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Self-Control at Meals in Order Not to Gain Weight and Its Relationship with Food Cravings in Low-Carb Dieters

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Abstract: Aims: This study's objective was to verify the level of food cravings and cognitive restraint in women who reported having followed a low-carb diet. Methods: The volunteers filled out the binge eating scale, the cognitive restraint subscale, the food cravings trait and state questionnaires, and the food frequency questionnaire. This study has also compared participants according to the self-reported practice of a low-carb diet. Parametric tests were used to compare the groups and Pearson's correlations between some variables of interest ($p > 0.05$ adopted). Results: According to the question regarding the practice of the low-carb diet, 39 participants had tried a low-carb diet in the last six months (46.2% of these with binge eating) and 48 did not (16.7% with binge eating). Dieters showed higher levels of binge eating, cognitive restriction, and food cravings (trait and state). Dieters consumed less rice and bread but did not present lower consumption of sweets. Correlations showed that for dieters who 'Consciously hold back at meals in order not to gain weight', it was negatively associated with 'Intention and plans to eat', 'positive reinforcement' and 'relieving negative states' and food cravings scores. Conclusions: Despite the higher levels of cognitive restriction in dieters, they are negatively correlated with food craving factors and negatively associated with the consumption of sweets.



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Keywords: low-carb diet; binge eating; eating behavior; food craving; cognitive restraint

1. Introduction

Caloric restriction is associated with decreased levels of food cravings (FC) in several studies [1]. The American College of Cardiology and the American Heart Association reviewed evidence on restrictive diets and their nutritional content. One of the first conclusions was that all diets that generate calorie restriction would be indicated for weight loss [2]. Other developments have sparked discussions between comparisons of high-protein and low-carbohydrate diets (i.e., "low-carb" diets), and high-carbohydrate and low-fat diets [3].

Low-carb diets comprise a range of 30 to 130 carbohydrates/day. This type of modification in the diet has been widely used, regardless of professional monitoring, in order to lose weight and change the appearance [4], which depends not only on dietary changes, but also on cognitions and strategies to consume less food [5]. Santos and colleagues demonstrated 12 reasons for weight control in a meta-analysis carried out with 72 studies. The first reason for prevalence was to improve appearance (in 71.4% of studies) [6]. This behavior is prevalent in women, who have more factors associated with body dissatisfaction, and are consumers of content on the internet through social media [6].

Thus, dietary intentions are modified, and desires are questioned in the face of dietary rules imposed through cognitive restriction. May et al. [7] demonstrated that the factors which anticipated reward and relief (e.g., 'I am tired/uncomfortable' and 'physically needed'), resistance (e.g., 'I try to resist having it') and factors in the elaborate intrusion theory (e.g., 'I suddenly think about it', 'I imagine the smell/taste of it') were responsible for 36% of the variation in the strength of desire [7].

Some studies have explored the outcomes in individuals who perform dietary changes on their own, or by gathering recommendations from different sources [8]. In the study by Sares-Jaske and colleagues, 32.8% of the participants declared themselves ‘Self-report dieters’ at baseline, and of these, 28.4% had lost weight during the previous year. The study demonstrated the outcome of body mass index and waist circumference, higher for dieters during the follow-up [8].

A common way to investigate the practice of unsupervised dieting in these studies is by using questions such as “How many days of the last 28 days did you try to limit the amount of food you eat to influence your body shape or weight (regardless of whether you have succeeded or not)” [6]. Regardless of the exact content of the modification made in the diet, these studies have shown several adverse outcomes for respondents on a diet [4,6].

There is little information about FC levels as an outcome in these studies. Defined as an intense desire to consume a specific food [9], it is defined as an experience influenced by cognitive, emotional, physiological and external components [10]. While researchers continue to debate about the relationship of FC with deprivation [11], a sense of anticipation for consumption can generate awareness of a lack, deprivation, and how it would be nice to consume the food. The feeling of deprivation is recognized as a factor associated with the onset of FC [12,13].

