Artigo Original

https://www.revistardp.org.br https://doi.org/10.25118/2763-9037.2023.v13.832

Insights into compulsive eating behavior, body image, and inflammation among individuals with schizophrenia

Percepções sobre comportamento alimentar compulsivo, imagem corporal e inflamação em indivíduos com esquizofrenia

Percepciones sobre el comportamiento alimentario, la imagen corporal y la inflamación en individuos con esquizofrenia

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ABSTRACT:
Objective: Binge Eating Disorder (BED) is highly prevalent in individuals with schizophrenia. This study aimed to explore the perception of compulsive eating in patients with schizophrenia and its associations with clinical, psychopathological, and inflammatory markers. **Methods**: 45 participants with a complaint of binge eating were assessed using the Binge

Eating Scale (BES). Clinical and anthropometric assessments were performed, which included body fat measurements, as well as psychopathological dimension measurements using the Positive and Negative Symptom Scale (PANSS). In addition, a body image satisfaction questionnaire based on items from the Body Shape Satisfaction Scale (BSSS) and the Body Shape Questionnaire (BSQ) was administered. Serum inflammatory marker analyses were also conducted, which included the measurement of IL-1β, IL-6, IL-10, TNF-α, and leptin. **Results**: Spearman correlation tests revealed positive correlations between BES scores, body image dissatisfaction, and PANSS score, as well as a negative correlation with IL-10. Multiple linear regression models showed that BES scores, although not sufficient for the diagnosis of binge eating, were positively associated with body image dissatisfaction score, IL-1β, IL-6 levels (both proinflammatory cytokines), and negatively with IL-10 (an anti-inflammatory cytokine). **Conclusion**: Our findings suggest that chronic inflammation and psychopathology in individuals with schizophrenia may be associated with impulsive eating behaviors and poorer body image perception. In addition to inflammation, binge eating may contribute to increased cardiovascular mortality and worsening health status of these patients.

Keywords: binge-eating disorder, binge eating, inflammation, schizophrenia, body dissatisfaction.

RESUMO:
Objetivo: O Transtorno da Compulsão Alimentar Periódica (TCAP) é altamente prevalente em indivíduos com esquizofrenia. Este estudo tem como objetivo explorar a percepção da compulsão alimentar em pacientes com esquizofrenia e suas associações com marcadores clínicos, psicopatológicos e inflamatórios. **Métodos**: 45 participantes com queixa de compulsão alimentar foram avaliados por meio da Escala de Compulsão Alimentar Periódica (BES). Medidas clínicas e antropométricas, gordura corporal, dimensões psicopatológicas (PANSS) e um escore de satisfação com a imagem corporal com base nos itens da Body Shape Satisfaction Scale (BSSS) e do Body Shape Questionnaire (BSQ) e marcadores inflamatórios séricos, como IL-1β, IL - 6, IL-10, TNF-α e leptina foram dosados. **Resultados**: Os testes de correlação de Spearman revelaram correlações positivas entre escores de BES, insatisfação com a imagem corporal e escore PANSS, bem como correlação negativa com IL-10. Modelos de regressão linear múltipla mostraram que os escores de BES,

embora não tenham sido suficientes para o diagnóstico de compulsão alimentar, estiveram associados positivamente com escore de insatisfação com a imagem corporal, níveis de IL-1β, IL-6 (ambas interleucinas pró inflamatórias) e negativamente com IL-10 (uma interleucina anti-inflamatória). **Conclusão**: Nossos achados sugerem que a inflamação crônica e a psicopatologia em indivíduos com esquizofrenia podem estar associados a comportamentos alimentares compulsivos e pior percepção de autoimagem corporal. Além da inflamação, o comer compulsivo pode contribuir para o aumento da mortalidade cardiovascular e piora do estado de saúde desses pacientes.

Palavras-chave: transtorno da compulsão alimentar, compulsão alimentar, inflamação, esquizofrenia, insatisfação corporal.

