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Is Plate Clearing a Risk Factor for Obesity? A Cross-Sectional Study of Self-Reported Data in US Adults

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Abstract

Objectives—Identifying eating behaviors which contribute to excess weight gain will inform obesity prevention strategies. A tendency to clear one's plate when eating may be a risk factor for obesity in an environment where food is plentiful. Whether plate clearing is associated with increased body weight in a cohort of US participants was examined.

Methods—Nine hundred and ninety-three US adults (60% male, 80% American European, mean age = 31 years) completed self-report measures of habitual plate clearing together with behavioral and demographic characteristics known to be associated with obesity.

Results—Plate clearing tendencies were positively associated with BMI and remained so after accounting for a large number of other demographic and behavioral predictors of BMI in analyses ($\beta = 0.18$, 95% CIs = 0.07, 0.29, $P < 0.001$); an increased tendency to plate clear was associated with a significantly higher body weight.

Conclusions—The tendency to clear one's plate when eating is associated with increased body weight and may constitute a risk factor for weight gain.

Introduction

Excess food consumption directly underpins weight gain (1,2) and there is an increasing interest in specific eating behaviors or practises which may be related to adiposity. For example, faster eating speeds are associated with increased body weight (3) and interventions to reduce eating speed lower energy intake (4).

Energy intake during a meal is determined by the decision to terminate eating and the tendency to clear one's plate when eating may be particularly relevant (5). A tendency to plate clear when eating could be a learnt behavior (6) or reflect moral or economic concerns regarding waste (7). All other things being equal, a tendency to clear one's plate when eating could result in consumers eating more food than required and increase their risk of weight

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gain. For example, in the context of meals eaten outside of the home (8,9), initial meal size is often not individually selected and frequently in excess of energy needs, so a tendency to clear one's plate in this environment could promote weight gain.

Although a small number of feeding studies have examined the incidence of plate clearing during an individual meal and found inconsistent differences between overweight and normal weight consumers (e.g. see 10-12), there has been no specific research to examine whether a tendency to clear one's plate when eating is associated with increased body weight. Accordingly, the present study was designed and conducted to test the relationship between plate clearing tendencies and body weight in a large cross-sectional survey, while accounting for a range of other behavioral and demographic variables known to be associated with obesity. We also tested whether there was an interaction effect between plate clearing tendencies and how often participants eat outside the home on body weight, in order to examine if plate clearing is more likely to be associated with a heavier body weight amongst individuals who eat in environments in which meals are high in energy and typically portions are not self-selected.

Methods

Recruitment and procedure

US adults (n = 1007) were recruited from Amazon Mechanical Turk (13), in exchange for a small monetary reward. The study was approved by the University of Liverpool's research ethics board. Participants completed a battery of online questionnaires; self-reported weight and height, plate clearing, demographics, and behavioral measures known to be associated with eating behavior or weight.

Plate clearing tendencies

Our primary measure of interest consisted of five self-devised questions (5 point Likert, strongly disagree to strongly agree) to measure plate clearing tendencies: "I always tend to clear my plate when eating," "I normally finish eating when my plate is empty," "Before I start eating, I normally plan to finish the serving I am about to eat," "I rarely leave food on my plate," and "It is normal for me to have very little food left or an empty plate at the end of a meal." The five items all loaded strongly onto the same factor (α = 0.89) suggesting that they all measured the same construct of clearing one's plate when eating, so scores were collapsed to form a single measure.

Demographic measures

Participants reported their gender, age in years, ethnicity, and smoking status. Participants selected their highest level of education (did not complete high school, high school, some college, bachelor's degree, master's degree, doctoral or professional degree), and current annual income (<$25,000, $25,000-39,999, $40,000-49,999, $50,000-74,999, $75,000-99,999, $100,000 or higher). Participants reported their weight (pounds) and height (feet and inches) and were provided with metric conversion tables if required. BMI was calculated as kg/m^2.

Behavioral measures

Eating rate—A validated single-item measure was used (14) "How would you describe your usual rate of eating?" Very slow, relatively slow, medium, relatively fast, very fast, fast.

Frequency of eating out of the home and meal consumption—Participants reported on average, how many times per week they ate meals prepared in a restaurant/diner, including eat-in or carry out restaurants, and restaurants that deliver food (9). Participants also reported on average, how many meals a day they ate *alone* and in the company of at least one *other* person. We distinguished between meal frequency alone and when in company, as energy intake may vary if eating alone or with others (15).