Thus, understanding the behavioral component associated with self-reported diet is necessary, considering the role of adverse outcomes associated with it. Therefore, this study aimed to explore data from women recruited from social media where there are discussions and information about diets and eating behavior. Additionally, the main objectives of the study were to verify if those who reported low-carb practice in the last six months displayed higher levels of FC and binge eating, and if there is a relationship between cognitive restraint and FC levels.

2. Materials and Methods

2.1. Methods

The present study is a quantitative cross-sectional and exploratory survey conducted with Brazilian community members recruited from social media (Instagram®) who followed a profile about eating behavior, food, and eating disorders. The collection of general data and participant characteristics (age, weight, and height) used a structured questionnaire. The online questionnaire contained a reminder option to avoid data loss when any question was not answered. Eligibility criteria consisted of women aged 18–60 years old. Respondents who were living outside Brazil in the last two years (considering cultural influences on food consumption) were excluded. The procedures were approved by the University’s Institutional Review Board (2,695,532). To accept the consent form used in electronic format, the participants marked a binary question with the agreement or not for participation. The conduction of this study was according to the Declaration of Helsinki and all participants included in the research consented to their role in it.

2.2. Instruments

All instruments were transcribed to an online questionnaire, and information about the characteristics of the participants (age, weight, height), marital status and education, as well as the self-report of the history for ED diagnosis and treatment history were collected through a structured questionnaire. In addition, an online questionnaire gathered socioeconomic data. Based on previous studies about the practice of diet, refs. [4,6] for group division, we used a specific question, ‘In the last six months have you tried a low-carb diet?’ (Options of the answer: yes or no).

2.3. Binge Eating Scale (BES)

The Binge Eating Scale (BES) was used to assess the presence and severity of binge eating [14]. The questionnaire contains 64 questions that evolve in severity with statements. The questionnaire has a cut-off score of 17, with values between 18–26 points considered

relative to the presence of binge eating of medium severity and a score greater than 26 characterizing severe binge eating [15]. In the validation study for Brazilian Portuguese, BES was compared with a semi-structured interview for Binge Eating Disorder (Structured Clinical Interview, SCID), and the cut-off score was confirmed for the Brazilian population. The study reported a sensitivity of 97.9%, and test–retest reliability according to the kappa coefficient (0.65) and weighted kappa of 0.66, with Cronbach’s alpha of 0.89, demonstrating the adequacy of its psychometric characteristics in the Brazilian population [16,17]. The Cronbach’s alpha calculated for this sample was 0.90.

2.4. Cognitive Restraint Subscale of the Three-Factor Eating Questionnaire

The levels of cognitive restriction (mentality focused on food control to influence weight and body shape) comprise one of the three subscales of the Three-Factor Eating Questionnaire [18]. The subscale comprises six statements (for example: ‘I consciously control myself at meals to avoid gaining weight’) arranged in a Likert format. The questionnaire used comes from the reduced version with twenty-one items [19], translated into Brazilian Portuguese [20], and recently validated [21] presenting internal consistency by means of Cronbach’s alpha equal to 0.83. The alpha calculated for this sample was also 0.83.

2.5. State and Trait Food-Cravings Questionnaires (FCQ-T/S)

To assess FC as a multidimensional state, we used two questionnaires [22]. They divide FC into a trait (FCQ-T), as a constitutional element and the most frequent in eating behavior, assessed through 39 Likert questions (e.g., ‘I eat to feel better’). The result is a total score where the highest levels reflect the highest FC. It results in nine subscales, namely: (1) intention and plans to eat; (2) anticipation of the positive reinforcement; (3) anticipation of relieving negative states; (4) lack of control over eating; (5) thoughts or concerns about food; (6) food cravings as a physiological state; (7) possible emotions before or during food cravings; (8) triggers that can increase the food cravings; and (9) guilt about food cravings or of giving in to them. The version adapted for Brazilian Portuguese showed satisfactory internal consistency values that ranged from 0.6 to 0.8 [23]. The alpha calculated for this sample was 0.97.

