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ORIGINAL ARTICLE

Association of weight control behaviors with body mass index and weight-based self-evaluation

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Objective: To determine the frequency of weight control behaviors (WCBs) and their correlation with body mass index (BMI) and weight-based self-evaluation.
Methods: Data were collected by the Brazilian Internet Study on Temperament and Psychopathology (BRAINSTEP) from 27,501 volunteers (30.4% men, mean age 28.9±8.7 years).
Results: The most prevalent WCBs for men and women were exhaustive physical exercise and prolonged fasting, respectively. Frequent exhaustive physical exercise was the only behavior more often adopted by men. BMI was positively associated with WCBs, which were very frequent in obese subjects. About 15% of normal-weight women reported using diuretics and laxatives, and 12.2% reported vomiting as a WCB at least occasionally. Among subjects who regarded body weight highly in their self-evaluation, there was a strong positive association with all WCBs, at similar degrees, in both genders. Compared to those who never base their intrinsic personal value on body weight, those who frequently base intrinsic value on body weight were at 25-30 times higher risk of inducing vomiting.
Conclusion: The prevalence of participants adopting WCBs was high, especially in women and obese subjects. Weight-based self-evaluation was more strongly associated with WCBs than BMI.

Keywords: Weight perception; body weight; weight loss; body mass index; self-concept

Introduction

A healthy body weight is a common desire; it is associated with longer life expectancy, less health expenditure, and better quality of life.[1] To achieve this aim, people use many strategies, such as physical activity, diet, and medical treatments. However, the worldwide prevalence of overweight remains high, affecting more than 1.9 billion people, of whom 600 million are obese.[2] In Brazil, 52.5% of the population is overweight and 17.9% is obese.[3] These numbers suggest that overweight and obesity are public health problems. Pre-obese and obese individuals are at higher risk of developing several diseases, including mental disorders,[4,5] and mortality risk is also increased.[3-5]

Being overweight may contribute to feelings of dissatisfaction with one's body. This depends heavily on sociocultural ideals. Many societies have a fixation about thinness as the standard of beauty, which may influence individuals, particularly women, to develop unhealthy weight control behaviors (WCBs).[6] Prolonged fasting, exhaustive physical exercise, vomiting, and intake of appetite suppressants, diuretics, and laxatives are some examples of WCBs. These behaviors are often inadequate and may endanger the physical and mental health of the individual, who can develop eating disorders.[4]

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WCBs have been increasingly investigated in the general population,[5,7] mostly in women[8,9] or adolescents.[10] About 5 to 15% of American teenagers claim to use laxatives and diuretics to lose weight.[10] Australian data show that obese women adopt twice as many WCBs as the general population,[7] whereas in Germany, 5.9% of women and 1.5% of men perform WCBs.[11] About 49% of university students in Vietnam answered yes to questions regarding key aspects of eating disorders, such as vomiting.[5] To our knowledge, no large study has been conducted in Brazil, a country that is second only to the United States of America in prevalence of cosmetic procedures and interventions.[12]

The aim of this study was to determine the frequency of WCBs in a large web-based sample of the Brazilian population and the association of these behaviors with body mass index (BMI) and weight-based self-evaluation. We also explored sociodemographic risk factors related to these behaviors. To do so, we analyzed data from an anonymous and voluntary web survey on many psychological and psychiatric measures.[13] This approach is highly suitable for expanding research about sensitive and morally charged issues, such as WCBs.[14]

Methods

Sample and data collection

Data were obtained from the Brazilian Internet Study on Temperament and Psychopathology (BRAINSTEP) project.[15] This is a web-based, anonymous and confidential survey designed to study temperament, psychiatric disorders, and psychobiological measures. Participants

answered questions concerning personal information and personality characteristics in a non-commercial, advertisement-free website (http://www.temperamento.com.br).