RESUMEN:
Objetivo: El Trastorno por Atracones (BED) es altamente prevalente en individuos con esquizofrenia. Este estudio tiene como objetivo explorar la percepción de la conducta alimentaria compulsiva en pacientes con esquizofrenia y sus asociaciones con marcadores clínicos, psicopatológicos e inflamatorios. **Métodos**: Se evaluaron 45 participantes con quejas de conducta alimentaria compulsiva mediante la Escala de Atracón Alimentario (BES). Se realizaron evaluaciones clínicas y antropométricas que incluyeron mediciones de grasa corporal, así como mediciones de dimensiones psicopatológicas mediante la Escala de Evaluación de Síntomas Positivos y Negativos (PANSS). Además, se aplicó un cuestionario de satisfacción con la imagen corporal basado en los ítems de la Escala de Satisfacción con la Forma del Cuerpo (BSSS) y el Cuestionario de la Forma Corporal (BSQ). También se llevaron a cabo análisis de marcadores inflamatorios en muestras de suero, que incluyeron la medición de IL-1β, IL-6, IL-10, TNF-α y leptina. **Resultados**: Las pruebas de correlación de Spearman revelaron correlaciones positivas entre las puntuaciones de BES, la insatisfacción con la imagen corporal y la puntuación PANSS, así como una correlación negativa con IL-10. Los modelos de regresión lineal múltiple mostraron que las puntuaciones de BES, aunque no fueron suficientes para el diagnóstico de conducta alimentaria compulsiva, estuvieron asociadas positivamente con la puntuación de insatisfacción con la imagen corporal, los niveles de IL-1β, IL-6 (ambas interleucinas proinflamatorias) y negativamente con IL-10 (una interleucina antiinflamatoria). **Conclusión**: Nuestros hallazgos sugieren que la inflamación crónica y la psicopatología en individuos con

esquizofrenia pueden estar asociadas con conductas alimentarias impulsivas y una peor percepción de la imagen corporal. Además de la inflamación, la conducta alimentaria compulsiva puede contribuir al aumento de la mortalidad cardiovascular y la disminución del estado de salud de estos pacientes.

Palabras clave: trastorno por atracón, conducta alimentaria compulsiva, inflamación, esquizofrenia, insatisfacción corporal.

How to cite: Amato IA, Silva RO, Lorencetti PG, Vicentin SRC, Prado TP, Bobbo VCD, Nogueira GAS, Celeri EHRV, Azevedo RCS, Velloso LA, Dalgalarrondo P, Santos Junior A. Insights into compulsive eating behavior, body image, and inflammation among individuals with schizophrenia. Debates em Psiquiatria, Rio de Janeiro. 2023;13:1-23. https://doi.org/10.25118/2763-9037.2023.v13.832

Disclosure of potential conflicts of interest: none
Funding: FAPESP – CEPID number 2013/07607-8
Approval Research Ethics Committee (REC): Faculdade de Ciências Médicas, UNICAMP - number 309.774
Received on: 26/07/2023
Accepted on: 28/09/2023
Published on: 07/12/2023
Editor in chief responsible for this article: Marsal Sanches
Authors contributions according to the CRediT Taxonomy: Amato IA, Silva RO [1,2,5,6,8,13], Lorencetti PG [1,5,6,8,13], Vicentin SRC, Prado TP [3], Bobbo VCD, Nogueira GAS [2], Celeri EHRV [10,14], Azevedo RCS [6,10,14], Velloso LA [10,11,13], Dalgalarrondo P, Santos Junior A [1,4,7,13,14]

Introduction

Binge eating disorder (BED) is the most common eating disorder (ED) and represents a significant global public health concern [1]. It is defined by recurrent episodes of consuming a quantity of food in a discrete period of time (e.g., two hours) that exceeds what most individuals would typically consume under similar circumstances [2]. These episodes occur at least

once a week for three months and are marked by a lack of control over food intake, along with associated distress during eating. Even people who do not have a formal diagnosis of BED but exhibit compulsive eating behaviors may experience weight gain, diabetes, hypertension, dyslipidemias, pain, and sleep disorders such as insomnia and sleep apnea [3]. Psychiatric comorbidities are also common in people with BED, with depression and anxiety being the most prevalent [4].