The second questionnaire evaluates desire as a changing element (state) according to contexts and internal state assessed at that moment (FCQ-S). It comprises 15 questions also in Likert format that punctuate the frequency of questions, such as ‘I have an intense desire to eat one or more of a specific food’ [23]. In addition to the total score that increasingly reflects FC levels, the questionnaire provides 5 subscales: (1) intense desire to eat; (2) anticipation of positive reinforcement; (3) anticipation of relieving negative states; (4) lack of control over food; and (5) food cravings as a physiological state. The version adapted for Brazilian Portuguese showed satisfactory internal consistency values, which varied from 0.5 to 0.8. The alpha calculated for this sample was 0.92.

2.6. Questionnaire of Food Frequency

To assess the frequency of consumption of some foods that are sources of carbohydrates, we used the questionnaire adapted from Ribeiro and colleagues [24], where they evaluate only sweets, bread, pasta, rice, and potato. This questionnaire consists of a 7-point Likert scale that covers the frequencies from ‘rarely or never’ to ‘2 or 3 times a week’. These frequencies were transformed into scores of 0–7 points for analysis of correlation with other measures of the study.

2.7. Statistical Analyses

The data expressed mean values, standard deviation (SD), and minimum and maximum values. The calculus of body mass index (BMI) was according to the weight/height² formula. The normality of the variables considered the parameters of asymmetry and kurtosis of up to 2.0 and up to 7.0, respectively, to check for distortions in the data distribution, according to the criteria suggested [25]. After verification of this analysis, we proceeded

with the execution of parametric tests (t-test Student) for comparing the average results between groups according to the diet practice. For categorical variables, the distribution and comparison analysis, we used the chi-square test. As for effect sizes of differences between groups, we used Cohen's *d* calculation (<0.19: insignificant, 0.2–0.49: small, 0.5–0.79: moderate, and >0.80: large). We performed correlation analyses (Pearson) between the total binge eating score with FC levels according to FCQ-T/S, subscales and the score attributed to the frequency of food consumption. In addition, we correlated analyses between the questions of the cognitive restriction subscale and all FCQ-T subscales. A significance level of 5% was considered with analyses conducted in the JASP software.

3. Results

In the study, 87 women participated with an average age of 26 (SD = 7.36), an average weight of 66.98 kg (SD = 15.29), and a BMI of 25.05 kg/m² (SD = 4.92). Most participants stated that they were single (*n* = 72, 82.8%). Ethnic distribution was 88% white (*n* = 77), 9% black (*n* = 8) and 3% in the 'undeclared' category (*n* = 2), and there was one Asian. The vast majority reported following an omnivorous diet (*n* = 82, 94.3%). Among the chronic diseases investigated, five participants reported the diagnosis of hypercholesterolemia and four reported lactose intolerance. The report regarding a previous diagnosis for eating disorder was four participants for binge eating disorder, BED (4.6%), three for bulimia nervosa (3.4%) and one for the diagnosis of anorexia nervosa. Regarding income, the sample is divided into the categories '1 to 5 minimum wages' (*n* = 32, 36.8%), '5 to 10 minimum wages' (*n* = 36, 41.4%), '10 to 15 minimum wages' (*n* = 11, 12.6%) and eight participants with an income above 15 minimum wages (9.2%).

3.1. Comparisons between Groups

According to the question regarding the practice of a low-carb diet, 39 participants claimed they have practiced a low-carb diet in the last six months (low-carb group), and 48 who tried but did not practice the low-carb diet (no diet group). According to the BES cut-off point, the distribution of women with binge eating in the no-diet group was 16.7% (*n* = 8) and 46.2% (*n* = 18) in the low-carb group. The groups differed in the distribution of BMI ranges ($X^2 = 6.90$; $p = 0.07$), with low weight (<18.5) present only in the no-diet group (*n* = 5; 10.4%). In the eutrophic range, *n* = 27 in the no-diet group (56.3%) and *n* = 19 in the diet group (48.7%). In the overweight range (BMI 18.6 to 24.9), *n* = 7 in the control group (14.6%) and *n* = 12 in the diet group (30.8%). In the distribution of the obesity range (BMI > 30), the groups had a similar frequency (*n* = 9 in the no diet group, and *n* = 8 in the diet group).