Validity questions were used throughout the protocol to ensure the quality of the data: 1) at the end of the first page on demographics, the question "Do you commit to answering the questions honestly?" was added to increase the validity of answers; 2) questions checking for attention were placed within some of the instruments throughout the system (e.g., "Please mark the option 'never' in this question"); and 3) at the end of each phase, there was one direct question on level of sincerity and another on attention. Our sample consisted of participants who answered all of these validity questions correctly. The initial sample consisted of 30,260 volunteers, but only 27,501 correctly answered all validation criteria and met the age criteria (age $>$ 18 and $<$ 55 years).

All participants volunteered to take part in the survey and could quit at any time without justification. All gave informed consent electronically before accessing the questionnaires. The response period from November 2010 to May 2015. The Institutional Review Board of Hospital São Lucas reviewed and approved the protocol. All necessary procedures were adopted to satisfy the National Research Council of Brazil (Resolution 466/2012) and the Code of Ethics of the World Medical Association.

Behavioral variables

Participants were asked about WCBs (fasting, physical exercise, vomiting, medication intake – diuretics and laxatives) and their respective frequencies (never, sometimes, or frequently). The questions used in the study to assess the WCBs were as follows: "To control your weight, have you done prolonged fasting? Have you done exhaustive physical exercise? Have you taken diet pills, laxatives, or diuretics? Have you induced vomiting?". Excessive value placed on body weight was measured by the following item from the Adult Self-Report Inventory[16]: "I must be thin to like myself," which could be rated as never, sometimes, frequently or very frequently. This variable was named "self-evaluation." Participants also reported height, current weight, history of bariatric surgery, and previous diagnoses of bulimia and anorexia nervosa.

Descriptive variables

Demographic data (gender, race, education, and religion), WCBs, and BMI were the descriptive variables of interest. BMI was calculated as weight (kg)/height^2 (m^2) and categorized in accordance with World Health Organization (WHO) recommendations[17] as follows: very thin ($<$ 17.00 kg/m^2); thin (17.00-18.49 kg/m^2); normal (18.50-24.99 kg/m^2); pre-obese (25.00-29.99 kg/m^2); and obese, grade I (30.00-34.99 kg/m^2), II (35.00-39.99 kg/m^2), or III ($\geqslant$ 40.00 kg/m^2).

Statistical analysis

Differences in the frequencies of WCBs between groups were analyzed with the chi-square test. Risk ratios with 95% confidence intervals (95%CI) for having a WCB rated as frequent were calculated using multinomial logistic regression analysis. These analyses were adjusted for gender, BMI, education level, race, and history of bariatric surgery. Analyses were conducted in SPSS version 22. Statistical significance was set at $p < 0.05$.

Results

The sample consisted of 27,501 participants aged 18 to 55 years (mean age 28.9$\pm$8.7 years, 69.6% women). Most participants were Caucasian (69.5%), had at least a high-school education (95.1%), and had a normal BMI (45.7% of males and 56.4% of females). In this sample, a lifetime diagnosis of anorexia or bulimia nervosa was reported for 0.3% (n=25) and 0.2% of men (n=17), compared to 0.9% (n=169) and 1.1% (n=207) of women, respectively.

Regarding demographic variables, the prevalence of frequent WCBs differed significantly between men and women for all behaviors ($p < 0.001$, df = 1 for all, χ^2 = 61.18 to 414.75). Frequent exhaustive physical exercise was the only behavior adopted more often by men; all other behaviors were three to eight times more common in women. Overall, the most prevalent WCB was exhaustive physical exercise in men and prolonged fasting in women. The prevalence of frequent WCBs varied little according to race and educational level. While in men there was no statistical significance, in women, those of mixed race adopted laxatives (odds ratio [OR] = 0.83, 95%CI 0.72-0.96) and medication intake (OR = 0.79, 95%CI 0.69-0.91) less often than Caucasian women. Regarding education, among men, having a low educational attainment (only elementary school) was associated with a higher risk of vomiting (OR = 3.90, 95%CI 1.29-11.82) and lower risk of exhaustive physical exercise (OR = 0.67, 95%CI 0.47-0.97). For women, having a low educational attainment was associated with a higher risk of prolonged fasting (OR = 1.36, 95%CI 1.08-1.72) and vomiting (OR = 1.44, 95%CI 1.21-1.70), but lower risk of exhaustive exercise (OR = 0.54, 95%CI 0.39-0.76).