Recent data from the World Health Organization Mental Health Survey, which surveyed adults from 14 countries across four continents, reported a lifetime prevalence rate of BED at 1.4% [3]. The median age of onset is typically during late adolescence to early 20s, with a higher lifetime risk observed among women. Alarmingly, less than half of individuals with a lifetime history of BED receive treatment [1]. There is a high prevalence of comorbidity between schizophrenia and the spectrum of eating disorders (EDs). EDs may occur together with or independently from psychotic symptoms in individuals with schizophrenia. Among them, binge eating disorders and night-eating syndromes are frequently found, with a prevalence of approximately 10%, while anorexia nervosa seems to affect between 1% and 4% of these patients [5]. While disturbances in eating behavior were already described as a feature of schizophrenia by Eugen Bleuler back in the early nineteenth century [6], the understanding of eating disorders (EDs) in individuals with schizophrenia remains limited [7]. Given the challenging nature of assessing EDs in people with schizophrenia, and the fact that many patients do not meet all the criteria for typical EDs, clinicians may overlook or not give adequate attention to ED diagnoses among these patients [8].

Dissatisfaction with body image and low eating self-control are strongly associated with BED. Additionally, people with BED tend to experience higher levels of emotional distress [9]. The occurrence of psychopathology among overweight individuals appears to be more closely related to the presence or absence of binge eating rather than the severity of the weight gain itself [9]. Individuals with obesity who binge eat tend to exhibit higher levels of depressive symptoms and greater dissatisfaction with their body image compared to those with obesity but without BED [10]. These characteristics highlight the importance of assessing this dietary pattern among patients with schizophrenia, a population known to be more vulnerable to distress and low self-esteem [9].

Studies have explored the effects of BED on the metabolic and inflammatory profile in different populations. For example, one study found that individuals with obesity and BED had more adverse metabolic and inflammatory markers than their counterparts with obesity but without BED. These markers included elevated body mass index (BMI), reduced levels of high-density lipoprotein (HDL) cholesterol, increased glycated hemoglobin levels, higher erythrocyte sedimentation rate (ESR), and elevated C-reactive protein (CRP) and white blood cell (WBC) counts [11].

On the contrary, stress has been shown to trigger the activation of proinflammatory cytokines, such as interleukins (IL) 1β and 6, and tumor necrosis factor-alpha (TNF-α), leading to general fatigue, sleep disturbances, and appetite loss in animal models [12]. Moreover, cytokines can directly and indirectly influence appetite and food intake in both animal and human studies [13]. While the role of cytokine systems in the development or perpetuation of eating disorders, including binge eating behavior, has been explored to some extent, there remains a paucity of research in this area, particularly concerning individuals with schizophrenia [14].

This line of investigation is crucial because proinflammatory interleukins are also involved in the onset and progression of schizophrenia symptoms [15], as well as cardiovascular diseases, which stand as the primary cause of reduced life expectancy in this population [16, 17]. The study aimed to investigate the perception of compulsive eating in a sample of patients with schizophrenia and its potential associations with proinflammatory markers, such as IL-1β, TNF-α, IL-6, adiponectin, leptin, and the anti-inflammatory marker IL-10, psychopathological scores, and levels of body image dissatisfaction.

Our hypothesis is that more compulsive eating behaviors are associated with more severe psychopathological changes, poorer body image, and a proinflammatory profile in patients with schizophrenia, contributing to worse health outcomes and reduced life expectancy in this population.

