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MESTRADO EM PSICOLOGIA
PSICOLOGIA

Addictive Behaviours Before and After Bariatric Surgery: A 3-Year Longitudinal Study

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2026

Universidade do Porto

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Outubro 2026

Dissertação apresentada no Mestrado em Psicologia, área de especialização de Psicologia Clínica e da Saúde, Faculdade de Psicologia e de Ciências da Educação da Universidade do Porto, orientada pela Professora Doutora ***Eva Martins da Conceição*** (FPCEUP).

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Agradecimentos

Perante o fim deste ciclo bonito, gostaria de deixar aqui marcado, neste que é um momento importante desta história, o meu agradecimento a todos aqueles que estiveram presentes nestes cinco anos e que ajudaram a tornar este caminho mais especial, assim como agradecer a esta área que me fascina cada vez mais e a esta minha futura profissão.

À minha família, que esteve sempre presente em todas as fases, pela força e coragem que me deram para continuar todos os dias, por terem acreditado em mim e no meu futuro. A eles, que me apoiaram desde o início do meu gosto pela área, acompanhando este crescimento até ao final deste percurso.

Às minhas amizades. A todas aquelas que acompanharam de fora o meu percurso, e em especial à Barbara e à Joana, que fizeram questão de acompanhar de perto e de me incentivarem a continuar com o orgulho que expressavam por mim.

Às minhas amigas de Coimbra, pois Coimbra é algo que se sente, mas com amigas como estas ainda se faz sentir mais. As minhas Beas e a minha Rita, que desde o primeiro até ao último ano de curso caminharam ao meu lado, fazendo com que concluíssemos esta etapa juntas. Para além do curso, partilhámos histórias, vivências, uma casa e memórias para sempre recordas.

Às minhas Saras, que tornaram a transição para o Mestrado numa nova Faculdade e cidade tornar-se fácil, pois sem elas os desafios teriam sido ainda maiores.

Um agradecimento especial à equipa que me acompanhou durante o estágio, por terem ajudado a realçar a importância desta profissão e por me transmitirem trabalho árduo e a paixão necessários para querer fazer sempre melhor.

À Dra. Eva Conceição, pela orientação, disponibilidade e conhecimento prestado para a realização deste marco.

E, por fim, a mim, por ter acredito que seria capaz de finalizar aquilo que começou como um sonho e que agora se tornou realidade.

Um profundo e carinhoso obrigada.

Resumo

Sendo a cirurgia bariátrica uma intervenção eficaz no tratamento da obesidade grave, é importante ter em consideração os alertas evidenciados pela literatura para o risco do surgimento ou agravamento de comportamentos aditivos no período pós-operatório.

Objetivos: O presente estudo pretendeu avaliar a evolução do consumo de álcool e de tabaco ao longo de 36 meses após a cirurgia bariátrica (pré-operatório, 6, 12, 18, 24 e 36 meses) e a sua associação com a presença de perda de controlo alimentar pré-operatória.

Metodologia: A amostra compreendeu 373 participantes acompanhados em seis momentos de avaliação através de entrevistas clínicas. Para a análise estatística utilizaram-se o teste Q de Cochran, o teste de McNemar e o Teste Exato de Fisher com cálculo de *Odds Ratios*.

Resultados: Observou-se uma variação estatisticamente significativa no consumo de álcool, caracterizada por uma trajetória em formato de "U", com uma redução acentuada aos 6 meses, seguida de um aumento progressivo até aos 36 meses. O consumo de tabaco permaneceu estável. O LOCE apresentou uma remissão inicial, mas regressou aos valores basais aos 36 meses. A presença de LOCE pré-operatório associou-se ao tabagismo na linha de base, mas não ao consumo pós-operatório de álcool ou tabaco em nenhum dos momentos de *follow-up*.

Conclusões: O risco de consumo frequente de álcool manifesta-se tardiamente. Os dados não apoiam a hipótese de transferência de adição a partir do LOCE pré-operatório, destacando a necessidade de monitorização psicológica contínua e prolongada, especialmente a partir do segundo e terceiro anos pós-cirurgia.

Palavras-chave: Cirurgia Bariátrica; Consumo de Álcool; Tabagismo; Perda de Controlo Alimentar; Estudo Longitudinal.

Abstract

Since bariatric surgery is an effective intervention for treating severe obesity, it is important to consider the warnings highlighted in the literature regarding the risk of the onset or worsening of addictive behaviors in the postoperative period.

Objectives: This study aimed to evaluate the evolution of alcohol and tobacco use over 36 months after bariatric surgery (preoperative, 6, 12, 18, 24, and 36 months) and its association with the presence of preoperative loss of control over eating.

Methodology: The sample included 373 participants who were followed at six evaluation points through clinical interviews. For statistical analysis, Cochran's Q test, McNemar's test, and Fisher's Exact Test with Odds Ratios calculation were used.

Results: A statistically significant variation in alcohol consumption was observed, characterized by a "U"-shaped trajectory, featuring a marked reduction at 6 months, followed by a progressive increase up to 36 months. Tobacco use remained stable. LOCE showed an initial remission, but returned to baseline values at 36 months. The presence of preoperative LOCE was associated with baseline smoking, but not with postoperative alcohol or tobacco use at any of the follow-up time points.

Conclusions: The risk of frequent alcohol consumption manifests late. The data do not support the hypothesis of addiction transfer from preoperative LOCE, highlighting the need for continuous and prolonged psychological monitoring, especially from the second and third post-surgery years onwards.

Keywords: Bariatric Surgery; Alcohol Consumption; Smoking; Loss of Control Eating; Longitudinal Study.

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Lista de Abreviaturas

AUD - Alcohol Use Disorder

AUDIT - Alcohol Use Disorders Identification Test

BED - Binge Eating Disorder

EDE - Eating Disorder Examination Questionnaire

IC - Confidence Interval

LOCE - Loss of Control Eating

OR - Odds Ratio

RYGB - Roux-en-Y gastric bypass

SBE - Subjective Binge Eating

Introduction

Obesity has increased substantially around the world in recent decades, becoming a major public health problem and linked to high levels of morbidity, mortality, and psychosocial impact (James, 2004). This rise in obesity has been associated with significant lifestyle changes, particularly changes in eating habits and lower levels of physical activity (Fryar et al., 2021). In this context, bariatric surgery is currently recognized as the most effective long-term intervention for treating severe obesity and related metabolic diseases, promoting sustained weight loss, improvements in comorbidities, and a better quality of life (Buchwald et al., 2004; Ribaric et al., 2013; Sjöström, 2013; Herpertz et al., 2015; Eisenberg et al., 2022).