Table 1 shows the comparisons according to the practice of the low-carb diet, where a significant difference appears between the groups for the levels of binge eating (*d*: −0.82), FCQ (Trait and State) and frequency of consumption of foods (except sweets, which did not differ between groups). The calculated effect sizes were high for the differences between groups in the subscales 'Thoughts or concerns about food' (*d*: −0.89), 'Guilt because of food cravings or of giving in to them' (*d*: −0.83) and 'Lack of control in overeating' (*d*: −0.83) of FCQ-T. There were no differences between groups for the 'Anticipation of the positive reinforcement' and 'Food cravings as a physiological state' subscales.

Table 1. Comparisons between eating behaviors, food cravings and food consumption between groups.

	Low-Carb (<i>n</i> = 39)	No Diet (<i>n</i> = 48)	<i>t</i>	<i>d</i>	<i>p</i> Value
	Mean (SD)	Mean (SD)			
Binge Eating	16.70 (10.06)	9.75 (7.42)	−3.84	−0.82	<0.001 ^a
Cognitive Restraint	17.43 (4.71)	14.10 (4.66)	−3.29	−0.71	<0.001
FCQ-Trait	129.17 (50.73)	102.27 (31.26)	−3.11	−0.68	0.001
(1) Intention and plans to eat	11.00 (3.85)	9.02 (3.20)	−2.61	−0.56	0.011
(2) Anticipation of the positive reinforcement	17.97 (5.70)	16.35 (4.98)	−1.41	−0.30	0.161
(3) Anticipation of relieving negative states	10.20 (4.27)	8.02 (3.41)	−2.65	−0.57	0.010
(4) Lack of control over eating	15.71 (7.48)	10.45 (5.09)	−3.88	−0.83	<0.001 ^a
(5) Thoughts or concerns about food	21.76 (8.94)	15.18 (5.73)	−4.15	−0.89	<0.001 ^a
(6) Food cravings as a physiological state	14.76 (4.96)	12.87 (4.41)	−1.88	−0.40	0.063
(7) Possible emotions before or during food cravings	14.33 (6.16)	10.52 (5.10)	−3.15	−0.68	0.002
(8) Triggers that can give rise to food cravings	15.51 (5.42)	12.25 (4.37)	−3.10	−0.67	0.003
(9) Guilt because of food cravings or of giving in to them.	7.04 (4.21)	11.05 (4.71)	−4.18	−0.90	<0.001
FCQ-State	45.33 (13.84)	35.02 (11.58)	−3.77	−0.68	<0.001
(1) Intense desire to eat	9.66 (3.61)	6.87 (3.09)	−3.87	−0.83	<0.001
(2) Anticipation of the positive reinforcement	9.74 (3.47)	7.62 (3.01)	−3.043	−0.65	0.003
(3) Anticipation of relieving negative states	8.84 (3.43)	6.45 (3.12)	−3.395	−0.73	0.001
(4) Lack of control over food	8.56 (3.42)	5.93 (2.34)	−4.232	−0.91	<0.001 ^a
(5) Food cravings as a physiological state	8.51 (2.75)	8.12 (2.68)	−0.660	−0.14	0.511
Bread	3.38 (1.66)	4.35 (1.22)	3.124	0.67	0.002 ^a
Pasta	1.89 (1.18)	2.83 (0.99)	3.997	0.86	<0.001
Rice	3.79 (1.73)	4.85 (1.72)	3.412	0.73	<0.001 ^a
Potato	2.66 (1.59)	3.27 (0.98)	2.167	0.46	0.033 ^a
Sweets	4.07 (1.50)	4.25 (1.13)	0.565	0.57	0.574

Legend: FCQ: Food Craving Questionnaire; *d*: Cohen's *d*. Note: Student's *t*-test; ^a: Levene's test is significant ($p < 0.05$), suggesting a violation of an equal variance assumption; *df*: degrees of freedom for all comparisons: 85,000.

