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Eating in response to hunger and satiety signals is related to BMI in a nationwide sample of 1601 mid-age New Zealand women

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Abstract

Objective: To examine the association between eating in response to hunger and satiety signals (intuitive eating) and BMI. A second objective was to determine whether the hypothesized higher BMI in less intuitive eaters could be explained by the intake of specific foods, speed of eating or binge eating.
Design: Cross-sectional survey. Participants were randomly selected from a nationally representative sampling frame. Eating in response to hunger and satiety signals (termed 'intuitive eating'), self-reported height and weight, frequency of binge eating, speed of eating and usual intakes of fruits, vegetables and selected high-fat and/or high-sugar foods were measured.
Setting: Nationwide study, New Zealand.
Subjects: Women (n 2500) aged 40–50 years randomly selected from New Zealand electoral rolls, including Māori rolls (66 % response rate; n 1601).
Results: Intuitive Eating Scale (IES) scores were significantly associated with BMI in an inverse direction, after adjusting for potential confounding variables. When controlling for confounding variables, as well as potential mediators, the inverse association between intuitive eating (potential range of IES score: 21–105) and BMI was only slightly attenuated and remained statistically significant (5·1 % decrease in BMI for every 10-unit increase in intuitive eating; 95 % CI 4·2, 6·1 %; $P < 0·001$). The relationship between intuitive eating and BMI was partially mediated by frequency of binge eating.
Conclusions: Eating in response to hunger and satiety signals is strongly associated with lower BMI in mid-age women. The direction of causality needs to be investigated in longitudinal studies and randomized controlled trials.

Keywords
Hunger and satiety
Intuitive eating
Mid-age
Women
BMI
Obesity

Traditional obesity treatments based on energy-restrictive diets show poor long-term success and weight regain is common[1]. There is evidence from both prospective studies and randomized trials that dieting or restrictive eating can promote increased food preoccupation[2,3], loss of control[2,4] and overeating[2,3]. Some studies suggest that dieting or weight-loss attempts may be associated with subsequent weight gain[5,6].

In response to the poor long-term outcomes of dieting treatments, eating in response to hunger and satiety signals (termed 'intuitive eating') has been promoted as an alternative to deliberate dietary restriction and the feeling of deprivation that often accompanies it. Intuitive eating has been defined as 'trust in and connection with physiological hunger and satiety cues and eating in response to these cues'[7]. Intuitive eating is a key recommendation of the non-dieting[8] and Health At Every Size approaches[9]. These approaches also advocate a shift in focus away from body weight to the improvement of health behaviours and psychological well-being. Important guiding principles of the Health At Every Size approach also include: accepting and respecting the diversity of body shapes and sizes; promoting eating in a manner that balances individual nutritional needs, hunger, satiety, appetite and pleasure; promoting enjoyable, life-enhancing activity, rather than exercise focused on achieving weight loss; and promoting all aspects of health and well-being for people of all sizes[9]. Intuitive eating has been shown to be negatively related to eating disorder symptomatology, body dissatisfaction and internalization of the thin ideal, and positively related to well-being[10].

Recent randomized trials in treatment-seeking obese women have shown that training in intuitive eating (eating in response to hunger and satiety signals) can prevent

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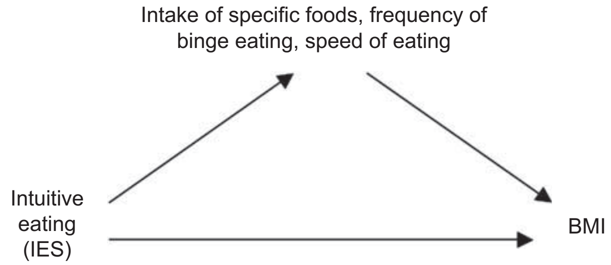

Figure 1 Proposed model of the relationship between intuitive eating, BMI and hypothesized mediators (intake of specific foods, frequency of binge eating and speed of eating; IES, Intuitive Eating Scale)

weight gain over 2 years[9,11]. Among college women, intuitive eating has been associated with lower BMI[10,12], lower TAG levels, higher levels of HDL cholesterol and decreased cardiovascular risk[12].