Despite the widely recognized clinical benefits, the literature has shown that individuals undergoing bariatric surgery have an increased vulnerability to developing or worsening addictive behaviors, both in the preoperative period and in the years following surgery (King et al., 2012b; Steffen et al., 2015; Müller et al., 2018; White et al., 2019; Miller-Matero et al., 2024). Therefore, it is important to highlight that the behaviors most frequently identified are problematic alcohol consumption and tobacco use (Chiappetta et al., 2020; Müller et al., 2018).

Indeed, this relationship between severe obesity and addictive behaviors has been widely discussed in the literature, where several authors suggest the existence of common biological and behavioral mechanisms between obesity and addictive disorders, particularly at the level of brain reward systems, impulsivity, and difficulties in emotional regulation (Blumenthal & Gold, 2010; Pursey et al., 2019). In this sense, the physical restrictions imposed on eating behavior by bariatric surgery may promote the emergence of other behaviors aimed at seeking emotional regulation and gratification (Saules et al., 2010). This perspective is often framed by the theory of "addiction transfer" or "cross-addiction," which argues that some individuals replace pre-existing compulsive eating with other addictive behaviors after surgery, such as alcohol or tobacco use (Steffen et al., 2015; Hardman & Christiansen, 2018; Jakobsen et al., 2018; Testino & Fagoonee,

2018). This idea can be supported by patient reports describing having 'replaced one addiction with another' (Miller-Matero et al., 2023).

At the same time, bariatric surgery seems to cause significant physiological changes that increase sensitivity to the effects of substances (Buffington et al., 2006). Procedures like Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy drastically alter how alcohol is absorbed and metabolized, leading to faster and stronger increases in blood alcohol concentration (Hagedorn et al., 2007; Woodard et al., 2010; Acevedo et al., 2017). In fact, Ertelt et al. (2008) found that 84% of patients reported feeling intoxicated after drinking small amounts of alcohol post-surgery, while 29% said these effects lasted longer compared to before surgery, a trend supported by studies showing greater subjective sensitivity to alcohol after bariatric surgery (*Alcohol Use And Health Risks: Survey Results - Metabolic & Bariatric Care Times*, s. f.-b; K. E. Smith et al., 2017).

Consequently, the trajectory of alcohol consumption after bariatric surgery is characterized by its own temporal dynamics. While stability or an initial reduction in drinking is usually observed during the first year after surgery, the literature shows a gradual and late increase in the frequency of problematic drinking and Alcohol Use Disorder (AUD), especially from two to three years of follow-up (King et al. 2012b; Ivezaj et al., 2019; Vides et al., 2023; Mitchell et al. 2014; Ertelt et al., 2008; Suzuki et al., 2010; Li & Wu, 2016).

In this way, a pre-surgery history of substance use is one of the most consistent predictors for developing addictive behaviors post-surgery, with up to 60% of bariatric surgery candidates having a history of substance use (Conason et al., 2012; Saules et al., 2010; Mitchell et al., 2014; King et al., 2017).

Thus, the early identification of at-risk candidates is, therefore, a key element in preventing substance misuse (Ivezaj et al., 2019). Among the main predictive factors are being male, young age, smoking, regular alcohol consumption, and a pre-surgical diagnosis of AUD. Although men have a higher relative risk of developing alcohol-related problems (Cañizares et al., 2025), recent studies suggest that women make up a high proportion of new cases of problematic use in the postoperative period (Riedel et al.,

2024). Age also seems to play a relevant role, with younger patients being particularly vulnerable to developing substance-related problems after bariatric surgery (King et al., 2012b). This association may be linked to the high levels of alcohol and tobacco use observed in adolescents and young adults (Winters et al., 2014; Carneiro et al., 2005).

Regarding smoking, although the results found in the literature are more inconsistent, some studies suggest that the overall frequency of smokers doesn't change significantly after bariatric surgery (Li & Wu, 2016). Grace et al. (1990) found that some smokers quit after surgery, although some individuals who hadn't smoked before started smoking postoperatively. Similar results were observed by Lent et al. (2013), who identified both smoking cessation and new cases of initiation. More recently, King et al. (2020) showed that, although many patients quit smoking before surgery, the frequency of smoking went back up over the next seven years, mainly due to relapses.

Tobacco use is particularly relevant in the context of bariatric surgery not just because of how common it is, but also due to its link with worse clinical outcomes and the development of other addictive disorders after surgery. Studies show that pre-surgery smoking is associated with a higher risk of chronic opioid use and alcohol-related problems after surgery. Additionally, smoking before and after surgery is linked to higher post-operative complications and poorer clinical results (Chow et al., 2020; Yuce et al., 2019).

Alongside chemical dependencies, eating behavior and its changes play a central role in the journey of bariatric patients. The literature shows that binge eating, BED, and loss of control over eating are relatively common in people who are overweight or obese, and are linked to weight gain and the maintenance of obesity (Spitzer et al., 1992; Morgan et al., 2002). Beyond the weight-related consequences, these behaviors are associated with greater psychological distress, leading individuals to turn to food as a response to negative emotional states (Masheb & Grilo, 2005; Stein et al., 2006; Telch & Stice, 1998).

In fact, several studies suggest that loss of control is more strongly related to psychological distress than the amount of food consumed, and is considered by some authors as the central element of binge eating (Goldschmidt et al., 2013).

At the same time, monitoring eating behavior, and especially loss of control eating, is particularly important. Although surgery initially helps reduce LOCE episodes, their persistence or return after surgery is linked to poorer weight outcomes and weight regain (Colles et al., 2008; Meany et al., 2013). However, the connection between LOCE and addictive behaviors is still unclear. It is thought that having LOCE before surgery might reflect a broader underlying addictive vulnerability, increasing the chances that a patient might turn to substances like alcohol or tobacco after surgery when their ability to eat is physically limited.

However, despite the growing number of studies in this area, the literature still shows significant methodological limitations, with a predominance of research focused exclusively on alcohol, a lack of longitudinal follow-ups, and limited use of structured clinical interviews. At the same time, there is a gap in the clinical context, where many patients report that post-surgical follow-up focuses mainly on dietary aspects, noting insufficient psychological support and a lack of interventions aimed at preventing addictive behaviors. In light of these findings, several authors argue that pre-operative psychological assessment in bariatric surgery should necessarily include the evaluation of alcohol, tobacco, and other substance use, as well as other addictive behaviors (Canizares et al., 2025).

In order to fill these theoretical and practical gaps, this study aims to rigorously and prospectively assess the evolution of alcohol and tobacco use over 36 months after bariatric surgery (preoperative, 6, 12, 18, 24, and 36 months), as well as to analyze whether the presence of loss of control (LOCE) in the preoperative period is associated with a higher likelihood of consuming alcohol and using these substances throughout the post-surgical follow-up.