Compared to participants with normal BMI, those in the obese groups were at significantly higher risk of adopting frequent WCBs – whether men (Table 1) or women (Table 2). ORs in the obese groups were higher in men, mostly due to a much lower prevalence of these behaviors in the normal-BMI group, except for exhaustive exercise. The use of weight-loss medications increased in both genders as a function of higher BMI, reaching ORs of 108 for men and 30 for women in the obese III groups compared to participants with normal BMI. Increasing value of weight in self-evaluation was positively and strongly associated with all WCBs, to similar degrees, in both genders (Tables 1 and 2), except for a lower degree of association with exhaustive exercise in men.

Figures 1A and 1B show that the number of frequent WCBs according to BMI increased steadily in men, while in women, this trend reached a plateau in the obese groups. Around 70% of men and 60% of women in the obese III groups reported no frequent WCBs. In contrast,

Table 1 Risk ratios for frequent weight control behaviors in men

Variable	Total population (%)†	Prolonged fasting	Exhaustive exercise	Laxatives	Diuretics	Medication	Vomiting
BMI*							
Very thin	1.0	0.91 (0.22-3.77)	0.23 (0.06-0.94)‡	0	0	0.66 (0.03-13.17)	2.53 (0.33-19.40)
Thin	2.5	0.75 (0.27-2.07)	0.37 (0.18-0.76)‡	0.94 (0.12-7.11)	1.27 (0.17-9.71)‡	1.07 (0.22-5.23)	0.99 (0.13-7.52)
Normal (ref)	45.7	1	1	1	1	1	1
Pre-obese	34.6	2.24 (1.69-2.96)‡	1.99 (1.68-2.36)‡	1.81 (0.98-3.36)	2.25 (1.15-4.43)‡	2.69 (1.70-4.27)‡	1.37 (0.67-2.78)
Obese I	11.6	4.39 (3.15-6.12)‡	2.62 (2.07-3.30)‡	3.77 (1.91-7.43)‡	9.02 (4.68-17.36)‡	17.90 (11.59-27.64)‡	1.96 (0.80-4.82)
Obese II	3.2	4.28 (2.48-7.41)‡	1.58 (1.01-2.48)‡	3.15 (1.04-9.56)‡	6.47 (2.30-18.99)‡	45.74 (26.79-78.08)‡	4.85 (1.75-13.43)‡
Obese III	1.3	8.58 (4.58-16.10)‡	2.41 (1.32-4.38)‡	8.82 (3.04-25.54)‡	33.97 (14.42-80.01)‡	108.45 (62.04-189.58)‡	4.48 (0.98-20.42)
Self-perception							
Never (ref)	60.5	1	1	1	1	1	1
Sometimes	22.8	2.10 (1.35-3.29)‡	1.77 (1.37-2.29)‡	2.81 (1.16-6.80)‡	1.47 (0.59-3.64)	1.31 (0.78-2.19)	3.11 (0.75-12.81)
Frequently	9.6	5.54 (3.45-8.92)‡	3.15 (2.29-4.33)‡	3.63 (1.27-10.40)‡	2.44 (0.90-6.66)	4.02 (2.44-6.61)‡	11.19 (3.04-41.17)‡
Very frequently	7.1	19.72 (12.88-30.19)‡	5.27 (3.80-7.30)‡	11.01 (4.60-26.36)‡	9.02 (4.07-19.99)‡	53.36 (35.35-80.56)‡	30.70 (9.38-100.49)‡

Data presented as odds ratios (95%CI) calculated by multinomial logistic regression analysis, adjusted for sex, BMI, education, race, and history of bariatric surgery.
95%CI = 95% confidence interval; BMI = body mass index; OR = odds ratio.
* BMI (kg/m^2): < 17.00, very thin; 17.00-18.49, thin; 18.50-24.99, normal; 25.00-29.99, pre-obese; 30.00-34.99, obese I; 35.00-39.99, obese II; $\geqslant 40.00$, obese III.
† Percentage of corresponding n for total population.
‡ Odds ratios are statistically significant ($p < 0.05$) when 1.0 is not included in the 95%CI; statistically significant odds ratios are marked with a double dagger.

the prevalence of frequent WCBs in the thin and very thin groups was lower than in the normal-weight group.