To our knowledge, only two previous studies have examined the relationship between intuitive eating and BMI in adult women[7,10], and no such studies have been undertaken in representative nationwide samples. Mid-age is a time when women are at particular risk of weight gain and obesity[13]. Perhaps in response to this, mid-aged women have been reported to rely to a lesser extent than younger women on their internal hunger and satiety cues to guide eating and to give themselves less permission to eat when hungry[7]. Thus, the aim of the present study was to test the hypothesis that lower levels of intuitive eating are associated with higher BMI in a representative sample of 40–50-year-old women. The study also aimed to determine whether the hypothesized higher BMI in less intuitive eaters could be explained by the intake of specific foods, speed of eating or frequency of binge eating (Fig. 1).

Experimental methods

Design and sample

A nationwide, self-administered mail survey of 2500 New Zealand women aged 40–50 years, randomly selected from the New Zealand electoral rolls (listings of New Zealand residents eligible to vote in elections including both the General electoral rolls and the Māori electoral rolls), was conducted in May 2009. The New Zealand electoral rolls contain up-to-date mailing details from approximately 97 % of the estimated eligible population of people aged 40–49 living in New Zealand[14]. The twenty-one-page questionnaire examined factors potentially influencing eating behaviour and weight, and took 30–40 min to complete. Prior to the main survey, thirty-six Dunedin, New Zealand, women in the target age range were asked to provide detailed feedback on the questionnaire booklet regarding its layout, appearance, instructions, clarity, ease of completion and interpretation of questions. Of these thirty-six women, seven identified as Māori and five were of Pacific origin. In response to their comments, improvements were made to the layout of the booklet and clarity of instructions. A pilot survey of 100 women selected randomly from the electoral rolls was also undertaken. In the pilot study, a complimentary pen was mailed with the survey questionnaire, and up to three reminders were provided to non-respondents. The pilot study resulted in a 56 % response rate. Based on the pilot study, the main survey was refined to include financial incentives in order to improve the response rate, and to change the final reminder from a telephone call to a postcard in order to reach more participants. The main survey consisted of up to four contacts with participants: the first mail-out of the questionnaire, a thank you/ reminder postcard, and for non-respondents, a replacement questionnaire and a final reminder postcard. The mail survey procedures were modified from Dillman's Tailored Design Method[15]. Incentives included a complimentary pen and an individually wrapped teabag in the initial mail-out, and a prize draw to win one of fourteen $NZ 100 (approximately £47) and three $NZ 200 (approximately £95) cash prizes. In addition, a random sample of 400 women also received a $NZ 5 (approximately £2·40) unconditional incentive in the first mail-out. Respondents were omitted from the sample if they did not meet inclusion criteria (women aged 40–50 years) or if they stated that they were pregnant or breast-feeding at the time of the survey. To minimize data errors, all data were entered twice and any inconsistencies corrected. Ethical approval was granted by the University of Otago Ethics Committee.

Measures

Intuitive eating was assessed using the twenty-one-item Intuitive Eating Scale (IES)[10]. This scale has been validated using data collected in four studies from 1260 women (17–61 years), with exploratory and confirmatory factor analysis revealing a three-factor model, and with evidence presented of internal consistency, stability over 3 weeks and construct validity. The scale measures three factors: (i) reliance upon internal hunger and satiety cues (e.g. 'I stop eating when I feel full (not overstuffed)'); and two factors for which the majority of items are reverse-scored, (ii) eating for physical rather than emotional reasons (e.g. 'I find myself eating when I am lonely, even when I'm not physically hungry') and (iii) unconditional permission to eat when hungry and what food is desired (e.g. 'I have forbidden foods that I don't allow myself to eat'). Item responses were rated on a 5-point scale ranging from 1 = 'strongly disagree' to 5 = 'strongly agree'. The possible range for total IES score was 21–105, with a higher total score corresponding to more intuitive eating.

Frequency of binge eating was assessed by one question, which asked how often the respondent had engaged in episodes of binge eating, defined as ‘eating an unusually large amount of food in one go and at the time feeling that your eating was out of control (that is, you could not prevent yourself from overeating, or that you could not stop eating once you had started)’[16]. Responses were rated on a 4-point scale including 1 = ‘not at all’, 2 = ‘less than weekly’, 3 = ‘once a week’ and 4 = ‘two or more times a week’. The time period referred to was modified from that in Hay *et al.*’s study (past 3 months)[16] to the past 12 months.