Objectives

The present study aims to examine the evolution of alcohol and tobacco use in individuals undergoing bariatric surgery, from the preoperative period up to 36 months after surgery, as well as to analyze its association with the presence of loss of control eating (LOCE).

1. Analyze the evolution and compare the frequency of addictive behaviors (alcohol and tobacco) at six assessment points: (a) pre-surgery (baseline); (b) 6 months after surgery; (c) 12 months after surgery; (d) 18 months after surgery; (e) 24 months after surgery; (f) 36 months after surgery.

Hypothesis1:

The frequency of alcohol and tobacco use varies at different assessment times after bariatric surgery, with an expected increase in use in the later periods of postoperative follow-up, particularly at 24 and 36 months.

2. Analyze the association between the presence of loss of control eating (LOCE) and the use of alcohol and tobacco at different assessment times.

Hypothesis2:

Participants who show loss of control eating (LOCE) in the preoperative period are more likely to drink alcohol and smoke throughout the postoperative follow-up than participants without loss of control eating.

Methods

Study Design and Procedures

This study is designed as a three-year longitudinal study, aiming to analyze the frequency and development of addictive behaviors, namely alcohol and tobacco use, as well as loss of control, in patients undergoing bariatric surgery. It allows for an assessment of their progression from the preoperative period to different points after surgery (6 months, 12 months, 18 months, 24 months, and 36 months). The sample for this study consists of a secondary analysis of data from a previously collected database

that was part of a larger longitudinal study conducted with these same patients. This data collection took place at a central hospital in northern Portugal, in the context of clinical follow-up for patients enrolled in the bariatric surgery program and eligible for the study, between April 2014 and April 2017. All candidates for bariatric surgery were evaluated in the month before the surgery, on the day of their medical appointment. Follow-up assessments were conducted after their medical consultations at the hospital. Thus, data collection was carried out in the context of patients' clinical follow-up appointments, with the instruments applied by trained members of the research team.

The study was approved by the University Ethics Committee and the Hospital Institutional Review Boards, and all participants provided written informed consent after being informed about the study's objectives and the voluntary nature of participation (Pinto-Bastos et al., 2019). The original study, therefore, has a longitudinal design, with multiple assessment points throughout the participants' follow-up period.

Participants

The final sample used for the purposes of this study included 373 adults at the start of the study. However, due to exclusion criteria, missed appointments with the multidisciplinary team, refusal to participate, transfers to another hospital, and delays in previous medical appointments that caused scheduling conflicts with the research interviews, some patients were lost during the longitudinal follow-up.

Thus, the exclusion criteria included pregnancy after surgery, severe cognitive deficits that limited patients' autonomy, serious psychiatric conditions with significant impairment of overall functioning, major active psychiatric disorder that was not an eating disorder as the main diagnosis, inability to understand Portuguese, and following ketogenic or liquid diets before surgery.

Measures

In the original study, different assessment tools were used to gather information about sociodemographic, clinical, and psychological variables. For the present study,

only the variables relevant to analyzing addictive behaviors in individuals undergoing bariatric surgery were selected.

I. Semi-Structured Clinical Interview

Data collection began with a semi-structured clinical interview, conducted in person by a trained psychologist, through which sociodemographic and clinical information from the participants was obtained.

Sociodemographic and Anthropometric Measures

Anthropometric measures, namely height, preoperative weight, and weights recorded at different follow-up times, were collected from the participants' hospital records. Regarding sociodemographic measures, variables such as gender, age, level of education, employment status, type of bariatric surgery, and weight history were collected.

Alcohol and Tobacco Variables

The database used in this study also includes variables related to alcohol and tobacco use, which were used in the analyses conducted. Tobacco use was assessed through a dichotomous variable (0 = current use; 1 = no use).

Regarding alcohol consumption, the frequency of drinking alcoholic beverages was assessed using an ordinal scale with six categories (0 = never; 1 = 1 to 3 times per month; 2 = once a week; 3 = 1 to 3 times per week; 4 = 4 to 6 times per week; 5 = every day). The variable for consuming more than one drink was also considered, which evaluates how often a participant consumed more than one drink per occasion on a weekly frequency, using the same response scale.

For statistical analysis purposes, the variables related to alcohol consumption were later recoded. At first, consumption frequency was turned into a dichotomous variable (0 = present consumption; 1 = absent consumption), allowing it to be compared with the variable for tobacco use. Later, a second dichotomous variable was created to distinguish different consumption frequency patterns. In this variable, categories 0 to 3 of the original scale, corresponding to “never” up to “1 to 3 times per week,” were

grouped as lower frequency consumption (1), while categories 4 and 5, corresponding to "4 to 6 times per week" and "every day," respectively, were grouped as frequent consumption (2).

Regarding this recoding of consumption frequency, the categorization from the Alcohol Use Disorders Identification Test (AUDIT), developed by the World Health Organization, was used as a reference. In this test, consumption frequency is assessed through categories that include, among others, "4 or more times a week," which is the highest frequency category (Saunders et al., 1993; AUDIT: The Alcohol Use Disorders Identification Test: Guidelines For Use In Primary Health Care, 2001b).

In this way, combining the categories corresponding to "4 to 6 times a week" and "every day" into a single consumption category (≥4 times a week) allowed for establishing a cutoff point based on a categorization previously used in an alcohol consumption screening tool. This recoding was done with the aim of reducing the number of categories and making statistical analyses easier, while still keeping a distinction between lower and higher frequency consumption patterns.

Regarding the variable of consuming more than one drink, it was also recoded. This variable, originally created to identify the consumption of more than one alcoholic drink on an occasion, was recoded dichotomously to distinguish participants who reported this drinking pattern at least once a week in the past month from those who did not report it that often (0 = less than once a week; 1 = once or more times a week). This categorization was based on the literature that uses weekly frequency as a criterion to distinguish different alcohol consumption patterns. In this sense, in line with the approach of Chaiyasonh et al. (2018), using the frequency of once or more times a week was set as the cutoff point to identify a higher frequency drinking pattern, serving as the reference for the categorization adopted in this study.