Figure 2 shows the raw data for men and women, including data on WCBs that were adopted sometimes. The prevalence of these WCBs rose sharply with increasing BMI. Even so, 14-16% of normal-weight women reported using diuretics and laxatives sometimes for weight loss purposes; 9.3% and 2.9% of normal-weight women reported vomiting sometimes and frequently, respectively. Among men, these rates were 1.8% and 0.4%. As shown in Figure 3, self-evaluation was strongly associated with number of WCBs (3A and 3B) and BMI (3C and 3D).

Discussion

Our results showed that WCBs are more common in women than in men, which is in agreement with most studies conducted worldwide.[18,19] The only exception was that men did more exhaustive physical exercise, which also corroborates previous studies.[20-23] About 10% of men and 18% of women in the normal BMI group endorsed at least one frequent WCB. High BMI and self-evaluation ratings were associated with an increased risk for frequent WCBs, especially in men. However, self-evaluation was more strongly associated with most WCBs than BMI. Race and education had associations of a much lower magnitude.

The number of WCBs increased with BMI. Only about 6% of thin and very thin participants adopted such behaviors frequently. Among them, only a minority had received a diagnosis of anorexia nervosa (1.2% and 1.8% for thin and very thin participants, respectively), although this may represent an underestimate. In many settings, very thin people may be erroneously regarded as having an eating disorder, but this may be the exception more often than the rule. The present study suggests that, at the population level, WCBs are less frequent in very thin participants and more common in obese participants, which is in line with previous studies, with significant gender differences.[7,8,13,24-26] Regarding the prevalence of WCBs, men adopted exhaustive physical exercise more often than women. This difference is probably related to sociocultural influences, as attractiveness in men is often conceived as a large, muscular, athletic physique.[27] This type of social pressure may also exist among women, but as identified in our sample, corroborating previous studies,[18,19] women usually adopt other strategies to lose weight.

The largest effect size for both men and women was found for the use of weight-loss medications and diuretics. Behavioral and lifestyle changes, such as reduced caloric intake, changes in meal composition, and increased levels of healthy physical activity, are necessary for successful weight loss.[28] However, the percentage of participants who fail to obtain satisfactory results with conservative measures is high.[29] Given the complications and high

Table 2 Risk ratios for frequent weight control behaviors in women

Variable	Total population (%)†	Prolonged fasting	Exhaustive exercise	Laxatives	Diuretics	Medication	Vomiting
BMI*							
Very thin	1.6	0.30 (0.16-0.54)‡	0.38 (0.20-0.72)‡	0.29 (0.12-0.70)‡	0.09 (0.1-0.67)‡	0	0.39 (0.15-1.06)
Thin	4.9	0.31 (0.22-0.44)‡	0.20 (0.12-0.33)‡	0.23 (0.13-0.41)‡	0.22 (0.10-0.46)‡	0.12 (0.05-0.30)‡	0.29 (0.15-0.57)‡
Normal (ref)	56.4	1	1	1	1	1	1
Pre-obese	23.0	2.10 (1.87-2.35)‡	1.84 (1.62-2.10)‡	2.35 (2.05-2.69)‡	3.03 (2.59-3.55)‡	5.60 (4.87-6.44)‡	1.56 (1.29-1.87)‡
Obese I	8.8	2.95 (2.53-3.45)‡	1.77 (1.46-2.14)‡	2.94 (2.46-3.51)‡	4.48 (3.67-5.46)‡	14.78 (12.45-17.54)‡	1.52 (1.17-1.98)‡
Obese II	3.3	2.96 (2.34-3.75)‡	1.58 (1.17-2.12)‡	2.58 (1.95-3.40)‡	5.20 (3.93-6.88)‡	24.16 (18.76-31.11)‡	1.98 (1.37-2.85)‡
Obese III	1.6	3.55 (2.54-4.95)‡	1.82 (1.21-2.73)‡	2.13 (1.39-3.27)‡	7.02 (4.86-10.12)‡	30.13 (21.28-42.64)‡	1.85 (1.10-3.11)‡
Self-perception							
Never (ref)	39.0	1	1	1	1	1	1
Sometimes	26.8	3.01 (2.44-3.70)‡	2.40 (1.92-2.99)‡	2.73 (2.09-3.56)‡	2.70 (2.01-3.62)‡	2.68 (2.11-3.40)‡	3.49 (2.29-5.31)‡
Frequently	16.0	7.13 (5.77-8.82)‡	3.78 (2.99-4.79)‡	4.99 (3.81-6.53)‡	4.42 (3.27-5.97)‡	4.57 (3.57-5.86)‡	5.05 (3.27-7.81)‡
Very frequently	18.1	21.72 (17.84-26.43)‡	9.23 (7.51-11.34)‡	13.41 (10.52-17.10)‡	10.22 (7.80-13.40)‡	11.88 (9.48-14.89)‡	25.49 (17.50-37-13)‡

