

# Weight gain since menopause and its associations with weight loss maintenance in obese postmenopausal women

M Sénéchal<sup>1,2</sup>

H Arguin<sup>6</sup>

DR Bouchard<sup>4,5</sup>

AC Carpentier<sup>3</sup>

JL Ardilouze<sup>3</sup>

IJ Dionne<sup>1,2</sup>

M Brochu<sup>1,2</sup>

<sup>1</sup>Research Centre on Aging, Health and Social Services Centre, University Institute of Geriatrics of Sherbrooke, <sup>2</sup>Faculty of Physical Education and Sports, University of Sherbrooke, <sup>3</sup>Clinical Research Centre, Sherbrooke University Hospital Centre, Sherbrooke, QC; <sup>4</sup>Faculty of Kinesiology and Recreation Management, University of Manitoba, Winnipeg, MB; <sup>5</sup>Health, Leisure & Human Performance Research Institute, Winnipeg, MB; <sup>6</sup>Division of Kinesiology, Department of Social and Preventive Medicine, Faculty of Medicine, Laval University, QC, Canada

**Objective:** To examine the association between weight gain since menopause and weight regain after a weight loss program.

**Methods:** Participants were 19 obese women who participated in a 15-week weight loss program and a 12-month follow-up. Main outcomes were: body composition, resting metabolic rate, energy intake, energy expenditure, and weight regain at follow-up.

**Results:** All body composition measures significantly decreased after intervention (all  $P \leq 0.01$ ) while all measures of fatness increased significantly after the 12-month follow-up ( $P \leq 0.01$ ). Body weight gain since menopause was associated with body weight regain ( $r = 0.65$ ;  $P = 0.003$ ) after follow-up even after adjustment for confounders.

**Conclusion:** Weight gain since menopause is associated with body weight regain following the weight loss program. Therefore, weight gain since menopause should be considered as a factor influencing weight loss maintenance in older women.

**Keywords:** obesity, body weight, weight regain, postmenopausal women, aging

## Introduction

The prevalence of obesity has increased significantly over the past few decades with the highest prevalence being in women aged between 45 and 64 years.<sup>1</sup> As previously reported, increase in body weight is associated with increased risks of metabolic disorders such as metabolic syndrome, type 2 diabetes, and cardiovascular diseases.<sup>2</sup>

The beneficial effects of caloric restriction-induced weight loss on body composition and health are well established.<sup>3</sup> A study by Weiss et al<sup>4</sup> revealed that more than 50% of women try to lose weight after menopause. Unfortunately, most of them will regain weight loss and even more over the following years,<sup>5</sup> dampening the health benefits associated with weight loss. Studies have reported many factors associated with body weight regain following a weight loss program, including physiologic,<sup>6</sup> metabolic,<sup>7</sup> psychological,<sup>8</sup> and behavioral<sup>9</sup> factors.

Lifetime body weight has been associated with higher risk of cardiovascular diseases,<sup>10</sup> cancer,<sup>11</sup> and weight regain following a weight loss intervention in young women.<sup>12</sup> However, this issue has yet received little attention in postmenopausal women.<sup>13</sup> Investigating the association between body weight gain since menopause and weight loss maintenance is of great interest considering that peak body weight gain is observed around age 50 in women,<sup>14</sup> weight gain rate is also high during this period,<sup>15</sup> and successful weight maintenance remains a challenge in all age groups.<sup>5</sup> Furthermore, weight gain since menopause may help identify older women at higher risk of body weight regain after weight loss programs.<sup>8</sup> Thus, the present study was

Correspondence: Martin Brochu  
Research Centre on Aging,  
1036 Belvédère Sud, Sherbrooke,  
QC, Canada J1H 4C4  
Tel +1 819 780 2220 ext 45326  
Fax +1 819 829 7141  
Email martin.brochu@usherbrooke.ca

conducted to examine the association between weight gain since menopause and weight regain after a weight loss program in postmenopausal women.

## Methods

### Population

Twenty-five postmenopausal women volunteered, and were recruited by advertising in the general community (eg, local journal). From those, six did not complete the study because they did not follow the weight loss protocol. Consequently, 19 obese postmenopausal women aged between 50 and 75 years participated in the study. Inclusion criteria: no menstruation in a previous year, obese ( $\geq 35\%$  body fat),<sup>16,17</sup> waist circumference  $\geq 90$  cm, sedentary ( $<$  two times a week of structured exercise), nonsmokers, low alcohol consumers ( $<$  two drinks per day), and had no body weight fluctuation  $\geq 5$  kg in the 6 months prior to the study. On physical examination and biological testing, all participants had no history or evidence of cardiovascular disease, peripheral vascular disease, stroke, or diabetes (fasting glucose  $\geq 7.0$  mmol/L). Moreover, all participants did not use hormonal replacement therapy in the 6 months prior to the study and were not taking any medication that could affect blood pressure, lipids and lipoproteins, glucose homeostasis, thyroid, and resting metabolic rate (RMR). All participants signed an informed consent document from the ethics committees of the Health and Social Services, University Institute of Geriatrics of Sherbrooke and Sherbrooke University Hospital Centre.