Materials and Methods

Participants

This transversal study was conducted at the Psychiatric Outpatient Clinic of the State University of Campinas Clinical Hospital (Unicamp–Brazil). Over the course of 15 months, forty-five adult individuals of both genders

were recruited. All individuals had a stable and well-established diagnosis of schizophrenia and had been receiving regular therapy with risperidone, clozapine, or olanzapine for at least three months. The evaluations included reviews of medical records and interviews done by experienced researchers.

The exclusion criteria considered avoiding conditions that could reflect dysfunctional eating behaviors and inflammation unrelated to antipsychotics or psychosis were the following: BMI ≥ 30 kg/m² before initiating antipsychotic treatment; comorbid diagnosis of dependence on psychoactive substances (excluding tobacco); diagnosis of moderate, severe, or profound intellectual disability; diagnosis of bulimia or anorexia; any medical conditions that could affect the nutritional or inflammatory status of the participants; use of other medications known to impact weight or inflammatory status; and female participants who are pregnant or breastfeeding

Ethics Approval

This study was approved by the respective Institutional Review Board (protocol number: 309.774; date of approval: June 20, 2013). All procedures involving human participants were conducted in accordance with the ethical standards of the institutional and national research committee and the principles outlined in the 1964 Declaration of Helsinki, as amended. Written informed consent was obtained from all individual participants, including explicit permission for the publication of their data.

Instruments and Variables

All participants underwent a structured interview conducted by a psychiatrist to obtain a diagnosis and gather sociodemographic data (gender, age, duration of schizophrenia symptoms, and chlorpromazine-equivalent dose of the second-generation antipsychotic used). Dosing was standardized in equivalent units of chlorpromazine, with each unit representing 100 mg/day of chlorpromazine, corresponding to a daily dose of 2 mg of risperidone, 5 mg of olanzapine, or 50 mg of clozapine [18].

The Brazilian version of the Mini International Neuropsychiatric Interview (M.I.N.I.) Plus (Amorim, 2000) [1] was employed to confirm diagnoses of schizophrenia and screen for other psychiatric disorders, including eating disorders (EDs) and exclusion conditions. The Positive and Negative Syndrome Scale (PANSS) [19] was used to assess the severity of positive

and negative psychotic symptoms, with scores for each dimension ranging from 7 to 49 points. The general psychopathology scale, ranging from 16 to 112 points, was also used to screen for other symptoms such as depression, anxiety, or social avoidance.

Given that impulsivity is a key indicator of schizophrenia severity, and may predispose individuals with the disorder to aggressive behavior, and may also be associated with binge eating behaviors, we assessed impulsivity using questions related to hostility (P7), poor impulse control (G14), and uncooperativeness (G8), as indicative of disorder severity, with specific scoring parameters ranging from 3 to 21 [20]. The Binge Eating Scale (BES) [21, 22] is a self-administered questionnaire that assesses eating behaviors. The scale has a minimum value of 0 and a maximum value of 46. Binge eating problems can be stratified according to total score as follows: none to minimal (<17), moderate (18 – 26), and severe (>27). In this study, the BES scores were used as a continuous variable to analyze the severity of binge eating behaviors rather than to diagnose binge eating disorder (BED) [2]. Body image was assessed using an adapted version of the Body Shape Questionnaire (BSQ) due to the absence of validated instruments to evaluate body shape satisfaction among individuals of both genders with schizophrenia in the Brazilian context. The original BSQ was developed for a female audience and included questions that did not apply to men. Additionally, questions that address typical behaviors of anorexia or bulimia, such as laxative use, vomiting, measuring fat folds, and compensating for excessive exercise by feeding, were removed, as these had already been part of the exclusion criteria. The sum score of the adapted instrument ranged from 21 to 126 points, with higher scores indicating greater body image dissatisfaction.