Data presented as odds ratios (95% CI) calculated by multinomial logistic regression analysis, adjusted for sex, BMI, education, race, and history of bariatric surgery.
95%CI = 95% confidence interval; BMI = body mass index; OR = odds ratio.
* BMI (kg/m^2): $<$ 17.00, very thin; 17.00-18.49, thin; 18.50-24.99, normal; 25.00-29.99, pre-obese; 30.00-34.99, obese I; 35.00-39.99, obese II; $\geqslant$ 40.00, obese III.
† Percentage of corresponding n for total population.
‡ Odds ratios are statistically significant ($p < 0.05$) when 1.0 is not included in the 95%CI; statistically significant odds ratios are marked with a double dagger.

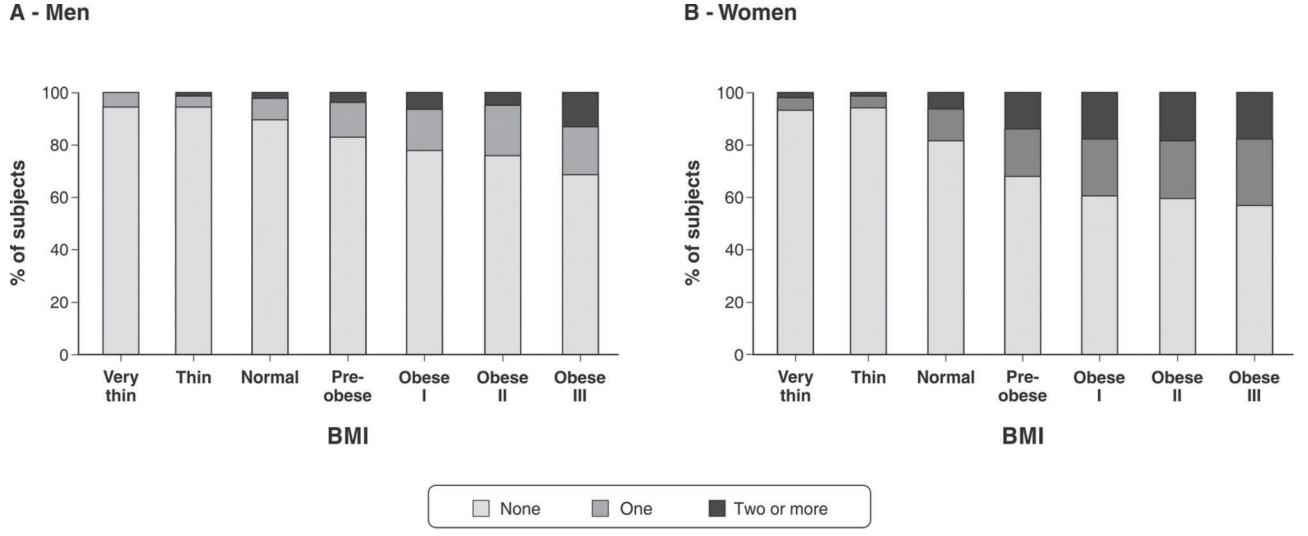

Figure 1 Lifetime prevalence of frequent WCBs – none, one, two or more – according to BMI in men (A) and women (B). BMI (kg/m^2): $<$ 17.00, very thin; 17.00-18.49, thin; 18.50-24.99, normal; 25.00-29.99, pre-obese; 30.00-34.99, obese I; 35.00-39.99, obese II; $\geqslant$ 40.00, obese III. BMI = body mass index; WCB = weight control behavior.