II. Eating Disorder Examination interview (EDE)

The assessment of eating behaviors was carried out through the diagnostic items of the 17th edition of the Eating Disorder Examination (EDE) (Fairburn et al., 2008), used

to identify eating behavior disorders according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; American Psychiatric Association [APA], 2013). This semi-structured clinical interview allowed for the identification of episodes of objective binge eating (Objective Binge Eating – OBE) and subjective binge eating (Subjective Binge Eating – SBE), both characterized by the presence of loss of control over eating (Loss of Control Eating – LOCE). The presence of LOCE in the past 28 days was assessed through a screening item (Item 13: "Over the past 28 days, has there been any time when you felt out of control while eating?"), followed by the quantification of the number of days the behavior occurred (Item 14: "On how many days in the past 28 days did this happen?"). Loss of control episodes were subsequently categorized into two main types: objective binge episodes (OBE; Items 15 and 16; e.g., 'Over the past 28 days, how many times have you eaten an amount of food that most people would consider unusually large under the circumstances, feeling a loss of control?'), defined by the intake of an objectively large volume of food; and subjective binge episodes (SBE; Item 17; e.g., 'Over the past 28 days, how many times have you eaten an amount of food you considered excessive [but not unusually large] and felt that you lost control?'), where the amount eaten is objectively small or normal, but perceived by the patient as excessive due to post-surgical anatomical restriction.

Regarding the frequency of these behaviors, the same six-category ordinal scale was used (ranging from 0 = never to 5 = every day).

Statistical Analysis

The statistical analysis of the data was carried out using the IBM Statistical Package for the Social Sciences (IBM SPSS Statistics), version 30.0, adopting a significance level of $\alpha = 0.05$ for decision-making in all inferential analyses.

In the first phase, descriptive analyses were performed to characterize the sample and describe the variables under study. For categorical variables such as alcohol consumption, tobacco use, and the presence of Loss of Control Eating (LOCE), absolute

(n) and relative (%) frequencies were calculated, while quantitative variables were described using the mean and standard deviation.

To address the hypotheses formulated in the study, non-parametric inferential tests were selected, suitable for the categorical and longitudinal nature of the data.

Checking Hypothesis 1, which anticipates changes in the frequency of alcohol and tobacco use over the six assessment points (pre-operative, 6, 12, 18, 24, and 36 months post-surgery), will be supported by applying Cochran's Q test. This statistical test, recommended for evaluating the consistency of proportions across multiple groups in a dichotomous dataset (Aslam, 2023), allows us to assess whether the overall proportion of participants who use each substance, as well as the presence of LOCE, undergoes any statistically significant change over the entire follow-up period.

To deepen the analysis and test the hypothesis of an increase in alcohol and tobacco use in the later postoperative periods (24 and 36 months), the McNemar test was used, which is suitable for comparing two paired measures of a dichotomous categorical variable (Smith & Ruxton, 2020) in 2x2 contingency tables. This test helps verify the hypothesis by assessing the significance of pairwise changes in proportions between specific time points, namely comparing the baseline with each follow-up point, as well as the early phases with the later postoperative phases. Additionally, the contingency tables associated with the McNemar test make it possible to identify individual transitions in behaviors, categorizing participants according to whether they maintained, stopped, started, or continuously lacked each behavior.

Finally, the verification of Hypothesis 2, which states that participants with loss of control over eating (LOCE) pre-operatively might have a higher likelihood of consuming alcohol and tobacco post-operatively, was carried out by cross-checking the presence of LOCE at baseline with substance use at each post-surgery time point. To assess the statistical significance of these associations in independent groups, Fisher's Exact Test was used, chosen to determine whether there is a significant association between two categorical variables (Anderson, 2023). Additionally, to quantify the magnitude of this association and understand to what extent pre-operative LOCE acts as

a risk predictor, Odds Ratios (OR) were calculated, accompanied by their respective 95% Confidence Intervals (CI 95%), which directly indicate the variation in the likelihood of addictive behaviors over time.

Results

Sample Characterization

Regarding the participants' characteristics, the sample in this study consists of 373 individuals scheduled for bariatric surgery, aged between 20 and 67 years (M = 44.83; SD = 10.42). The sample is marked by a strong predominance of women compared to men. As for the type of surgical procedure, the sample includes patients undergoing both primary and revision surgery, with the gastric band being the most commonly used type.

Although the study began with 373 participants at the pre-operative assessment (baseline), the number of individuals assessed varied across different evaluation points due to loss to follow-up during the study, a common phenomenon in longitudinal studies. There was a decrease recorded at 6 months (n=270), followed by an increase to 295, 312, and 323 participants at 12, 18, and 24 months, respectively, with another drop at 36 months (n=188). The detailed characteristics of the sample are shown in Table 1.

Table 1. *Sociodemographic Characteristics of Participants at Baseline*

Sociodemographic characteristic	n/M	%/SD
Gender		
Female	338	90.6
Male	35	9.4
Educational level		
Without	4	1.1
Until 4th grade	92	24.7

Until 6th grade	66	17.7
Until 9th grade	75	20.1
Until 12th grade	62	16.6
Frequency in High Education	17	4.6
Graduate Level	41	11.0
Post Graduate Level	16	4.3
Employment Situation		
Employed	198	53.1
Unemployed	111	29.8
Retired	58	15.5
Student	6	1.6
Surgery Status		
Primary	216	57.9
Revisional	157	42.1
Type of Surgery		
Gastric Bypass	247	66.2
Gastric Sleeve	126	33.8

Longitudinal Evolution of Addictive Behaviors

Alcohol Consumption

Regarding Hypothesis 1, which predicted changes in the frequency of alcohol and tobacco use over the six assessment points (pre-operative, 6, 12, 18, 24, and 36 months post-surgery), the results showed a statistically significant change in the overall proportion of alcohol consumption over time ($Q(5)=68.041$, $p<0.001$). As shown in Figure 1 and detailed in Table 2, the frequency of alcohol consumption sharply decreased

from baseline (45%) to 6 months post-surgery (14.8%), a statistically significant reduction (X2 (1) = 70.78, p<0.001) (Table 4, attached). However, after this initial phase, there was a gradual increase in the following time points, with 26.1% at 12 months, 25% at 18 months, 26.9% at 24 months, and reaching a post-surgery peak of 33% at 36 months post-surgery, confirming the hypothesis of an increase in the later post-operative periods.

Problematic Alcohol Use and Drinking More Than One Glass

Still regarding alcohol consumption, but specifically in relation to problematic drinking patterns and drinking more than one glass, these variables show similar trends to the overall variation in alcohol use in the early stages, but with lower frequencies over time (Figure 1).

For these variables, both curves show a sharp decrease from baseline, reaching their lowest values at 6 months post-surgery. In the following follow-up periods, there was a stabilization at low levels throughout the entire follow-up period, remaining consistently below 10% up to 36 months.