Clinical parameters measured included waist circumference (cm), body mass index (BMI, calculated by dividing weight in kilograms by height in meters squared), and body fat percentile. Serum concentrations of the proinflammatory cytokines TNF-α, IL-1β, and IL-6 (pg/ml) and the anti-inflammatory cytokine IL-10 (pg/ml) were measured from 20 ml of venous blood using the enzyme-linked immunosorbent assay (ELISA; Phoenix Pharmaceuticals), according to the manufacturer's instructions. Additionally, leptin (ng/ml) and adiponectin (µg/ml) concentrations were measured from 10 ml of venous blood using the ELISA (Phoenix Pharmaceuticals).

Data Analysis

Descriptive analyses were performed, followed by normality tests, revealing non-normal data distribution. Spearman's correlation tests were then applied to compare the clinical and laboratory biochemical and physiological parameters. The following parameters were considered in these analyses: BES scores; age; BMI (kg/m²); waist circumference (measured at the level of the umbilical scar in cm); percentile of body fat (measured using an impedance meter); duration of schizophrenia symptoms (measured in months); dose of chlorpromazine equivalent to the second-generation antipsychotic used; a score derived from the composite questionnaire used to assess body shape satisfaction; and concentrations of leptin, adiponectin, proinflammatory cytokines (IL-6, IL-1β, TNF-α), and anti-inflammatory cytokine (IL-10).

To determine if the aforementioned variables could independently predict BES scores, a mathematical square root transformation was applied to normalize the data. Therefore, BES scores could be considered as a dependent variable for multiple stepwise linear regression analysis. The threshold for statistical significance was $p < 0.05$. All data analyses were performed using the Statistical Package for the Social Sciences (IBM Co., Armonk, NY, USA) version 22.0.

Results

Demographic, Anthropometric, Psychopathological, and Inflammatory Profile Data

Among the 45 participants, 33 were male (73.3%), with a mean age of 33.8 ± 12 years (95% confidence interval – CI = 30.5–37.1). A total of 21 (46.7%) participants were using clozapine, 18 (40.0%) olanzapine, and 6 (13.3%) risperidone. The mean values, standard deviations, and 95% confidence intervals (CI) for BMI, waist circumference, and body fat were as follows: BMI 27.1 ± 5.8 (CI 25.4-28.9) kg/m²; waist circumference 91.5 ± 20.8 (CI 85.3-97.8) cm; body fat 20.6 ± 10.9 (CI 17.3–23.9).

The scores for the BES, the adapted version of the Body Shape Satisfaction questionnaire, the PANSS, and the serum concentrations of cytokines (IL-1β, IL-6, IL-10, TNF-α), adiponectin, and leptin are presented in Table 1. Table 2 shows significant positive and negative correlations between variables. In partial correlations controlled for age and BMI, BES scores were positively correlated with body image dissatisfaction ($p < 0.001$, $\rho = 0.586$) and PANSS general psychopathology score ($p = 0.047$, $\rho = 0.305$),

while negatively correlated with levels of the anti-inflammatory interleukin IL-10 ($p = 0.044$, $\rho = -0.309$).

Linear regression analyses yielded a significant model [$Z (4.40) = 20.582$; $p < 0.001$; $R^2 = 0.673$]. The following variables were found to be associated with BES scores: composite score of body image satisfaction evaluation ($ß = 0.645$; $t = 6.863$; $p < 0.001$), IL-10 serum concentrations ($ß = -0.318$; $t = -3.192$; $p = 0.003$), IL-1ß serum concentrations ($ß = 0.312$; $t = 3.253$; $p = 0.002$), and IL-6 serum concentrations ($ß = 0.193$; $t = 2.13$; $p = 0.039$).