mortality associated with obesity,[3-5] the use of pharmacological treatments should be considered under medical supervision. However, the use of diuretics is not a healthy weight control strategy.[30] In Brazil, diuretics are available for purchase over the counter. Such frequent intake of these medications for weight-loss purposes highlights the need for greater control in the sale and distribution of diuretics, as their indiscriminate use is associated with major health risks.[30] Of note, ORs were even higher in obese men than in participants with normal BMI.

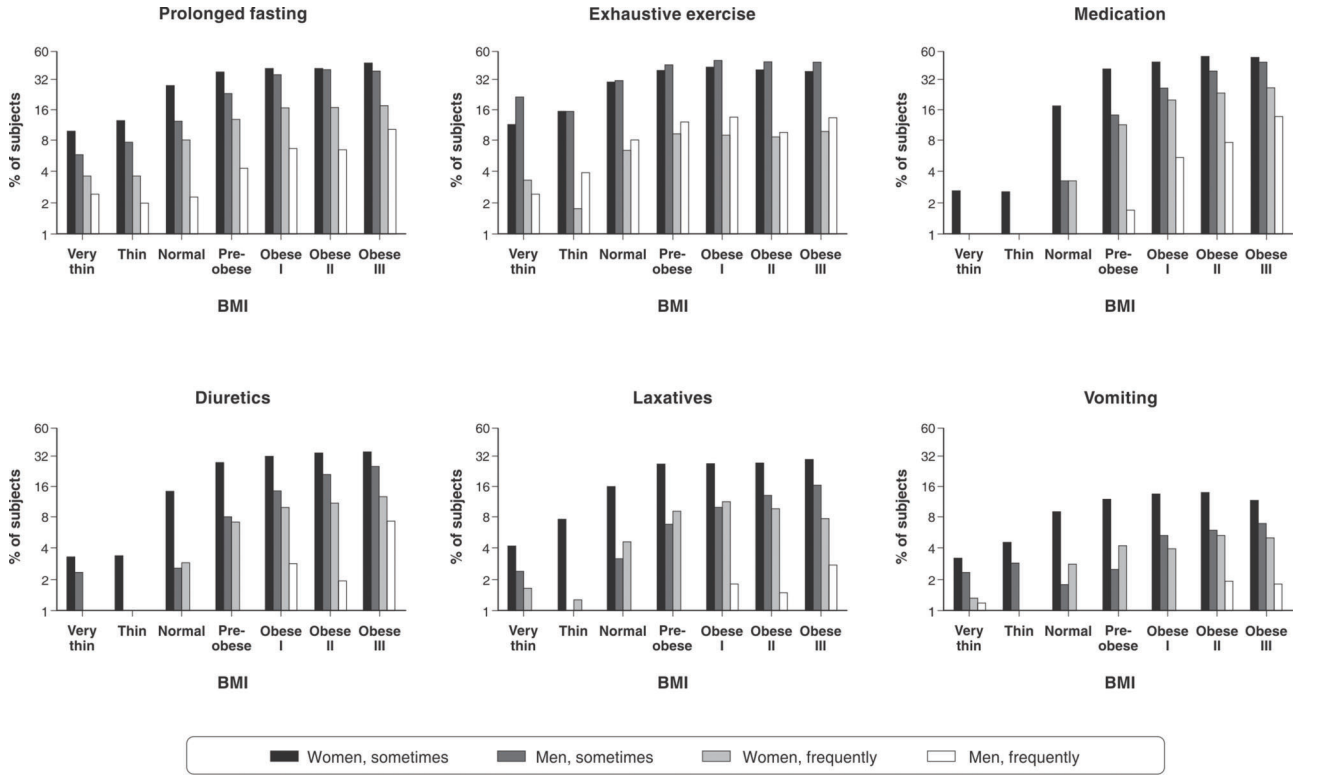

Figure 2 Frequency of each WCB adopted sometimes or frequently according to BMI in men and women. Frequencies (Y-axis) are plotted on a logarithmic scale (log_2). BMI (kg/m^2): $<$ 17.00, very thin; 17.00-18.49, thin; 18.50-24.99, normal; 25.00-29.99, pre-obese; 30.00-34.99, obese I; 35.00-39.99, obese II; $\geqslant$ 40.00, obese III. BMI = body mass index; WCB = weight control behavior.

Besides the stigma about eating disturbances, men are more reluctant to reveal and recognize psychiatric disorders.[31] Previous studies of men's behaviors are sparse and focused mainly on sexual orientation.[32,33] In our sample, a substantial percentage of men (12%, n=966), though still fewer than women, carried out WCBs frequently.

Regarding the frequency of WCBs in women, our findings are in line with previous research; in short, women were more likely to adopt WCBs,[20,21] even sometimes or frequently, especially when obese. However, we also found a high percentage (11.3%) of normal-BMI women adopting WCBs frequently. As shown in Figure 2, normal-BMI women adopted several WCBs (use of diuretics, laxatives, and self-induced vomiting) at rates similar to those of obese men. Moreover, normal-BMI women adopted laxative intake as a weight-control strategy as often as men with grade III obesity, and vomiting was even more prevalent in normal-BMI women than in men with morbid obesity (Figure 2). This suggests that normal-BMI women are as dissatisfied with their body as overweight women, which is in line with previous research.