The intake of specific foods was assessed using questions from the New Zealand National Nutrition Survey 1997[17]. Questions asked about the usual number of servings of fruits and vegetables consumed daily. Participants were also asked to estimate how often they usually ate each of five food types high in fats and/or sugars (chocolate-coated and/or cream-filled biscuits; potato crisps, corn snacks or corn chips; cakes, scones, muffins or sweet buns; meat pies or sausage rolls; and burgers) using an 8 point-scale ranging from 1 = ‘never’ to 8 = ‘two or more times a day’.

Self-reported rate of eating was assessed by a single item, adapted from a study by Otsuka *et al.*: ‘How would you describe your usual rate of eating?’[18]. A second item examined the usual time spent eating the main meal of the day.

Habitual levels of physical activity were measured using the Rapid Assessment of Physical Activity (RAPA)[19]. The RAPA provides participants with descriptions, several examples plus diagrams of light, moderate and vigorous activities. In the present study the diagrams were modified to include only pictures of women and not men. Using the diagrams and examples, participants were asked to respond ‘yes’ or ‘no’ to items regarding their usual physical activity: 1 = ‘I rarely or never do any physical activities’, 2 = ‘I do some light activity every week’, 3 = ‘I do at least 30 min of moderate physical activity on 5 or more days per week’, 4 = ‘I do at least 20 min of vigorous physical activity on 3 or more days per week’ and 5 = ‘I lift weights or do other muscle strengthening activities at least once a week’[19]. The RAPA questionnaire has been shown in a sample of US adults to be more highly correlated with energy expenditure than two other self-report physical activity questionnaires[19].

Menopausal status was determined using questions from the Australian Longitudinal Study of Women’s Health[20]. Participants were asked to indicate whether or not they had ever been diagnosed with any thyroid problems. Self-reported current weight and height were used to calculate BMI. Demographic questions were taken from the 2006 New Zealand Census[21]. Participants’ age, highest level of education, employment status, usual occupation (open-ended question requesting description of their usual job, where applicable), living circumstances/marital status, smoking status and ethnicity were collected. In response to the question ‘Which ethnic group(s) do you belong to?’, women were asked to indicate from a list of nine ethnicities all those that applied to them[21]. Since multiple ethnicities could be provided (e.g. New Zealand European and Māori), in categorizing each participant into one ethnic group, prioritized ethnicity was used. For example, if one of the ethnicities selected was Māori, this was given priority and the participant was categorized as Māori. Ethnicities were prioritized as follows: first Māori, then Pacific People, then Asian ethnicities, other ethnicities and finally New Zealand European. Occupational status was coded using the New Zealand Standard Classification of Occupations 1999[22]. Where occupation was not provided or was unable to be classified, occupation was obtained from the electoral roll. Participants were assigned a 3-digit code, broadly falling into eight overall categories of occupations. From these 3-digit occupation codes, socio-economic status (SES) was estimated using the New Zealand Socioeconomic Index 1996[23] where a score between 10 and 90 is generated. This was then used as a continuous SES score. If a participant responded to a question on spouse/partner occupation, the higher of the two scores was used in all analyses as an estimate of household SES.

Data analysis

Linear regression models were developed to examine the univariate associations between demographic, health and behavioural variables and BMI. The reference categories for the categorical variables were: smoking status = never, menopause status = premenopause, thyroid condition = never diagnosed, prioritized ethnicity = New Zealand European and physical activity = none. All subsequent multivariate regression models controlled for these possible confounding variables with the addition of age and SES. Log transformations of dependent variables were investigated where there were issues with residual diagnostics (normality and/or homogeneity). Variance inflation factors were calculated to check for excessive collinearity. Adjusted and unadjusted results are reported as a percentage change when data were log-transformed or as β coefficients otherwise. Corresponding 95 % CI and P values were reported. When the two-sided P value was $<0·05$, the relationship was considered statistically significant. If a particular participant had missing items, total IES scores and subscale scores were imputed using the mean item score providing that 80 % or more of the items in the scale or subscale were answered.