Discussion

This study aimed to explore the perception of compulsive eating in a sample of non-obese patients with schizophrenia before the use of atypical antipsychotics, and its possible associations with inflammatory markers (IL-1β, TNF-α, IL-6, adiponectin, and leptin), anti-inflammatory markers (IL-10), psychopathology, and body image dissatisfaction. The low median and mean values of the BES scores found (5 and 7, respectively - Table 1) indicate that the majority of the patients in this sample, which was mainly composed of middle-aged male subjects being treated with second-generation antipsychotics, did not present binge eating behavior, as evaluated by clinical interview and self-report. This finding is surprising, however, the literature indicates that even binge eating behaviors that do not meet the criteria for BED can be associated with metabolic control problems [23] and EDs may manifest in atypical ways in patients with schizophrenia [8].

The median and mean BMI values (26.4 and 27.1 kg/m², respectively - Table 1) indicate that a significant portion of the patients were overweight or obese, a common condition among individuals with schizophrenia, affecting up to 55% of this population [16, 17]. Obesity in individuals with schizophrenia can be attributed to various factors, including sedentary behavior and adverse effects associated with antipsychotic medications [24]. Obesity and its metabolic consequences, including hepatotoxicity, insulin and leptin resistance, hyperglycemia, and hyperinsulinemia, are associated with increased morbidity and mortality from cardiovascular disease, cancer, and sleep, bone, and joint problems [15, 24].

Recent data have highlighted inflammation as a crucial mediator between metabolic disorders and increased cardiovascular mortality, especially among individuals with schizophrenia [15]. Chronic low-grade

inflammation is related to obesity and plays an essential role in numerous metabolic abnormalities and cardiovascular illnesses due to greater levels of TNF-α, IL-6, and IL-1 and lower levels of IL-10 [25]. Interestingly, chronic inflammation is also associated with the onset and progression of schizophrenia [15, 26]. Moreover, despite the correlation between binge eating and higher BMI, individuals with obesity and BED displayed more unfavorable metabolic and inflammatory profiles compared to their counterparts without BED, suggesting that BED may contribute to inducing inflammation [11].

This study revealed a positive partial controlled correlation between BES scores and body image dissatisfaction and a negative correlation between BES scores and the anti-inflammatory cytokine IL-10 [Table 2]. In multiple linear regression analysis, BES scores were positively correlated with body image and concentrations of IL-1β, IL-6, and negatively correlated with IL-10 [Table 3]. Both analyses were controlled for BMI and age. These findings support the hypothesis that binge eating behavior itself may be involved in the proinflammatory status.

Despite being investigated by some studies, the role of cytokines in the pathogenesis of EDs remains poorly understood. Experimental studies in animal models of anorexia have yielded conflicting data regarding the involvement of IL-1, IL-6, and TNF-α [27, 28]. A recent meta-analysis examined both transversal and longitudinal studies that assessed the concentrations of IL-1β, IL-6, TNF-α, and TGF-β in various types of EDs [1, 29]. The results indicated increased concentrations of TNF-α and IL-6 in participants with any ED, and this correlation was consistent in the subgroup of participants with anorexia nervosa (AN). However, it is important to highlight two critical aspects. First, the meta-analysis included 27 studies, with 23 of them focusing on AN, three on bulimia nervosa (BN), and none including participants diagnosed with BED, despite being part of the systematic search. This underscores the limited and fragile data available regarding inflammation in other EDs. Second, BED is a relatively recent diagnostic category, included for the first time in the DSM-5 [2], which accounts for the relative scarcity of studies exploring this diagnosis.

Another study investigated the concentration of cytokines on a broad spectrum of EDs, including AN, BN, BED, and obesity, although obesity itself is not classified as an ED [30]. The concentrations of IL-2, IL-10, IFN-γ, and IL-1α were higher in AN than in healthy controls and individuals with

obesity, both with and without BED. This study was the first to measure IL-10 concentrations and found that their levels were lower in patients with BED compared to patients with AN and healthy controls. The findings from our present study corroborate those of Caroleo et al. [30]. Both studies identified a correlation between higher BES scores and lower IL-10 concentrations, suggesting a specific inflammatory profile associated with BED.