### Caloric restriction intervention

Dietary intervention was designed to reduce body weight by 1% of initial body weight per week for a maximum of 15 weeks. Prior to baseline testing, a period of body weight stabilization was executed ( $\pm 2$  kg during 4 consecutive weeks). A food diary was used during the weight stabilization period to help subjects monitor their food intake and to quantify total daily caloric intake. The mean daily intake recorded during the last 7 days prior to study was used to determine baseline total daily caloric intakes. The energy deficit needed to achieve the amount of weight loss per week was then determined for each participant by subtracting the energy equivalent to 1% of initial body weight to the total daily caloric intake. Food was self-selected under dietician supervision but a standard diet was followed with 55% of carbohydrates, 30% of fat, and 15% of energy intake from proteins.<sup>18</sup>

Subjects were asked to bring their food diary to every weekly group session on nutrition information (45 minutes)

given by a dietician. Results were closely monitored and the dietician individually supervised the following week caloric goal.

### Energy intake

Subjects were provided with a food scale and instructed on how to complete a 3-day dietary record. Caloric intake was calculated using a 3-day food diary (2 week days and 1 weekend day). Daily caloric intake was calculated using Candat System software (v 6.0; Godin London Inc, London, ON).

### Energy expenditure

Daily energy expenditure was estimated using a Caltrac uniaxial accelerometer (Muscle Dynamics Fitness Network, Torrance, CA). The accelerometer was attached to the waist and worn during all waking hours over a 3-day period (2 week days and 1 day over the weekend).<sup>19</sup> Average kcal/day over the measurement period was used for data analyses. Participants were asked not to enroll in an exercise program and to maintain their baseline physical activity throughout the duration of the study.

### Anthropometric and body composition measures

Body weight was measured to the nearest 0.2 kg on a calibrated balance (Seca 707; Seca, Hamburg, Germany) and height was obtained with a standard stadiometer (Takei Scientific Instruments Co Ltd, Tokyo, Japan). Waist circumference was measured with a steel measuring tape to the nearest 0.1 cm at the highest point of the iliac crest at minimal respiration. Body composition was assessed using dual emission X-ray absorptiometry (GE Lunar Corp, Madison, WI), as previously described.<sup>20</sup> Finally, weight gain since menopause was calculated by using self-reported body weight gain since having no menstruation for a complete year or menopause diagnosis by measuring follicle stimulating hormone level. Despite relying on a self-reported body weight gain since menopause, it has been previously shown that self-reported body weight is a reliable measure specifically in older adults (ranging  $r = 0.85-0.98$ ).<sup>21-23</sup>

### RMR

The test was done in the morning after a 12-hour fasting period. Subjects were asked to consume no alcohol, not to take any medication, and to restrain physical activity for 24 hours before testing. RMR was measured on a 30-minute period by indirect calorimetry. RMR (kcal/day) was calculated using the Weir equation.  $VO_2$  and  $VCO_2$  were measured using a CCM/D metabolic cart (Medical Graphics

Corporation, St Paul, MN) and resting respiratory quotient. Both absolute and relative RMR (RMR/lean body mass) were used in analyses.

### Statistical analyses

Normality of variables was tested by Shapiro–Wilk tests. Wilcoxon signed rank tests were performed to quantify the effect of treatment. Spearman's correlations were used to quantify the relationship between body weight since menopause and body weight regain after the 12-month follow-up. Finally, partial correlation was used to assess the correlation between body weight since menopause and body weight regain after the 12-month follow-up adjusted for potential confounders. Variables not normally distributed were log transformed to normalize their distribution before performing partial correlation. Analyses were performed using SPSS (v 18.0; SPSS Inc, Chicago, IL). A level of significance of  $P \leq 0.05$  was used unless stated otherwise.

## Results

Women enrolled in this study were  $12 \pm 9$  years since menopause, while the average weight gain since menopause was  $10.7 \pm 5.6$  kg (Table 1). As expected, energy

intake decreased significantly during the intervention (mean  $-354 \pm 443$  kcal/day;  $P < 0.01$ ) especially from carbohydrate and fat (mean  $-38.8 \pm 70.9$  g/day,  $-19.2 \pm 24.1$  g/day; both  $P < 0.05$ ). Moreover, all fat types (trans, saturated, monounsaturated, and polyunsaturated fat) significantly decreased during the intervention (all  $P < 0.05$ ). A significant decrease was also observed for all adiposity measures (body weight, body mass index, waist circumference, and fat mass) after the 15-week intervention (all  $P < 0.01$ ). Finally, lean body mass also significantly decreased during the intervention ( $P < 0.01$ ), while RMR and daily energy expenditure remained stable.