Regression modelling was used to assess the relationship between intuitive eating (total score and subscale scores) and BMI. It was also used to assess the relationship between intuitive eating and the intake of specific foods (fruits, vegetables and several high-fat/sugar foods), frequency of binge eating and speed of eating. The four-step approach of Baron and Kenny was used to explore possible mediators[24]. As part of this approach, the regression of each of the above-mentioned variables *v.* BMI, and of the combined effect of all these variables (intake of specific foods, frequency of binge eating and speed of eating) *v.* BMI, was performed (Fig. 1). After establishing associations between intuitive eating and these potential mediators and between intuitive eating and BMI, the final multivariate model examined the relationship between intuitive eating and BMI while controlling for selected potential mediators. These potential mediators were those variables that were statistically significantly associated with both IES scores and BMI (frequency of binge eating and speed of eating). The STATA statistical software package version 10·0 (2007; StataCorp, College Station, TX, USA) was used for all statistical analysis.

Results

Response rate and sample characteristics

Of the 2500 questionnaires mailed to potential participants, 1627 completed questionnaires were returned and forty-seven questionnaires were returned as 'non-deliveries'. Twenty respondents were omitted from the sample because they did not meet inclusion criteria. Six completed questionnaires were excluded because there was reason to doubt the reliability of answers (respondent indicated a poor understanding of English, geometric patterns were made by circling answers, respondent simultaneously answered opposite ends of a scale or the questionnaire was answered on behalf of someone else). The final response rate was 66 % ((1607 − 6)/(2500 − 47 − 20)).

The sample had a mean age of 45·5 (SD 3·2) years, a mean weight of 70·1 (1·2) kg and mean BMI of 25·8 (SD 1·2) kg/m^2. Other respondent characteristics are reported in Table 1. The sample was comparable to the general New Zealand population in terms of SES and prioritized ethnicity, but included a higher proportion of university educated and a lower proportion of obese women[21,23,25].

Table 2 describes the relationship between health, demographic and behavioural variables and BMI. Respondents with higher SES had a statistically significantly lower BMI ($P < 0·001$). Overall, there was a statistically significant difference in BMI among the physical activity categories ($P < 0·001$) with a lower BMI among those more active, and among the prioritized ethnic groups ($P < 0·001$). Compared with New Zealand Europeans, Māori and Pacific People had a higher BMI and Asian women had a lower BMI. BMI was significantly higher for participants who were postmenopausal compared with those who were premenopausal ($P = 0·016$). Women reporting a thyroid condition had a higher BMI than those without thyroid problems ($P = 0·005$).

Regression and mediation outcomes

The IES displayed good internal consistency (Cronbach's $\alpha = 0·86$). Total IES scores and all three of the IES subscale scores were significantly associated with BMI in an inverse direction after adjusting for confounding variables (age, smoking status, menopause status, thyroid condition, prioritized ethnicity, physical activity and SES; $P < 0·001$). For every 10-unit increase in total IES score (potential range: 21–105), there was a decrease in BMI of 6·5 % (95 % CI −7·4, −5·6 %; $P < 0·001$). A 10-unit

Table 1 Demographic and behavioural characteristics of New Zealand female participants compared with national data

Characteristic (*n*, number of respondents)	*n*	%*	National data (%)†
BMI classification (*n* 1581)			
Underweight (<18·5 kg/m^2)	27	1·8	
Normal range (18·5–24·9 kg/m^2)	732	48·1	
Overweight (25·0–29·9 kg/m^2)	448	29·4	
Obese (≥30·0 kg/m^2)	315	20·7	28·3
Prioritized ethnicity (*n* 1594)			
European and others‡	1280	80·3	73·4
Māori	181	11·4	12·1
Pacific People	48	3·0	4·6
Asian	85	5·3	9·9
Highest educational level attained (*n* 1590)			
Primary and some secondary school	489	30·8	50·2
Completed secondary school	153	9·6	8·9
Technical/trade school or polytechnic	438	27·6	23·2
University	510	32·1	17·7
SES (NZSEI) category (*n* 1597)§			
10–29	234	14·7	17·5
30–59	1065	66·7	60·0
60–90	298	18·7	22·5

SES, socio-economic status; NZSEI, New Zealand Socioeconomic Index 1996.
*Percentages may not add to 100 % due to rounding.
†Population estimates for rates of obesity in mid-age women from the New Zealand Health Survey 2006/07; prioritized ethnicity and education level in mid-age women from the 2006 New Zealand Census; and total population NZSEI distribution from the 1991 New Zealand Census.
‡In our sample 'others' made up 13·1 % (*n* 209).
§In NZSEI, 10 represents the lowest socio-economic group and 90 represents the highest socio-economic group. This is based on a standard New Zealand classification of occupations, and is used as a continuous variable in all analyses.