Body dissatisfaction extends beyond food restriction and is evident in binge eating as well. This relationship is not solely driven by the shared association with other symptoms of EDs [31, 32]. Various studies have attempted to comprehend how and why body dissatisfaction is associated with binge eating. The most plausible model explaining this relationship is a dual model, wherein body dissatisfaction leads to food restriction, but it also leads to negative emotions that are associated with compulsive eating [33]. Furthermore, individuals displaying these behaviors may experience poorer physical health, given the strong correlation between these metrics and metabolic abnormalities [34].

The main aim of this study was to assess the occurrence of binge eating behaviors in individuals with schizophrenia. Although no participant had a formal diagnosis of BED, the study found associations between BES scores and inflammatory factors, psychopathology, and body image dissatisfaction. The study found that participants with the highest binge eating scores had lower concentrations of IL-10, higher concentrations of IL-1β and IL-6, and greater body image dissatisfaction, independent of age and BMI. To the best of the authors' knowledge, this is the first study to assess the complex associations between compulsive eating behaviors, body image satisfaction, and inflammatory patterns in individuals with schizophrenia. Although more research is needed, all these factors must be considered and managed when providing care to individuals with schizophrenia, as the presence of these comorbidities holds significant implications for a patients' health.

The transversal design employed in this study precludes the establishment of cause-and-effect relationships among the variables studied. Additionally, the study faced limitations due to its relatively small sample size and the absence of control groups comprising healthy individuals or individuals with BED but without schizophrenia. Other limitations encompassed the lack of a specific instrument for assessing binge eating behaviors among individuals of both genders with schizophrenia within the

Brazilian context, and the BES scores did not necessarily indicate BED within our sample. Nevertheless, the identification of a proinflammatory profile associated with more compulsive eating behaviors in individuals with schizophrenia holds significant implications, and suggests the need for future studies with larger samples, including individuals with schizophrenia and other EDs, as well as the analysis of altered eating patterns among individuals with other severe psychiatric disorders.

Individuals with schizophrenia present a high prevalence of obesity, which is associated with increased cardiovascular mortality. Chronic inflammatory status has been postulated as a core mechanism underlying this outcome. Despite its traditional association with obesity, research has indicated that eating disorders, such as BED, can promote inflammation independently. Most of the existing literature on inflammation and eating disorders pertains to subjects without severe mental disorders. However, the present study has shed light on the fact that binge eating behaviors can be an independent factor for chronic inflammation in individuals with schizophrenia, thereby contributing to the increased mortality in this.

Acknowledgment
The authors would like to acknowledge the São Paulo Research Foundation (FAPESP) for providing financial assistance for the study (process number 2013/07607-8 – Center of Excellence for Production Innovation and Development - CEPID); the Laboratory of Cell Signaling, from both the Obesity and Comorbidities Research Center of the University of Campinas, and the Brazilian National Institute of Science and Technology, for processing laboratory tests and data analysis; and the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) for supporting the study.

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Table 1. Demographic, Clinical Data and Inflammatory Profile of 45 Schizophrenia Patients (33 Males, 73.3%)