On average, women regained  $2.5 \pm 3.3$  kg body weight at 12-month follow-up ( $P < 0.01$ ) and increased body mass index, waist circumference, and fat mass (all  $P < 0.01$ ). No significant change was observed for lean body mass, RMR, and energy intake at follow-up. Finally, energy expenditure significantly decreased during 12-month follow-up ( $P < 0.01$ ).

Weight gain since menopause ( $r = 0.65$ ;  $P = 0.003$ ) was associated with weight regain at follow-up. However, baseline body weight ( $r = 0.48$ ;  $P = 0.03$ ), body mass index ( $r = 0.58$ ;  $P = 0.008$ ), fat mass ( $r = 0.44$ ;  $P = 0.05$ ), absolute RMR ( $r = 0.65$ ;  $P = 0.002$ ), and relative RMR

**Table 1** Characteristics of the cohort

| N = 19  | Baseline     | Post- intervention | 12-month follow-up |
|---|--------------|--------------------|--------------------|
| Age (years)                                   | 61.2 ± 6.0   | –                  | –                  |
| Age at menopause (years)                      | 49.2 ± 7.1   | –                  | –                  |
| Years since menopause (years)                 | 12.0 ± 8.8   | –                  | –                  |
| Body weight gain since menopause (kg)         | 10.7 ± 5.6   | –                  | –                  |
| Body weight (kg)                              | 79.3 ± 11.1  | 69.2 ± 10.2*       | 71.8 ± 12.4‡       |
| BMI (kg/m <sup>2</sup> )                      | 31.8 ± 4.0   | 27.5 ± 3.8*        | 28.7 ± 4.9‡        |
| Waist circumference (cm)                      | 98.6 ± 8.7   | 88.0 ± 7.4*        | 93.1 ± 10.0‡       |
| Total fat mass (kg)                           | 36.7 ± 8.4   | 27.8 ± 8.1*        | 30.5 ± 9.4‡        |
| Trunk fat mass (kg)                           | 18.6 ± 3.9   | 12.9 ± 3.7*        | 14.0 ± 4.5‡        |
| Appendicular fat mass (kg)                    | 17.1 ± 4.6   | 14.1 ± 4.4*        | 15.6 ± 5.1‡        |
| Total lean body mass (kg)                     | 40.3 ± 4.5   | 39.1 ± 3.8*        | 39.0 ± 4.1         |
| Absolute RMR (kcal/day)                       | 1,170 ± 186  | 1,209 ± 198        | 1,270 ± 192        |
| Relative RMR (kcal/kg of lean body mass)      | 29.1 ± 3.9   | 30.8 ± 3.9         | 32.5 ± 3.7         |
| Energy intake (kcal/day)                      | 1,875 ± 490  | 1,539 ± 340*       | 1,410 ± 277        |
| Total carbohydrates (g)                       | 236.5 ± 69.2 | 199.7 ± 43.3*      | 175.0 ± 32.4       |
| Total proteins (g)                            | 86.0 ± 21.3  | 79.1 ± 20.9        | 70.9 ± 13.0        |
| Total fat (g)                                 | 66.6 ± 23.2  | 47.5 ± 18.5*       | 45.0 ± 14.3        |
| Trans fat (g)                                 | 0.49 ± 0.46  | 0.38 ± 0.88*       | 0.52 ± 1.0         |
| Saturated fat (g)                             | 19.9 ± 9.5   | 14.2 ± 6.6*        | 12.1 ± 5.2         |
| Monounsaturated fat (g)                       | 24.6 ± 9.6   | 14.7 ± 6.2*        | 15.4 ± 6.2         |
| Polyunsaturated fat (g)                       | 12.8 ± 6.5   | 8.3 ± 3.6*         | 8.7 ± 3.5          |
| Estimated daily energy expenditure (kcal/day) | 2,084 ± 448  | 1,956 ± 426        | 1,747 ± 304‡       |

**Notes:** Data are presented as means ± SD. Wilcoxon signed rank tests were used to measure the intervention effect between baseline and post-intervention and post-intervention and 12-month follow-up. \*Significant difference between post-intervention and baseline values,  $P < 0.05$ ; †significant difference between 12-month follow-up and post-intervention values,  $P < 0.05$ .

