unpublished Doctoral Dissertation, Kaohsiung Medical University.

Huang, Y.H., Chiou, C.J., 1996. Assessment of the health-promoting lifestyle profile on reliability and validity. *Kaohsiung Journal of Medical Sciences* 12, 529–537.

Hui, A.L., Ludwig, S.M., Gardiner, P., 2006. Community-based exercise and dietary intervention during pregnancy: a pilot study. *Canadian Journal of Diabetes* 30, 169–175.

Kac, G., Benicio, M.H., Velasquez-Melendez, G. Nine months postpartum weight retention predictors for Brazilian women. *Public Health Nutrition* 7, 621–628.

Kac, G., Benicio, M.H., Velasquez-Melendez, G. Gestational weight gain and prepregnancy weight influence postpartum weight retention in a cohort of Brazilian women. *Journal of Nutrition* 134, 661–666.

Kinnunen, T.I., Pasanen, M., Aittasalo, M. Reducing postpartum weight retention—a pilot trial in primary health care. *Nutrition Journal* 6, 1–9.

Kinnunen, T.I., Pasanen, M., Aittasalo, M. Preventing excessive weight gain during pregnancy—a controlled trial in primary health care. *European Journal of Clinical Nutrition* 61, 884–891.

Ko, H.C., Huang, K.Y., Lee, Y.D. Beck Depression Inventory as a screening tool for pre- and postpartum depression among Chinese women. *Chinese Journal of Public Health* 15, 208–219.

Leermakers, E.A., Anglin, K., Wing, R.R., 1998. Reducing postpartum weight retention through a correspondence intervention. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 22, 1103–1109.

Moher, D., Schulz, K.F., Altman, D. The CONSORT Statement: revised recommendations for improving the quality of reports of parallel-group randomized trials 2001. *Explore: The Journal of Science & Healing* 1, 40–45.

Nielsen, J.N., O'Brien, K.O., Witter, F.R. High gestational weight gain does not improve birth weight in a cohort of African American adolescents. *American Journal of Clinical Nutrition* 84, 183–189.

Olson, C.M., Strawderman, M.S., Reed, R.G., 2004. Efficacy of an intervention to prevent excessive gestational weight gain. *American Journal of Obstetrics and Gynecology* 191, 530–536.

Onwude, J.L., 2008. Weight gain restriction for obese pregnant women: a case-control intervention study. *BJOG: an International Journal of Obstetrics & Gynaecology* 115, 796.

O'Toole, M.L., Sawicki, M.A., Artal, R., 2003. Structured diet and physical activity prevent postpartum weight retention. *Journal of Women's Health* 12, 991–998.

- Peterson, K.E., Sorensen, G., Pearson, M. Design of an intervention addressing multiple levels of influence on dietary and activity patterns of low-income, postpartum women. *Health Education Research* 17, 531–540.
- Polley, B.A., Wing, R.R., Sims, C.J., 2002. Randomized controlled trial to prevent excessive weight gain in pregnant women. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 26, 1494–1502.
- Rae, A., Bond, D., Evans, S. A randomised controlled trial of dietary energy restriction in the management of obese women with gestational diabetes. *Australian and New Zealand Journal of Obstetrics and Gynaecology* 40, 416–422.
- Siega-Riz, A.M., Evenson, K.R., Dole, N., 2004. Pregnancy-related weight gain—a link to obesity? *Nutrition Reviews* 62, S105–S111.
- Setse, R., Grogan, R., Cooper, L.A. Weight-loss programs for urban-based, postpartum African-American women: perceived barriers and preferred components. *Maternal & Child Health Journal* 12, 119–127.
- Stevens, J., 1996. *Applied Multivariate Statistics for the Social Sciences*. Mahwah, New Jersey.
- Strang, V.R., Sullivan, P.L., 1985. Body image attitudes during pregnancy and the postpartum period. *Journal of Obstetric, Gynecologic, & Neonatal Nursing* 14, 332–337.
- Stotland, N.E., Haas, J.S., Brawarsky, P. Body mass index, provider advice, and target gestational weight gain. *Obstetrics and Gynecology* 105, 633–638.
- Thornton, P.L., Kieffer, E.C., Salabarria-Pena, Y. Weight, diet, and physical activity-related beliefs and practices among pregnant and postpartum Latino women: the role of social support. *Maternal & Child Health Journal* 10, 95–104.
- Walker, L.O., 1998. Weight-related distress in the early months after childbirth. *Western Journal of Nursing Research* 20, 30–44.
- Walker, L.O., Freeland-Graves, J., 1998. Lifestyle factors related to postpartum weight gain and body image in bottle- and breast-feeding women. *Journal of Obstetric, Gynecologic, & Neonatal Nursing* 27, 151–160.
- Walker, L.O., Sterling, B.S., Timmerman, G.M., 2005. Retention of pregnancy-related weight in the early postpartum period: implications for women's health services. *Journal of Obstetric, Gynecologic, & Neonatal Nursing* 34, 418–427.
- Walker, S.N., Sechrist, K.R., Pender, N.J., 1987. The Health-Promoting Lifestyle Profile: development and psychometric characteristics. *Nursing Research* 36, 76–81.
- Wells, C.S., Schwalberg, R., Noonan, G. Factors influencing inadequate and excessive weight gain in pregnancy: Colorado, 2000–2002. *Maternal & Child Health Journal* 10, 55–62.
- Wing, R.R., Goldstein, M.G., Acton, K.J. Behavioral science research in diabetes: lifestyle changes related to obesity, eating behavior, and physical activity. *Diabetes Care* 24, 117–123.
- Wolff, S., Legarth, J., Vangsgaard, K. A randomized trial of the effects of dietary counseling on gestational weight gain and glucose metabolism in obese pregnant women. *International Journal of Obesity* 32, 495–501.