Table 2 Health, demographic and behavioural variables and their relationship with BMI among mid-age New Zealand women

Variable	*n*	% increase/decrease in BMI*	95 % CI	*P* value
Age (per year)	1512	−0·03	−0·35, 0·29	0·856
Prioritized ethnicity†	1516			<0·001‡
Māori		9·07	5·54, 12·72	
Pacific People		23·17	15·74, 31·08	
Asian		−12·20	−15·98, −8·25	
Other		−0·80	−3·69, 2·17	
SES (per unit)	1520	−0·18	−0·24, −0·11	<0·001
Smoking status†	1502			0·051‡
Current smoker		0·82	−1·94, 3·64	
Former smoker		3·08	0·60, 5·63	
Postmenopause†	1509	3·02	0·55, 5·54	0·016
Physical activity†	1503			<0·001‡
Light activity		−9·43	−15·20, −3·26	
Moderate activity		−12·78	−18·33, −6·85	
Vigorous activity		−13·85	−19·29, −8·04	
Thyroid condition†	1521	5·83	1·72, 10·10	0·005

SES, socio-economic status.
*Percentage increase or decrease in BMI and 95 % confidence intervals were obtained using linear regression models.
†Reference category: ethnicity = European, smoking status = never, menopause status = premenopause, physical activity = none, thyroid condition = never diagnosed.
‡Overall effect.

increase in total IES score in a woman with a BMI of 25·8 kg/m^2 and a height of 1·65 m (i.e. a woman typical of our sample) would equate to a reduction of 1·63 kg/m^2 in BMI, which is equivalent to 4·4 kg. A 5-unit increase in the Unconditional Permission to Eat subscale (potential range: 9–45), the Eating for Physical Reasons subscale (potential range: 6–30) and the Reliance on Hunger and Satiety Cues subscale (potential range: 6–30) corresponded to a decrease in BMI of 3·21 % (95 % CI −4·07, −2·35 %; $P<0·001$), 6·62 % (95 % CI −7·49, −5·73 %; $P<0·001$) and 8·25 % (95 % CI −9·49, −6·98 %; $P<0·001$), respectively.

Although the cross-sectional nature of the data means that causality cannot be ascertained, the study aimed to test whether data were consistent with a model where the higher BMI in less intuitive eaters could be at least partially mediated by factors such as the intake of specific foods, speed of eating or frequency of binge eating.

The relationship between intuitive eating and binge eating, self-reported rate of eating, fruit and vegetable intake, and intake of various high-fat or high-sugar foods can be seen in Table 3.

Table 4 reports the associations between BMI and each of the following: binge eating, self-reported rate of eating, fruit and vegetable intake and intake of various high-fat or high-sugar foods, while controlling for all other food and eating-related variables. The final regression model of intuitive eating and BMI, with frequency of binge eating and self-reported rate of eating included as potential mediators, is reported in Table 5. The inverse association between total IES scores and BMI remained statistically significant but was somewhat attenuated (−5·1 % for every 10-unit increase in intuitive eating; 95 % CI −6·1, −4·2 %; $P<0·001$). The relationship between intuitive eating and BMI was partially mediated by frequency of binge eating.

Discussion

The present study represents the first nationwide population survey to explore the association between intuitive eating and BMI. Total IES and all three subscales were significantly associated with BMI in an inverse direction in mid-age New Zealand women, after adjusting for potential confounding factors. This is consistent with suggestions that people who have a stronger awareness of physiological signals of hunger and satiety, and eat in response to these signals, are less likely to engage in behaviours that may lead to weight gain (e.g. eating when not physically hungry, binge eating) than those who follow restrictive diet rules[10,12]. The body signals of chronic dieters may have been weakened as a result of being ignored or replaced with external diet rules; therefore, these individuals may have lost their ability to detect when they are hungry or full[26]. The inverse association between intuitive eating and BMI is consistent with the findings of Augustus-Horvath and Tylka[7] among early adult (26–39 years) and middle adult women (40–65 years). In contrast, for 18–25-year-old women, intuitive eating was not associated with BMI[7].