**Abbreviations:** BMI, body mass index; RMR, resting metabolic rate.

**Table 2** Correlations between independent variables of interest and body weight maintenance at 12-month follow-up

| Variable                           | Spearman's correlations |
|------------------------------------|-------------------------|
|                                    | Body weight regain      |
| Age                                | 0.13 (0.570)            |
| Age at menopause                   | -0.34 (0.140)           |
| Body weight gain since menopause   | 0.65 (0.003)            |
| Baseline body weight               | 0.48 (0.030)            |
| BMI                                | 0.61 (0.005)            |
| Waist circumference                | 0.15 (0.530)            |
| Total fat mass                     | 0.44 (0.050)            |
| Trunk fat mass                     | 0.43 (0.060)            |
| Appendicular fat mass              | 0.43 (0.060)            |
| Total lean body mass               | 0.35 (0.140)            |
| Absolute RMR                       | 0.65 (0.002)            |
| Relative RMR                       | 0.48 (0.030)            |
| Energy intake                      | -0.02 (0.910)           |
| Estimated daily energy expenditure | 0.39 (0.090)            |

**Notes:** Results are coefficients of correlation (*P* value).  $\Delta$ Body weight at 12-month follow-up = changes between 12-month follow-up and post-intervention.

**Abbreviations:** BMI, body mass index; RMR, resting metabolic rate.

( $r = 0.49$ ;  $P = 0.03$ ) were also correlated with weight regain after the 12-month follow-up (Table 2). Nonetheless, weight gain since menopause remained significantly associated with weight regain at follow-up once adjusted for years since menopause and initial body weight ( $r = 0.50$ ;  $P = 0.03$ ) (results not shown).

## Discussion

The current study suggests that women who gained more weight since menopause are at greater risk to be unsuccessful in their weight loss attempt (with caloric restriction) within a few years after intervention. Therefore, weight gain during the menopause period has to be monitored closely because it may be hard to successfully lose those extra pounds and keep them off after menopause.

The fact that initial fat mass, lean body mass, and RMR were associated with body weight regain is not novel.<sup>6</sup> However, with this study we add another variable that needs to be taken into account when evaluating the risk of weight regain following a caloric restriction in postmenopausal women. Several studies have reported an association between loss in lean body mass and decrease in RMR after weight loss.<sup>24</sup> Surprisingly, we observed no overall decrease in RMR after the intervention despite significant decreases in lean body mass. It is likely that the mean lean body mass loss of  $1.3 \pm 1.3$  kg or 3.2% in the present study might be statistically significant but clinically trivial. In fact, Busetto et al<sup>25</sup> reported a mean lean body mass loss of 9.4%, while we only observed a mean loss of 3.2%. Consequently, the observed difference between

study results could be explained by the magnitude decrease in lean body mass during weight loss intervention.

From a clinical point of view, the fact that weight gain since menopause might be an important component of weight regain after a caloric restriction intervention is of great interest considering that more than 50% of women in the menopausal period try to lose weight without successful maintenance.<sup>4</sup> Determining how much weight was gained since menopause, as one of the variables that predicts weight loss maintenance, could be useful since that information is easy to get. A question asking women how much weight they gained since menopause may be too simple and invalid but a study conducted by Lawlor et al<sup>22</sup> concluded that self-reported and measured body weight are highly correlated in older adults ( $r = 0.98$ ). Thus, women who report gaining a large amount of weight since menopause should have a tight follow-up to favor weight loss maintenance. In 2005, the Obesity Society and the American Society for Nutrition stated that innovative studies are needed to identify and better understand factors associated with weight loss maintenance in older individuals<sup>24</sup> and this study, with some reservations, goes exactly in that direction.

As this study was exploratory and based on a small sample, many limitations of this study must be mentioned. First, the lack of a control group and the small sample size affect the external validity of the results. Consequently, results translate only to obese postmenopausal women aged between 50–75 years. Second, weight gain since menopause was evaluated with a single question. Thus, objective measure of lifetime body weight would be needed to validate the results. Moreover, we do not have the obesity status before menopause which could impact on the association between weight gain since menopause and weight regain. Similarly, some may argue that age of menopause can also play a role in this association. However, we can partially rule out this hypothesis since we observed no significant correlation between weight loss maintenance and the duration of menopausal status ( $r = 0.37$ ;  $P = 0.11$ ). Third, because of the study design, it is not possible to investigate mechanisms or other variables that may help to understand our results. Despite these limitations, we need to highlight that these results are based on a well-characterized sample of obese postmenopausal women and the limited number of subjects allowed us to closely follow the participants. Nonetheless, our results are really intriguing and need to be confirmed with a tighter design and objective methods to assess the exact time of menopause as well as a measured follow-up of body weight since menopause.

In conclusion, our study suggests that greater weight gain since menopause is correlated with lower weight maintenance after a caloric restriction intervention in obese postmenopausal women. Indeed, weight gain since menopause could be considered a variable to identify postmenopausal obese women at greater risk of weight regain after a caloric restriction regimen. Despite this intriguing finding, further studies are needed to validate our results.

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## Disclosure

The authors report no conflicts of interest in this work.

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