



Is weight cycling associated with adverse health outcomes? A cohort study

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ABSTRACT

Evidence about the health effects of weight cycling is not consistent, with some studies suggesting it is harmful for health. Here we investigated whether weight cycling was associated with weight change and mental health outcomes in 10,428 participants in the mid-age cohort of The Australian Longitudinal Study of Women's Health (ALSWH) over 12 years. In 1998 the women were asked how many times they had ever intentionally lost at least 5 kg and how many times had they regained this amount. Women were categorised into four weight pattern groups: frequent weight cyclers (*FWC*, three or more weight cycles), low frequency weight cyclers (*LFWC*, one or two weight cycles), non-weight cyclers (*NWC*), and weight loss only (*WL*). We used generalised linear modelling to investigate relationships between weight pattern group, weight change and mental health outcomes. In 1998, 15% of the women were *FWC*, 24% *LFWC*, 46% *NWC* and 15% were *WL*. Weight change was similar across weight pattern groups in women with obesity, however healthy weight and overweight *FWC* gained more weight than women who did not weight cycle. We found no difference in overall mental health scores between groups, but both *LFWC* and *FWC* had higher odds of depressive symptoms (adjusted OR 1.5, 95%CI: 1.1 to 1.9 and 1.7, 95%CI: 1.1 to 2.4, respectively) than *NWC*. Our results suggest that, although weight cycling is not associated with greater weight gain in women with obesity, it may increase depressive symptoms.

1. Introduction

The prevalence of overweight and obesity is concerning, with approximately 63% of the adult population of Australia classified as overweight or obese (Australian Bureau of Statistics, 2013). The consequences of excess weight include increased risks of developing type 2 diabetes, cardiovascular disease, musculoskeletal problems and many cancers, leading to premature death (Blissmer et al., 2006; Guh et al., 2009; Renehan et al., 2008). However losing at least 5% of initial body weight is associated with improvements in glycaemic control, blood pressure, triglycerides and HDL cholesterol (Van Gaal et al., 2005; Vidal, 2002; Wing and Hill, 2001; Wing et al., 2011). For these reasons it is recommended that people who are classified as overweight and obese should lose weight, using effective weight loss interventions (Jebb et al., 2011; Jolly et al., 2011; LeBlanc et al., 2011). However, while interventions can result in clinically meaningful weight loss, weight regain is common, due to a combination of low adherence to weight control strategies and compensatory physiological mechanisms that influence weight regain (Hartmann-Boyce et al., 2013; MacLean et al., 2015).

There are concerns that periods of intentional weight loss followed by unintentional weight gain, commonly described as weight cycling, are harmful for health (Lissner et al., 1991; Sørensen et al., 2005). Weight cycling has been associated with greater risk of mortality (Lissner et al., 1991), and increased risk of developing chronic diseases such as stroke, heart disease and diabetes (French et al., 1997) as well as increased risk of fractures (French et al., 1997; Søgaard et al., 2008). It is hypothesized that the harmful effects are caused by a reduction in lean mass during weight loss that is not regained when weight is regained, with adverse effects on metabolism (Beavers et al., 2011). However, a recent review concluded that the evidence that weight cycling is harmful for health is sparse (Mehta et al., 2014). For example, some studies (Arnold et al., 2010; French et al., 1997) did not take intention to lose weight into account. This is important because weight loss due to illness could confound the association with adverse health outcomes. It is therefore important to consider the intentionality of weight loss, and whether weight is regained.

As the prevalence of obesity continues to increase, there may be more weight loss attempts, and therefore multiple cycles of weight loss and regain in adulthood. However, the prevalence of weight cycling in

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the general population is unclear. A cross sectional study in Finland found that 10% of women and 7% of men were classified as severe weight cyclers. In other words participants had lost ≥ 5 kg three times or more and regained the lost weight (Lahti-Koski et al., 2005). However participants were only questioned about the last ten years, so these proportions could be conservative.

Although research has investigated relationships between weight cycling and physical health outcomes, few studies have examined the mental health sequelae of weight cycling (Foster et al., 1997). The Finnish study (above) found cross-sectional associations between weight cycling and poor mental health (Lahti-Koski et al., 2005), which may reflect feelings of demoralisation and failure when weight is regained (Markowitz et al., 2008).

As women are more likely than men to report attempts at weight loss (Green et al., 1997; Thompson and Thomas, 2000), in this study we used data from the Australian Longitudinal Study of Women's Health (ALSWH) to examine: (1) the prevalence of weight cycling; (2) the characteristics of women who weight cycle, and of those with other weight patterns; and (3) whether weight cycling is associated with weight gain and mental health outcomes 12 years after reporting weight cycling.