Tobacco Use

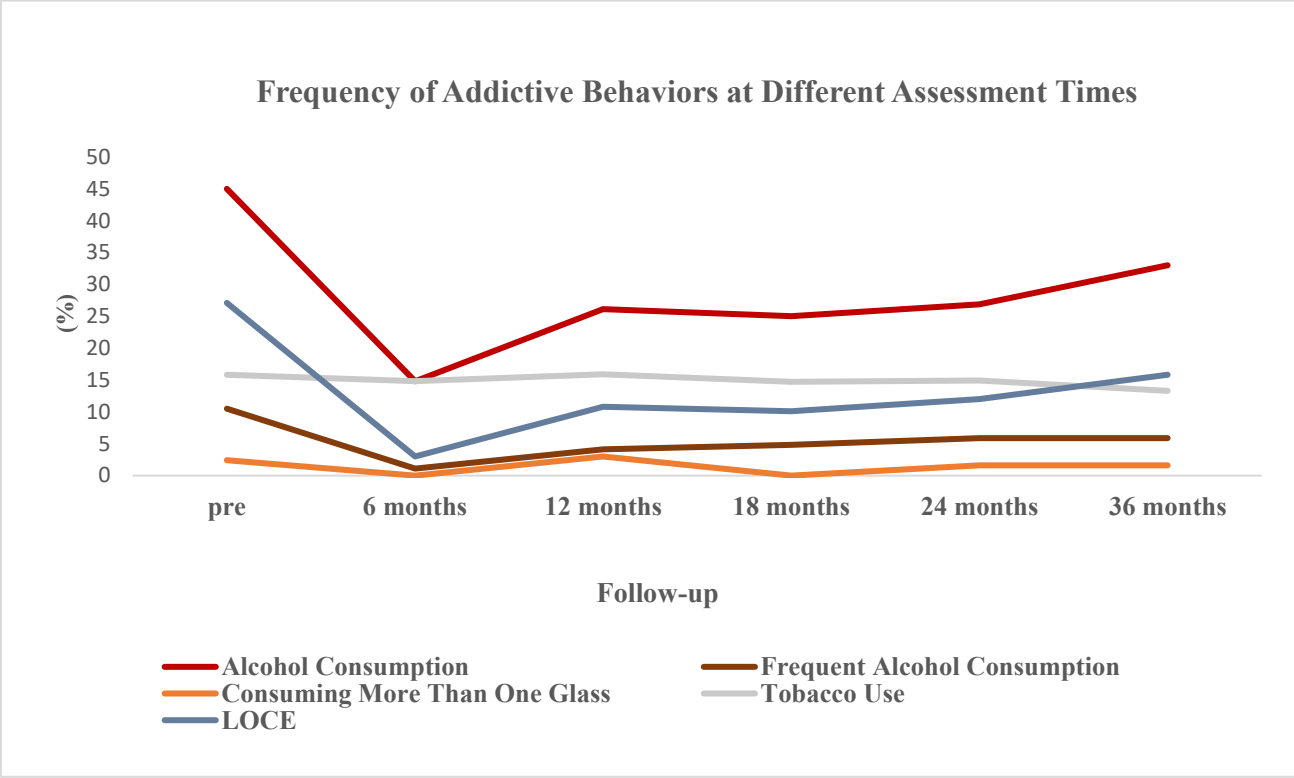
Unlike what was observed with alcohol, the frequency of tobacco use did not show statistically significant changes over the 36 months (Q(5)=0.763, p=0.979), remaining stable throughout the entire follow-up period, around 13% to 15% (Figure 1 and Table 2).

Loss of Control Eating (LOCE)

In terms of the evolution over the study of the presence of Loss of Control Eating, the results showed statistically significant variations over time (Q(5)=23.962, p<0.001), following a trend similar to that of alcohol, with a sharp drop from 27.1% in the preoperative period to 3% at 6 months post-surgery (X2(1) = 64.00, p<0.001), followed by a gradual increase up to 36 months (15.8%) (Figure 1 and Table 4 are attached).

At 36 months, the overall frequency of LOCE did not differ statistically from the preoperative baseline (X2(1) = 0.49, P=0.486).

Figure 1. *Trajectory of the Frequency of Addictive Behaviors at Different Evaluation Points*



Note. Alcohol consumption = Overall proportion of alcohol beverage consumption; Frequent alcohol consumption = High frequency of consumption (ranging from a minimum of 4 times per week to a maximum of daily); Consumption of more than one drink = Intake of more than one drink per occasion with weekly frequency; Tobacco use = Overall proportion of smokers; LOCE (Loss of Control Eating) = Presence of episodes of loss of control over eating.

Table 2. *Analysis of Paired Comparisons of Additive Behaviors at Different Evaluation Times*

Variables	**Pré** *(n= 373)*		**6m** **(n=270)**		**12m** *(n= 295)*		**18m** *(n= 312)*		**24m** *(n= 323)*		**36m** *(n= 188)*		**Q de Cochran** *(n= 106)*	**P (McNemar)**
	M(n)	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***		
Alcohol													*Q(5) = 68.041; p< 0,001*	*Pre>6m,12m,18m,24m,36m*; p6m<12m<24m<36m**
Consumers	*168*	*45*	*40*	*14.8*	*77*	*26.1*	*78*	*25*	*87*	*26.9*	*62*	*33*		
Maintained consumption			*34*	*27.6*	*66*	*47.1*	*67*	*46.5*	*65*	*45.5*	*51*	*59.3*		
Stopped consumption			*89*	*72.4*	*74*	*52.9*	*77*	*53.5*	*78*	*54.5*	*35*	*40.7*		
Started consumption			*6*	*4.1*	*11*	*7.1*	*11*	*6.5*	*22*	*12.2*	*11*	*10.8*		
Maintained no consumption			*141*	*95.9*	*144*	*92.9*	*157*	*93.5*	*158*	*87.8*	*91*	*89.2*		
Tobacco													*Q(5) = 0.763; p = 0.979*	*n.s.*
Users	*59*	*15.8*	*40*	*14.8*	*47*	*15.9*	*46*	*14.7*	*48*	*14.9*	*25*	*13.3*		
Maintained use			*34*	*81*	*36*	*80*	*40*	*80*	*40*	*85.1*	*18*	*78.3*		
Cessation of use			*8*	*19*	*9*	*20*	*10*	*20*	*7*	*14.9*	*5*	*21.7*		
Initiation os use			*6*	*2.6*	*11*	*4.4*	*6*	*2.3*	*8*	*2.9*	*7*	*4.2*		
Maintained no use			*222*	*97.4*	*239*	*95.6*	*256*	*97.9*	*267*	*97.1*	*158*	*95.8*		