If training in intuitive eating among mid-age women could increase total IES scores by 10 units (on a scale from 21 to 105), this would equate to a decrease of about 4·4 kg in a woman typical of our sample. This would require responses to less than half of the twenty-one items to change by 1 point on the 5-point response scale. This is a realistic and achievable improvement[27]. It is noteworthy that in a 3-year prospective study of women aged 42–52 years, a one-unit increase in reported level of sports/exercise (on a scale of 1 to 5) was longitudinally related to a decrease in weight of 0·32 kg ($P<0·001$)[13].

Table 3 The relationship between intuitive eating and other variables (frequency of binge eating, speed of eating, intake of specific foods) among mid-age New Zealand women

	Unadjusted result				Adjusted* result			
Variable	*n*	% increase/decrease or unit increase/decrease	95 % CI	*P* value	*n*	% increase/decrease or unit increase/decrease	95 % CI	*P* value
Binge eating†	1570	−1·62	−1·79, −1·46	<0·001	1505	−1·65	−1·82, −1·48	<0·001
Self-reported rate of eating	1588	−0·016	−0·02, −0·01	<0·001	1520	−0·015	−0·02, −0·01	<0·001
Time taken to eat main meal	1579	0·01	0·008, 0·015	<0·001	1511	0·01	0·007, 0·014	<0·001
Fruit intake	1589	−0·002	−0·007, 0·003	0·419	1521	0·002	−0·003, 0·007	0·369
Vegetable intake	1589	0·004	−0·0002, 0·009	0·060	1521	0·008	0·003, 0·01	0·001
Chocolate-coated and/or cream-filled biscuits	1591	−0·004	−0·01, 0·002	0·204	1523	−0·003	−0·01, 0·004	0·382
Potato crisps, corn snacks or corn chips	1590	0·003	−0·002, 0·009	0·246	1522	0·004	−0·002, 0·01	0·179
Cakes, scones, muffins or sweet buns	1590	−0·007	−0·01, −0·001	0·020	1522	−0·004	−0·01, 0·003	0·251
Meat pies or sausage rolls	1591	0·0004	−0·004, 0·005	0·881	1523	−0·002	−0·007, 0·002	0·322
Burgers	1591	−0·0002	−0·004, 0·004	0·927	1523	−0·001	−0·005, 0·003	0·486

*Adjusted for age, smoking status, menopause status, thyroid condition, prioritized ethnicity, physical activity and socio-economic status.
†Log-transformed data presented as % increase or decrease.

Mid-age is a time when women are at particular risk of weight gain[13]. In a cohort of more than 8000 Australian women aged 45–50 years, over a 2-year period a third of the women gained 2·25 kg or more, nearly 18 % gained 4·5 kg or more, and there was a mean weight gain of 1 kg[28]. Among 3064 US women aged 42–52 years, mean weight increased by 2·1 kg over 3 years of follow-up[13]. A 5-year follow-up of 17 000 Australian women, aged 35–69 years, reported that those who were initially overweight or obese were about 20 % more likely to experience major weight gain (5 kg or greater) than healthy weight women[29].

Given that half of our participants were overweight or obese, a 4·4 kg decrease in body weight may be of great practical importance. Weight losses of a similar magnitude (4·7 kg; 6 % decrease in BMI) have been accompanied by meaningful decreases in total cholesterol (16 %), LDL cholesterol (12 %) and HDL cholesterol (18 %)[30]. Weight gain in adult women of about 5 kg has been associated with a 5 % greater risk of postmenopausal breast cancer[31].

Interventions that focus on deliberate energy restriction have achieved short-term weight losses of 5–15 % of body weight, although almost all weight is regained within 5 years[32,33]. In contrast, recent interventions among obese women suggest that training in intuitive eating can prevent weight gain over 2 years[9,11].