3.2. Correlation Analyses of the Diet Group (*n* = 39)

Correlation analyses showed positive results between the BES with food cravings (FCQ-T and FCQ-S), and with all subscales except for 'food cravings as a physiological state'. However, there were also no correlations between BES scores and the frequency of food consumption (Table 2), and the frequency of consumption of sweets showed an inverse correlation with the scores for cognitive restraint ($r = -0.50$; $p = 0.001$), and positive correlations with the total score for FCQ-S ($r = 0.37$; $p = 0.019$).

Table 2. Pearson's correlations with binge eating levels (low-carb group, *n* = 39).

	BES Scores	
	Pearson's <i>r</i>	<i>p</i> Value
FCQ-Trait	0.53	<0.001
(1) Intention and plans to eat	0.77	<0.001
(2) Anticipation of the positive reinforcement	0.70	<0.001
(3) Anticipation of relieving negative states	0.71	<0.001
(4) Lack of control over eating	0.86	<0.001
(5) Thoughts or concerns about food	0.82	<0.001
(6) Food cravings as a physiological state	0.72	<0.001
(7) Possible emotions before or during food cravings	0.84	<0.001
(8) Triggers that can give rise to food cravings	0.75	<0.001
(9) Guilt because of food cravings or of giving in to them.	0.80	<0.001
FCQ-State	0.73	<0.001
(1) Intense desire to eat	0.76	<0.001
(2) Anticipation of the positive reinforcement	0.57	<0.001

Table 2. Cont.

	BES Scores	
	Pearson's r	p Value
(3) Anticipation of relieving negative states	0.74	<0.001
(4) Lack of control over food and	0.74	<0.001
(5) Food cravings as a physiological state	0.13	0.410
Sweets	0.18	0.260
Bread	−0.10	0.530
Pasta	−0.01	0.900
Rice	−0.10	0.510
Potato	0.14	0.380

Legend: BES: binge eating scale, FCQ: food craving questionnaire.

Table 3 shows Pearson's correlation coefficients between the score of specific questions in the cognitive restriction subscale and FCQ-T subscales. Remarkably, 'Consciously hold back at meals in order not to weight gain' was negatively associated with 'Intention and plans to eat', 'Anticipation of the positive reinforcement' and 'Anticipation of relieving negative states'. The subscales 'Food cravings as a physiological state' and the statement 'Consciously hold back at meals in order not to weight gain' showed a negative correlation with the statement dealing with limiting the number of portions: 'Small helpings for controlling weight' of the Three-factor Eating Questionnaire. Additionally, cognitive restriction (on a scale of 1 to 8), correlated negatively with guilt (Table 3).

Table 3. Correlations between cognitive restriction issues and subscales of the food cravings questionnaire trait (low-carb group, $n = 39$).

		Food Cravings Questionnaire Trait				
		Sub 1	Sub 2	Sub 3	Sub 6	Sub 9
Cognitive restriction	#1 Small helpings for controlling weight.	-	-	-	−0.32	-
	#2 Consciously hold back at meals in order not to weight gain.	−0.33	−0.32	−0.34	−0.31	-
	#6 On a scale of 1 to 8, no restraint (1) to constantly limiting food intake (8)	-	-	-	-	0.32

Legend: Subscale 1: intention and plans to eat, Subscale 2: anticipation of the positive reinforcement, Subscale 3: anticipation of relieving negative states, Subscale 6: food cravings as a physiological state, Subscale 9: guilt because of food cravings or of giving in to them (subscales of food craving questionnaire trait). Note: only $p > 0.05$ reported.