Tabela 2. *(Continuation)*

Variables	**Pré** *(n= 373)*		**6m (n=270)**		**12m** *(n= 295)*		**18m** *(n= 312)*		**24m** *(n= 323)*		**36m** *(n= 188)*		**Q de Cochran** *(n= 106)*	**P (McNemar)**
	M(n)	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***		
LOCE													Q(5) = 23.962; p< 0.001	*Pre> 6m,12m,18m,24m > 0,01*; p6m> 12m,18,24,36m< 0,05 **
Had LOCE	*101*	*27.1*	*8*	*3*	*32*	*10.8*	*26*	*1.1*	*28*	*12*	*23*	*15.8*		
Maintained LOCE			*4*	*4.9*	*11*	*13.1*	*10*	*14.5*	*11*	*21.6*	*9*	*32.1*		
Remitted LOCE			*77*	*95.1*	*73*	*86.9*	*59*	*85.5*	*40*	*78.4*	*19*	*67.9*		
Developed LOCE			*4*	*2.1*	*21*	*10*	*16*	*8.5*	*17*	*9.3*	*14*	*11.9*		
Maintained no LOCE			*184*	*97.9*	*190*	*90*	*173*	*91.5*	*165*	*90.7*	*104*	*88.1*		

Note. n = total number of participants with valid data at each time point; LOCE = Loss of Control Eating. Cochran's Q test was used to assess the presence of significant overall variations across the six assessment points. The McNemar test was applied to perform pairwise comparisons between specific time points and to analyze individual transitions (maintenance, cessation, or onset of the behavior). *p<.001, McNemar values are in the attached table.

Association between Preoperative LOCE Presence and Postoperative Substance Use

To confirm Hypothesis 2, which suggested that the presence of LOCE in the preoperative period would be associated with a higher likelihood of alcohol and tobacco use during postoperative follow-up, the consumption rates at each follow-up point were compared between the group with preoperative LOCE and the group without preoperative LOCE (Table 3 and Figures 2, 3, and 4).

Regarding alcohol consumption, patients with and without preoperative LOCE did not show significantly different consumption percentages at any postoperative time points. Similarly, the analysis of problematic alcohol intake (consuming more than one drink) did not reveal significant differences between the groups over time, noting that it was impossible to calculate the Odds Ratio at 6 and 18 months (OR = N/A) due to the total absence of cases with problematic consumption at those times in the LOCE group.

Regarding tobacco use, it was found that people with LOCE reported higher tobacco use preoperatively compared to those without LOCE. However, the two groups did not differ at any point postoperatively, meaning this association was only observed during the pre-surgery period, as summarized in Table 3 and shown in Figure 4.

Overall, these results indicate that Hypothesis 2 was not confirmed for alcohol consumption or tobacco use in the post-operative period, with only a cross-sectional association between LOCE and smoking observed in the pre-surgical phase. These data challenge the concept of addiction transfer, suggesting instead that the development of these postoperative behaviors follows autonomous dynamics, independent of the eating control difficulties experienced prior to surgery

Table 3. *Association between the Presence of LOCE and Addictive Behaviors at Different Points of Assessment*

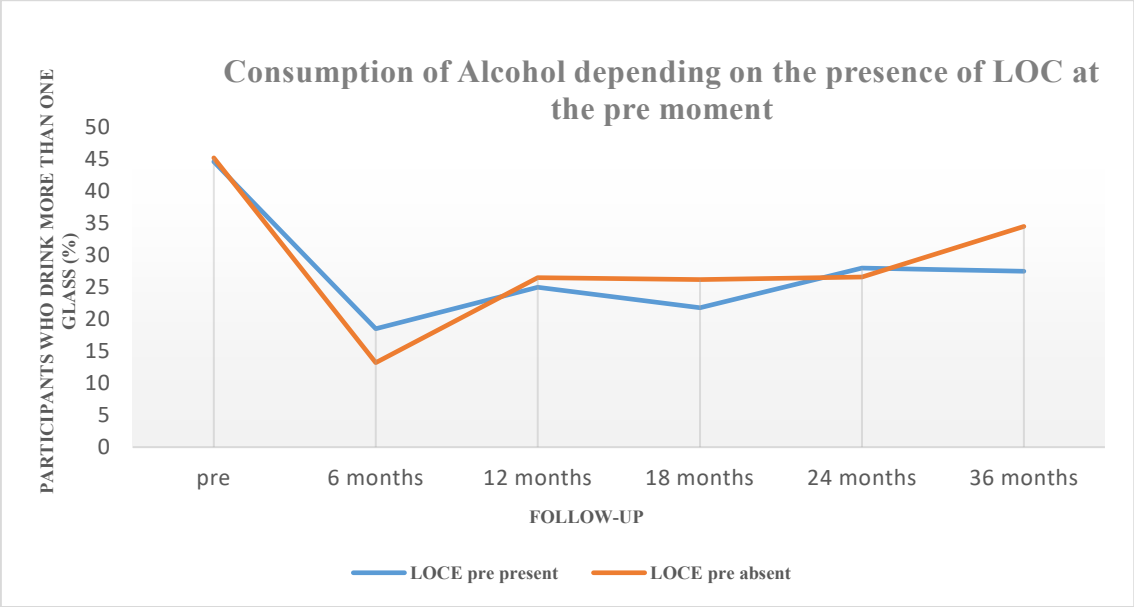
Variables	**Pré**		**6m**		**12m**		**18m**		**24m**		**36m**	
	M(n)	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***
alcohol												
LOCE pre absent (n=272)	123	45.2	25	13.2	56	26.5	59	26.2	64	26.6	51	34.5
LOCE pre present (n=101)	45	44.6	15	18.5	21	25	19	21.8	23	28	11	27.5
	(n=168)		(n=40)		(n=77)		(n= 78)		(n=87)		(n=62)	
p (Fisher)	1		.267		.883		.468		.775		.453	
Odds Ratio (OR) [IC 95%]	.973 [.615; 1.541]		1.491 [.740; 3.005]		.923 [.516; 1.649]		.786 [0.436, 1.417]		1.078 [0.616; 1.888]		.721 [0.333; 1.562]	
More than a glass												
LOCE pre absent (n=272)	15	5.5	0	0	3	1.4	0	0	5	2.1	2	1.4
LOCE pre present (n=101)	5	5	0	0	1	1.2	1	1.1	1	1.2	1	2.5
	(n=20)		(n=0)		(n=4)		(n=1)		(n=6)		(n=3)	
p (Fisher)	1		n.s.		1		.279		1		.514	
Odds Ratio (OR) [IC 95%]	.892 [0.316; 2.522]		n.s.		.835 [.086; 8.146]		n.s.		.590 [.068; 5.126]		1.872 [.165; 21.183]	