Restrained and uncontrolled eating traits—Participants completed the cognitive restraint scale and uncontrolled eating scale questions of the Revised Three Factor Eating Questionnaire (16), which measure restricting food intake for dieting purposes and over-eating.

Food frequency questionnaire—Using a 27-item shortened US food frequency questionnaire (17), participants reported frequency of consumption of common fruits and vegetables, energy-dense snack foods (e.g., cookies), and energy-dense main meal foods (e.g., pizza) on a "never" to "daily" (1-9) response scale. We collapsed frequency scores across items in each of the three food categories to produce frequency of consumption scores for the three food types.

Exercise—A validated short item scale (18) was used to measure how many days in the last week participants had exercised.

Analysis

Our interest was to examine the association between plate clearing and BMI. However, if examined on its own any significant association between the two could be potentially caused by confounding variables. Thus, we accounted for other behavioral and demographic measures by using a forced entry multiple regression model with plate clearing entered alongside the 16 other demographic and behavioral control variables (described earlier) in the model. We hypothesized that plate clearing may have a stronger association with BMI amongst individuals who ate out of the home frequently, so we included an interaction term between plate clearing and frequency of eating out of the home in the model.

Results

One thousand and seven participants enrolled in the study. Fifteen participants did not provide complete responses and data from these participants was not used, leaving 993 participants remaining. In total, 593 participants were male (60%) and 400 were female, 790 were European American (80%), the majority of participants earned either less than $25,000 (24.7%) or $25-$39,999 (24.5%). Consistent with population prevalence, mean BMI fell in

the overweight range (M = 26.5, SD = 6.6, range = 16-62). See Table 1 for demographic information and percentage of participants in each weight status.

The overall regression model was significant [$F(18,974) = 8.59$, Adj. $R^2 = 0.12$, $P < 0.001$]. Plate clearing was significantly positively associated with BMI (Unstandardized $\beta = 0.18$, 95% CIs = 0.07, 0.29, $P < 0.001$) but the interaction between plate clearing and eating out of the home was not ($\beta = 0.02$, 95% CIs = −0.07, 0.11, $P = 0.68$). See Table 2 for the relationships between BMI and the control variables. We also tested the relationship between plate clearing and BMI in a series of models with varying levels of adjustment and whether plate clearing interacted with gender or age to explain further variation in BMI. Plate clearing was a significant predictor in all models and did not interact with gender or age. See online material 1. We also examined whether demographic variables were associated with plate clearing, being male, of lower income and higher education were all predictive of a tendency to plate clear (see Table 3). The frequency of plate clearing was high (as in observational studies; 13) (see online material 2 for mean scores and variability in this measure).

Discussion

A tendency to clear one's plate when eating was associated with increased body weight, when controlling for a number of other predictors of body weight and eating behavior measures. One interpretation of these findings is that clearing one's plate out of habit could cause over-consumption if frequently served larger portions of food and promote weight gain.

We predicted that a lack of control over initial meal size might mean that eating out of the home would increase the likelihood that plate clearers were of heavier body weight, although this was not the case. Given that portion sizes in the home may often not be individually selected (e.g. a spouse may serve food), future work could use a more direct measurement of how often participants determine initial meal size and test if this interacts with plate clearing.

Plate clearing may be disadvantageous when food is plentiful, as is the case in many developed countries. Portion sizes have increased in recent times (19) but it is unclear whether the tendency to feel impelled to finish everything on one's plate has changed in line with this. Changing ingrained behaviors can be hard, but examining whether high risk populations can be trained to eat to satiety cues and not worry about leaving food may warrant investigation.

The present data were cross-sectional and it is not possible to infer causality, so future work to examine whether plate clearing has a prospective association with body weight is now needed. For example, reverse causality could in part explain our findings; overweight individuals may be more likely to plate clear because of an increased energy requirement. Likewise, the relationship between plate clearing and BMI amongst individuals of higher SES and in countries other than the US now needs to be examined. We also relied on a self-reported plate clearing measure devised for this study and this measure is yet to be validated.