4. Discussion

This study demonstrated behavioral aspects related to the eating behavior of women who practiced a low-carb diet. A characteristic of this study is that the sample comprised participants of a social network, where diet practices and related behaviors and outcomes are discussed. As expected, this group reached higher levels of binge eating (46% with presence of binge eating according to BES), as well as higher levels of FC, binge eating levels and cognitive restraint compared with those who did not practice the diet. In eating behavior, FC are formed by a complex relationship between reactivity to external stimuli, emergence of thoughts and the elaboration of a mental script of how the path to the target would be, and how pleasurable the experience could be [12].

It was recently shown that the levels of cognitive restriction differed as a function of low-carb dieting, even when both groups had binge eating. Thus, eating habits are related to increased diet mentality and cognitions related to self-control in the low-carb diet [26]. In the present analysis, the groups did not present differences in the more positive aspect of desires, such as 'Anticipation of the positive reinforcement' and 'food cravings as a physiological state' (i.e., hunger) subscales. Therefore, it is evident that eating for physical reasons (i.e., hunger) does not seem to be related to the differences between FC

levels, and that this difference would be due to the level of cognitive restriction. It was demonstrated that people who were on a diet and hungry and had time to decide on a choice of snacks chose less healthy options, compared to the group that had to make an immediate choice [27].

The FCQ-T/S questionnaires have been widely used to assess FC as a multidimensional construct in the eating disorders sample [10]. The subscales ‘Thoughts or concerns about food’, ‘Guilt about food cravings or of giving in to them’ and ‘Lack of control overeating’ were the most prominent in the comparisons between groups. This supports the idea that after the carbohydrate-related control process, eating attitudes change.

There is a relationship between negative eating attitudes, such as those aimed at portion control and avoidance for the consumption of some food groups, such as carbohydrates. In this study, dieters showed levels of cognitive restriction inversely correlated with the consumption of sweets. However, when the average consumption values between groups were compared, both had a similar frequency. The cognitive restriction subscale of the Three-Factor Eating Questionnaire indicates in one of its questions: ‘I do not eat some foods because they make me fat’, which can characterize a disordered eating attitude that differs from calorie restriction in terms of consumption, as well as demonstrated in the statement ‘I consciously hold back at meals in order not to gain weight’. All other foods (bread, pasta, rice and potato) had a significantly lower frequency of consumption for dieters, so these findings suggest that caloric restriction is probably related to a state of deprivation.

Binge eating cases, such as in bulimia nervosa and BED, have higher levels of FC compared to controls [10] and also when compared with patients with anorexia nervosa [28]. According to the explanatory model for success in diet, successful restrictive eaters access the goal of weight loss whenever they are exposed to palatable foods (due to repeated successes in refusing food [29]). In the present results, the previously mentioned statement ‘Consciously hold back at meals in order not to gain weight’ had a negative relationship with the FCQ-T subscales ‘Intention and plans to eat’, ‘Anticipation of the positive reinforcement’, ‘Anticipation of relieving negative states’ and ‘Food cravings as a physiological state’ (Table 3).

We must consider several factors according to the results presented by this study. Firstly, the transversal character that prevents the establishment of causal relationships. Secondly, the use of self-report questionnaires stands out. In addition, we also highlight the lack of sample calculation, and a more accurate assessment of food consumption related to low-carb diets. Previous studies suggest that self-dieters may have greater weight, inappropriate compensatory practices [4] and greater weight gain when reevaluated after two years [8]. Considering this, future studies should explore the differences between deprivation and caloric restriction in terms of subjectivity of the report and direct measures, considering whether the feeling of deprivation can exist regardless of the state of caloric restriction.

5. Conclusions

Individuals who have practiced a low-carb diet in the past six months have higher levels of binge eating and food cravings. Despite the higher levels of cognitive restriction in dieters, they are negatively correlated with FC factors, and also negatively associated with the consumption of sweets. Food consumption showed no differences, supporting a failure in cognitive restriction and worse eating attitudes for dieters.

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