Table 3. *(Continuation)*

Variables	**Pré**		**6m**		**12m**		**18m**		**24m**		**36m**	
	M(n)	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***	***M(n)***	***%***
Tobacco												
LOCE pre absent (n=272)	*36*	*13.2*	*26*	*13.8*	*32*	*15.2*	*29*	*12.9*	*34*	*14.1*	*21*	*14.3*
LOCE pre present (n=101)	*23*	*22.8*	*14*	*17.3*	*15*	*17.9*	*17*	*19.5*	*14*	*17.3*	*4*	*9.8*
	(n=59)		(n=40)		*(n=47)*		*(n= 46)*		*(n=48)*		*(n=25)*	
p (Fisher)	***.037***		*.459*		*.598*		*.155*		*.476*		*.605*	
Odds Ratio (OR) [IC 95%]	*1.933 [1.080; 3.461]*		*1.310 [.645; 2.633]*		*1.216 [.620; 2.384]*		*1.641 [.850, 3.215]*		*1.272 [.644; 2.513]*		*.649 [.209; 2.009]*	

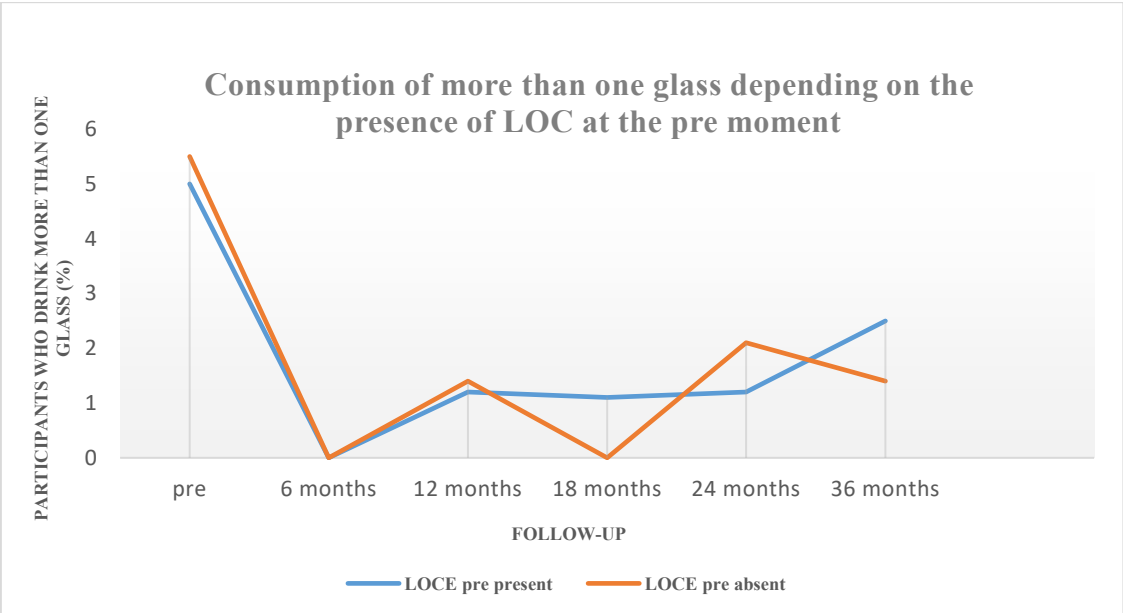
Note: LOCE = Loss of Control Eating; OR = Odds Ratio; 95% CI = 95% Confidence Interval; n.s. = Not applicable due to the total absence of cases (n=0). The Fisher Exact Test was used to assess the existence of statistically significant associations between the presence of preoperative LOCE and addictive behaviors at each time point. The Odds Ratio was calculated to quantify the magnitude and direction of the association (risk) between the groups with and without LOCE.

Figure 2. *Proportion of Alcohol Consumption Based on the Presence of LOCE*



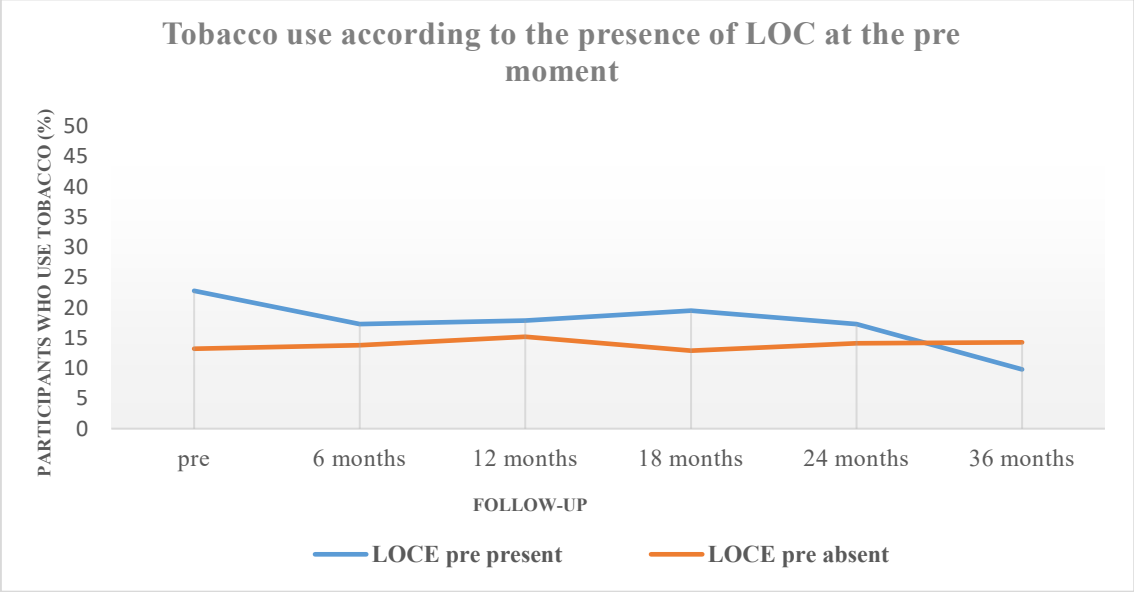
Note. LOCE = Loss of Control Eating

Figure 3. Proportion of Consuming More Than One Glass Based on the Presence of LOCE



Note. LOCE = Loss of Control Eating

Figure 4 . *Tobacco Use Proportion Based on the Presence of LOCE*



Note. LOCE = Loss of Control Eating

Discussion

This study aimed to analyze longitudinally how addictive behaviors and their relationship with loss of control change after bariatric surgery. The results from this study reveal that the post-operative journey is not uniform, with very different dynamics between alcohol consumption, smoking, and loss of control.

Regarding alcohol consumption, the results confirmed Hypothesis 1, showing a significant temporal variation characterized by a 'U'-shaped trajectory. There was a drastic reduction in the frequency of alcohol consumption from baseline (45%) to 6 months post-surgery (14.8%), followed by a gradual and statistically significant increase in the subsequent periods, reaching its peak at 36 months (33%) (Figure 1 and Table 2).