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Weight and height were self-reported. For this to generate a spurious association with plate clearing, we would have to assume that people who underestimate their BMI claim not to clear their plate. Given the strength of the association overall, this effect would have to be large to invalidate it, while surveys indicate that underestimation of weight is usually small (20).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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TABLE 1
Participant demographic characteristics

Age		Ethnicity		Education level		Income		BMI	
18-24 yrs old	289 (29.1%)	Caucasian	790 (79.6%)	Did not complete high school	3 (0.3%)	<$25,000	426 (42.9%)	<18.5, underweight	30 (3.0%)
25-44 yrs old	590 (59.4%)	Black	61 (6.1%)	High school	116 (11.7%)	$25-39,999	243 (24.5%)	18.5-24.9, healthy	477 (48.0%)
45-64 yrs old	101 (10.2%)	Asian	67 (6.7%)	Some college	396 (39.9%)	$40-49,999	105 (10.6%)	≥25-29.9, overweight	267 (26.9%)
65 + yrs old	13 (1.3%)	Hispanic	43 (4.3%)	Bachelor’s degree	392 (39.5%)	$50-74,999	125 (12.6%)	≥30, obese	219 (22.1%)
		Mixed race	25 (2.5%)	Master’s degree	67 (6.7%)	$75-99,999	63 (6.3%)		
		Other	7 (0.7%)	Doctoral or professional degree	19 (1.9%)	≥$100,000	31 (3.1%)		

Values correspond to number of participants and percentage of total sample in parentheses.

TABLE 2

Full results of linear regression model to examine the relationship between plate clearing and BMI while controlling for other measures associated with BMI and eating behavior

	Unstandardized β coefficient (95% CIs)	*t* value	*P* value
Model constant	16.4 (11.4, 21.5)	6.43	< 0.001*
Behavioral variables			
Plate clearing	0.18 (0.07, 0.29)	3.31	= 0.001*
Frequency of eating out of home	0.51 (0.07, 0.96)	2.27	= 0.023*
Plate clearing*eating out of home interaction	0.02 (−0.07, 0.11)	0.42	= 0.679
Frequency of exercise	−0.51 (−0.73, −0.28)	−4.37	< 0.001*
Dietary restraint	0.22 (0.11, 0.33)	3.97	< 0.001*
Uncontrolled eating	0.18 (0.11, 0.25)	5.07	< 0.001*
Usual rate of eating	0.51 (0.08, 0.93)	2.33	= 0.020*
Frequency of meals eaten alone	−0.19 (−0.49, 0.11)	−1.22	= 0.222
Frequency of meals eaten socially	−0.24 (−0.55, 0.07)	−1.53	= 0.127
Fruit and vegetable consumption	−0.12 (−0.38, 0.01)	− 0.93	= 0.353
Energy-dense snack food consumption	−0.05 (−0.11, 0.01)	−1.79	= 0.074
Energy-dense main meal food consumption	0.06 (−0.004, 0.12)	1.83	= 0.068
Demographic variables			
Age	0.11 (0.07, 0.15)	5.24	< 0.001*
Gender (dummy coded, male or female)	0.93 (0.03, 1.83)	2.03	= 0.042*
Ethnicity (dummy coded, Caucasian or not Caucasian)	−0.27 (−1.3, 0.72)	0.54	= 0.593
Education level	−0.50 (−0.83,−0.176)	−3.02	= 0.003*
Current income level	0.07 (−0.20, 0.33)	0.50	= 0.619
Smoking status (dummy coded, smoker: yes or no)	0.88 (−0.22, 1.98)	1.57	= 0.118

*Indicates a significant association between variable and BMI at $P < 0.05$. All variable variance inflation factors < 2.5, indicating no evidence of significant multi-collinearity.

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TABLE 3

Results of stepwise linear regression examining demographic predictors of plate clearing tendencies score

	Unstandardized β coefficient (95% CIs)	*t* value	*P* value
Gender	−2.0 (−2.5, −1.5)	−8.1	< 0.001
BMI	0.09 (0.06, 0.13)	5.2	< 0.001
Annual income	−0.37 (−0.52, −0.21)	−4.7	< 0.001
Education level	0.20 (0.007, 0.39)	2.0	0.042

Stepwise linear regression was used to test which demographic variables were independently associated with plate clearing tendencies (gender, age, BMI, education, income, and ethnicity). The final model (Adj. R^2 = 0.10, P < 0.001) included gender, BMI, income, and education level; whereby males, those with a higher BMI, higher annual income and lower educational level all had a greater tendency to plate clear.