Since weight gain results from an energy surplus, the inverse relationship between intuitive eating and BMI implies a difference in either the amount and/or the type of foods eaten. Although intuitive eating was significantly associated with slower eating and higher vegetable consumption, these effects were too small to be of practical significance (Table 3). Interestingly, despite giving themselves unconditional permission to eat any type of food, intuitive eaters do not consume high-fat/sugar foods more often than women who deliberately restrict their food intake. Given that binge eating is a mediator of the relationship between intuitive eating and BMI, and that intuitive eaters are less likely to eat in the absence of physical hunger, it is likely that intuitive eaters differ in the amount, rather than the types, of food eaten.

Study strengths and limitations

The present study was the first using a nationally representative sampling frame to examine intuitive eating and its association with BMI. Particular strengths are the large sample size, good response rate and reasonable representativeness of the sample in terms of prioritized ethnicity and SES, as well as the exploration of food intake and eating behaviours in the context of the BMI–intuitive eating relationship.

The main limitation was the cross-sectional design of the study, which means that the observed association does not necessarily indicate causality. Another significant weakness was reliance on self-reported height and

Table 4 Combined effect of the intake of specific foods, speed of eating and frequency of binge eating on BMI among mid-age New Zealand women (n 1434)

Food intake and eating behaviours	% increase/decrease in BMI*	95 % CI	*P* value
Binge eating	7·46	6·08, 8·85	<0·001
Self-reported rate of eating	1·87	0·50, 3·26	0·007
Time taken to eat main meal	−0·15	−1·56, 1·29	0·840
Fruit intake	−0·51	−1·48, 0·47	0·307
Vegetable intake	1·00	−0·03, 2·04	0·057
Chocolate-coated and/or cream-filled biscuits	0·36	−0·34, 1·06	0·313
Potato crisps, corn snacks or corn chips	−0·74	−1·57, 0·09	0·080
Cakes, scones, muffins or sweet buns	−1·44	−2·22, −0·66	<0·001
Meat pies or sausage rolls	2·44	1·31, 3·58	<0·001
Burgers	1·74	0·48, 3·02	0·007

*Adjusted for age, smoking status, menopause status, thyroid condition, prioritized ethnicity, physical activity and socio-economic status.

Table 5 Relationship between intuitive eating (IES score) and BMI controlling for potential mediators (intake of specific foods and eating behaviours) among mid-age New Zealand women (n 1441)

Food intake and eating behaviours	% increase/decrease in BMI*	95 % CI	*P* value
IES score	−0·51	−0·61, −0·42	<0·001
Binge eating	4·26	2·83, 5·70	<0·001
Self-reported rate of eating	0·8	−0·42, 2·04	0·199

IES, Intuitive Eating Scale.
*Adjusted for age, smoking status, menopause status, thyroid condition, prioritized ethnicity, physical activity and socio-economic status.

weight to calculate BMI. When self-reporting, women tend to underestimate weight and overestimate height[34]; however, the mean error is small[35]. A study of 536 New Zealand women (35–64 years) showed that this has little effect on analyses if self-reported BMI is used as a continuous measure[36] as in the present study. A large US study has recently concluded, from comparisons of BMI derived from self-reported and measured values, that the use of a continuous BMI measure derived from self-reports can be used to estimate associations with BMI[37]. Thus self-reported height and weight data are still considered valid in epidemiological studies[38,39]. Use of actual measures, while preferable, would have greatly limited the sample size and representation, and therefore the generalizability of the study findings.

The study would have benefited from a more comprehensive assessment of eating habits, including estimation of energy and nutrient intakes, and a more detailed measure of binge eating than the one-item measure used. However, this would have greatly increased respondent burden. Previous research on intuitive eating and the non-dieting approach has focused on women. The relationship between intuitive eating and BMI in adult men is unknown.

Conclusions

Women who follow external diet rules or eat in response to emotional and situational influences may be more likely to have a higher BMI than those who eat in accordance with their body signals. The association between BMI and intuitive eating appears to be partially mediated by frequency of binge eating. If these observations are confirmed in longitudinal studies and larger intervention trials, they may highlight a promising approach to weight management and weight gain prevention. Women who binge-eat may particularly benefit from training in intuitive eating.

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