Sociodemographic data	**Mean±SD**	**CI95%**
Age (Years)	33,8 ± 12	30,3 - 37,4
Time since disease onset (Months)	109,1 ± 114,2	74,8 – 143,4
Chlorpromazine equivalent dose (g)	3,9 ± 1,9	3,4 – 4,5
Anthropometric data		
BMI (kg/m^2)	27,1 ± 5,8	25,4 – 28,9
Waist Circunference (cm)	91,5 ± 20,8	85,3 – 97,8
Body Fat (%)	20,6 ± 10,9	17,3 – 23,9
Psychopathology Data		
Binge Eating Scale	7 ± 6,5	5 – 9
Body Image Scale	38,7 ± 22,3	32 – 45,4
PANSS-Positive symptoms score	13,8 ± 5,2	12,3 – 15,4
PANSS-Negative symptoms score	24,4 ± 10,6	21,3 – 27,6
PANSS-General psychopathology score	41,6 ± 13	37,7 – 45,5
PANSS- Impulsivity score	4,9 ± 3,7	3,8 - 6
Inflammatory Markers		
Leptin (ug/mL)	15,53 ± 19,1	9,58 – 51,48
Adiponectin (ng/mL)	2,07 ± 0,99	1,76 – 2,38
Interleukin-10 (pg/dl)	1,97 ± 0,98	1,67 – 2,28
Interleukin- 6 (pg/dl)	4,22 ± 4,7	2,75 – 5,68
Interleukin 1-β (pg/dl)	4,11 ± 4,63	2,67 – 5,56
TNF α (pg/dl)	7,29 ± 8,74	4,57 – 10,02

https://doi.org/10.25118/2763-9037.2023.v13.832

1. BMI: Body Mass Index
2. Binge Eating Scale Scores range from 0-46. Scores between 0-17 means no or mild BED, 18-26 moderate BED and 27-46 severe BED.
3. Body Image Dissatisfaction Score range from
4. PANSS Positive and Negative Scores range from 7-49.
5. PANSS General Psychopathology Scores range from 16-112.
6. PANSS Impulsivity Scores range from 3-21

Table 2. Spearman´s bivariable correlation test between Binge Eating Score and studied variables controlled by age and BMI

Variable	*ρ*	p-value
Time since disease onset (Months)	-.017	.915
Chlorpromazine equivalent dose (g)	-.256	.097
Waist Circunference (cm)	-.162	.300
Body Fat (%)	.290	.059
Body Image Dissatisfaction	.586	**.000**
PANSS-Positive symptoms score	.271	.079
PANSS-Negative symptoms score	.069	.661
PANSS-General psychopathology score	.305	**.047**
PANSS- Impulsivity score	.255	.099
Leptin (ug/mL)	.031	.843
Adiponectin (ng/mL)	.049	.757
Interleukin-10 (pg/dl)	-.309	**.044**
Interleukin- 6 (pg/dl)	.111	.477
Interleukin 1-β (pg/dl)	.264	.087
TNF α (pg/dl)	-.060	.702

ρ: Spearman Correlation Coefficient

https://doi.org/10.25118/2763-9037.2023.v13.832

Table 3. Results of Stepwise Multiple Linearegression for Binge Eatin

Model	Predictors	R^2	Adjusted R^2	R^2 Change	*p*-value	Standardized β	t	*p*-value	Tolerance `	VIF	ANOVA *p*-value	Durbin-Watson
1	Body Image Dissatisfaction	.499	.487	.499	.000	.706	6.540	.000	1.0	1.0	.000	
2	Body Image Dissatisfaction	.546	.525	.048	0.042	.646	5.996	.000	.930	1.075		
	Interleukin-10 (pg/dl)					-.226	-2.099	.042	.930	1.075	.000	
3	Body Image Dissatisfaction	.636	.609	.090	.003	.632	6.464	.000	.928	1.077		
	Interleukin-10 (pg/dl)					-.335	-3.235	.002	.828	1.207		
	Interleukin-1 β (pg/dl)					.318	3.178	.003	.889	1.125	.000	

https://doi.org/10.25118/2763-9037.2023.v13.832

4	Body Image Dissatisfaction	.673	.640	.037	.039	.645	6.863	.000	.924	1.082		
	Interleukin-10 (pg/dl)					-.318	-3.192	.003	.823	1.215		
	Interleukin-1 β (pg/dl)					.312	3.253	.002	.888	1.126		
	Interleukin-6 (pg/dl)					.193	2.130	.039	.992	1.009	.000	1.858

https://doi.org/10.25118/2763-9037.2023.v13.832