[5] Historically, women are required to follow the standards of beauty imposed by society more intensely. Brazilian culture worships beauty, as can be deduced from the huge number of women who undergo surgical procedures and interventions for purely cosmetic purposes.[12] The definition of beauty depends on each historical period and society. Currently, having a slim body and maintaining a youthful appearance seem to be desired by many, as this is the standard of beauty and health currently imposed by the media. However, in the present context, with increasing BMI, frequent intake of cheap, processed foods, and little time for healthy meals and regular physical activity,[34] achieving a lean body is quite difficult. Thus, the combination of social pressures and difficulty to maintain a normal weight may underlie the frequent adoption of WCBs, especially by women.

Weight-based self-evaluation is strongly associated with WCBs in women[35,36] and in adolescents.[37] In our sample, weight-based self-evaluation was also strongly associated with WCBs in men, which contrasts with previous studies.[38,39] This difference may be explained by the large number of men in our sample (n=8,347) as compared to previous studies; by a possible selection bias on our website for participants prone to WCBs, despite the prevalence of psychiatric disorders in our databank being generally consistent with epidemiologic studies[15]; and by greater sincerity among survey participants when responding to an anonymous, online questionnaire, which provides greater privacy.

The main limitation of our study is its cross-sectional design, relying exclusively on self-report data, in a convenience sample with inherent selection biases. Body weight and height used to calculate BMI were self-reported, although this type of data collection seems to be adequate for epidemiological research.[40] Another important limitation is that participants who adopt WCBs can