2. Methods

The ALSWH is a prospective study of factors shaping the health and well-being of three cohorts of Australian women (born in 1973–1978, 1946–1951, and 1921–1926), recruited from the national health insurance database. The focus of this paper is on the 1946–1951 cohort who completed mailed surveys in 1996, 1998, 2001, 2004, 2007 and 2010. Women were aged 47–52 years in 1998 when data on the main variable of interest (weight cycling) were collected. More details can be found at the study website (Australian Longitudinal Study of Womens Health, 2017). The study was approved by the Universities of Newcastle and Queensland Ethical Review Committees and all participating women provided informed consent.

2.1. Exposure variable

As there is no standardized definition of weight cycling, initial exploratory analyses were undertaken using responses from the following two questions: women were asked how many times (excluding pregnancy) had they ever lost 5 kg or more on purpose, and how many times they had ever gained 5 kg or more, which was previously lost on purpose. Responses (never, 1–2, 3–4, 5+ times) for each question were cross-tabulated and the number in each category was computed. Data from women who reported gaining 5 kg and never losing weight were removed from the analyses as the question asked how many times they had regained 5 kg that was previously lost on purpose ($n = 307$, 3% of the sample). Based on a previous study that examined the prevalence of weight cycling (Lahti-Koski et al., 2005), responses were used to create the following weight cycling pattern categories:

- Non-weight cyclers (NWC): Women who reported having never lost or gained 5 kg of weight.
- Weight losers (WL): Women who reported losing 5 kg of weight and not regaining 5 kg of weight.
- Low frequency weight cyclers (LFWC): Women who reported losing 5 kg 1–2 times and regaining 5 kg 1–2 times, and women who reported losing weight three times or more but only regaining weight 1–2 times.
- Frequent weight cyclers (FWC): Those who reported losing 5 kg three or more times and regaining 5 kg three or more times.

2.2. Outcome variables

All three-outcome measures were assessed in 1998 and in 2010,

with weight change calculated as the difference between weights reported in these two years. Weight (to the nearest kg) was reported at each survey. Health related quality of life (HRQL) was measured using the well-validated Medical Outcomes Study's Health Status survey short-form 36 (SF-36) (Ware et al., 1994). Four subscales (14 items) measure psychological HRQL: vitality, social functioning, mental health and role limitations from emotional problems. The mental health component summary score (MCSS), with factor structures validated using baseline ALSWH surveys, was used as a summary measure of these scales. Scores were standardized to range from 0 to 100, with the mean set at 50, with higher scores indicating more positive psychological well-being (Mishra and Schofield, 1998). Change in MCSS was the difference in MCSS in 1998 and 2010. The Center for Epidemiologic Studies Depression Scale (CESD-10) was used to measure depressive symptoms in 1998 and 2010, with scores ≥ 10 indicating depressive symptoms (Andresen et al., 1994).

2.3. Potential confounders

Socio-demographic (partnership status, parity), behavioural (smoking, alcohol use, physical activity, use of laxatives, diuretics or diet pills) and health related variables (BMI, use of hormone replacement therapy (HRT), age at menopause, and an indicator of overall physical health, (the physical components summary score of the SF36, PCSS)), which were indicated by previous work to be associated with either weight patterning group, weight change or psychological well-being, were selected as potential confounders. Data for all these variables were from the 1998 survey, except parity, which was only measured in 1996. The variables were categorised as shown in Table 1.

BMI was calculated as weight (kg)/height² (m²), physical activity was assessed using questions developed for national surveillance of physical activity in Australia (Armstrong et al., 2000; Brown et al., 2008), and women were categorised as meeting the minimal recommended amount of physical activity (500 MET min/week) or not. Women were asked whether they had used laxatives, diuretics or diet pills to control their weight as an indication of disordered eating.

2.4. Descriptive data

Prevalence of chronic conditions was based on responses to a question that asked whether a doctor had diagnosed any of the obesity-related conditions shown in Table 1. Information about education, area of residence and age first dieted are reported.

2.5. Statistical analysis

Analyses were conducted in September 2017. There were 12,388 women who completed the 1998 survey. Women were excluded if they had missing data needed to create the weight pattern variable ($n = 1960$). Therefore data from 10,428 women were included in the descriptive analyses; 7512 of these women provided full data for all variables in the model for the predictive analysis of weight change. For the other health outcomes, data were available for 7435 (MCSS) and 7259 (CESD-10 depression scores) women. Baseline characteristics were summarised using descriptive statistics. Initial analyses (using Chi² ANOVA and Pearson's correlations) were completed to assess whether each potential confounder was associated ($p < 0.05$) with both the independent (weight pattern group) and each of the dependent variables (weight change or MCSS or CESD-10 score ≥ 10). Variables which met this criterion were included as confounders in each model as follows:

Weight change: smoking, BMI and PCSS
 MCSS: alcohol consumption, physical activity, BMI and PCSS
 CESD-10: physical activity, smoking, alcohol consumption, BMI, PCSS and use of diuretics, laxatives or diet pills

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