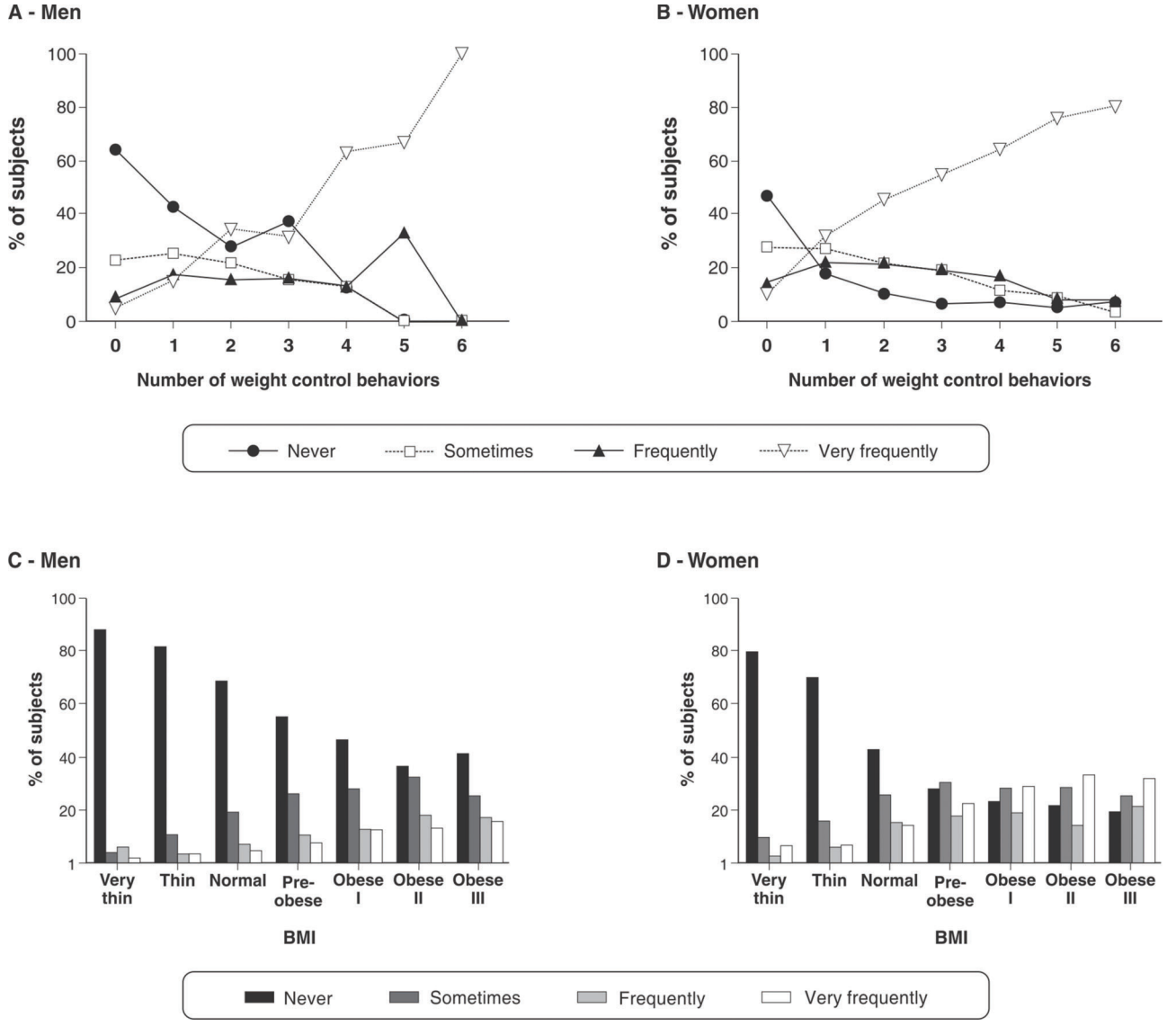

Figure 3 Weight-based self-evaluation stratified by number of WCBs (A and B) and by BMI (C and D).Participants responded how often they think they must be thin to like themselves: very frequently, frequently, sometimes, or never. BMI (kg/m^2): $<$ 17.00, very thin; 17.00-18.49, thin; 18.50-24.99, normal; 25.00-29.99, pre-obese; 30.00-34.99, obese I; 35.00-39.99, obese II; $\geqslant$ 40.00, obese III. BMI = body mass index; WCB = weight control behavior.

vary these practices over time, and these behaviors were not quantified. Strengths include the large sample size and the anonymity of participants, which may improve reporting of sensitive issues such as WCBs.[14]

In conclusion, the prevalence of WCB adoption in this sample was high, especially among obese participants and women. WCBs were more strongly associated with weight-based self-evaluation than with BMI, which helps to explain the high prevalence of WCBs in normal-weight women. Further research should address these issues and emphasize preventive actions where these behaviors are common, as is the case in Brazil.

Disclosure

The authors report no conflicts of interest.

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