This initial drop in the first six months likely reflects strict adherence to the medical and nutritional recommendations of the early postoperative period, as well as

patients' own fears about surgical complications. However, the subsequent increase from 12 months, and more noticeably between 24 and 36 months, aligns with international literature warning about the late onset of Alcohol Use Disorders (AUD) (King et al., 2012b; Mitchell et al., 2014; Vides et al., 2023).

Analyzing the individual transitions (McNemar's Test), between 6 and 36 months, 25.2% of patients started or resumed alcohol consumption, while only 3.9% stopped (Table 2). This phenomenon can be explained by a combination of physiological and psychosocial factors. Physiologically, procedures such as Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy alter the alcohol metabolism processes, leading to faster, higher, and prolonged blood alcohol peaks (Hagedorn et al., 2007; Woodard et al., 2010). From a psychosocial perspective, as the initial phase of rapid weight loss stabilizes, usually between 18 and 24 months, the return of daily stress and the easing of behavioral restrictions may prompt individuals to resort to alcohol as a mechanism for emotional regulation.

In this regard, the literature has increasingly emphasized that the specific type of bariatric procedure plays a relevant modulating role in the trajectory of postoperative alcohol consumption (King et al., 2012a; Suzuki et al., 2010). Several studies indicate that procedures with a greater malabsorptive component, such as the Roux-en-Y gastric bypass, are frequently associated with more pronounced pharmacokinetic alterations and an increased risk of developing alcohol-related problems compared to predominantly restrictive surgeries (Hagedorn et al., 2007; Mitchell et al., 2014). This evidence underscores the need for clinical teams to consider the surgical technique as a central predictive variable in long-term risk assessment.

Regarding tobacco use, unlike what was observed with alcohol, Hypothesis 1 was not confirmed. The frequency of smoking did not show statistically significant changes over the 36 months ($p=0.979$), remaining remarkably stable between 12% and 15%. The analysis of individual transitions reinforced this stability, with a residual percentage of participants starting (2.4%) or quitting (3.1%) smoking between 6 and 36 months (Figure 1 and Table 2).

These data suggest that smoking behavior in the bariatric population follows dynamics different from alcohol. Since quitting smoking is typically a mandatory pre-operative requirement imposed by surgical teams, individuals who continue or resume smoking seem to represent a group with established nicotine dependence, showing significant relapse rates in the post-operative period (Li & Wu, 2016; King et al., 2020).

Regarding Loss of Control Eating (LOCE), there was an observed pattern of sharp initial remission (from 27.1% pre-surgery to 3% at 6 months), followed by a gradual return of episodes over time, reaching 15.8% at 36 months, at which point the frequency was no longer significantly different from baseline (Figure 1 and Table 2). This trajectory shows that, although the physical limitation imposed by surgery is effective in the short term at controlling intake, it does not eliminate the psychological vulnerability underlying disruptive eating behaviors (Colles et al., 2008; Meany et al., 2013).

So, Hypothesis 2, which predicted that the presence of LOCE pre-surgery would be associated with a higher likelihood of alcohol and tobacco use post-surgery, was not confirmed. Based on the results, no statistically significant associations were found between pre-surgery LOCE and later alcohol or tobacco use at any of the follow-up points. A cross-sectional pre-surgery association between LOCE and smoking was only observed (OR=1.933; p=0.037), which weakened after the intervention (Table 3 and Figures 2, 3, and 4).

These results put the theory of 'addiction transfer' based on preoperative LOC into perspective. While qualitative literature describes patient reports of 'replacing food with alcohol' (Miller-Matero et al., 2023), our quantitative data suggest that vulnerability to alcohol use after surgery may operate independently of previous episodes of loss of control. Thus, the development of addictive behaviors after surgery seems more related to changes in substance absorption and individual vulnerabilities than to a direct 'switching of addictions' or substitution of loss of control.

Limitations

Although the study carried out here has contributed to the understanding of addictive behaviors and loss of control over eating after bariatric surgery, certain methodological limitations should be taken into account.

As a first limitation, the use of self-report measures to evaluate these behaviors, as well as clinical interviews based on symptom recall, stands out. These measures are subject to various types of bias, including social desirability, recall difficulties, and subjective interpretations by patients. In this way, these factors may have influenced the accuracy of the responses, particularly regarding behaviors considered socially undesirable or potentially stigmatizing in the bariatric population.

Following up on the limitations, it is also important to point out the loss of data over the different assessment points. This drop, although a common and expected phenomenon in longitudinal studies, reduced the number of participants with complete valid data at all follow-up points, especially at 36 months, which may limit the generalization of the results obtained in the later periods.

Additionally, it is important to note as a limitation the fact that this study did not include a detailed analysis of the differential impact of the type of surgical procedure, such as the distinction between Roux-en-Y gastric bypass and sleeve gastrectomy, or the exact percentage of weight loss at each point in time.

Finally, it should be noted that the data were collected at a single central hospital in northern Portugal, which, while ensuring clinical homogeneity, may limit the generalization of the results to different bariatric samples at the national and international level.

Study Implications

Throughout this study, potentialities and implications are highlighted that reinforce its scientific and clinical relevance. Notably, it is worth pointing out the large sample size at the start of the study, as well as the longitudinal design and the extended follow-up period of up to 36 months, which allowed the examination of the evolution and

timelines of addictive behaviors and eating disorders across the different phases of the post-surgical journey.

This dissertation shows its role in contributing to the conceptualization of the post-bariatric course as a non-linear process, demonstrating that the risk of addictive behaviors, particularly alcohol consumption, can emerge or worsen later on. Indeed, the results highlight the importance of a more integrative clinical approach in post-surgical follow-up, going far beyond just monitoring weight loss, showing the need to simultaneously address the patients' behavioral and psychological vulnerabilities. Furthermore, establishing a closer bridge between hospital bariatric teams and primary care physicians is vital, ensuring that primary care providers are equipped to screen for late-onset alcohol misuse during routine postsurgery check-ups long after hospital discharge.

In conclusion, the data also help to understand the variability of long-term outcomes. That is, although most patients experience substantial improvements in physical health, the recurrence of loss of control over eating and increased alcohol consumption show that surgery addresses the physical aspect, but not the psychological one. The lack of a direct link between preoperative LOCE and later substance use highlights that the development of addictive behaviors follows its own dynamics, challenging the straightforward notion of a direct 'addiction transfer' from previous eating behavior.

Directions for Future Research

Just as the results obtained from this study contribute to the emerging literature on the evolution of addictive and eating behaviors after bariatric surgery, they also raise new questions that deserve to be explored in future research.

Indeed, the data highlight the need for additional studies that aim to deepen the understanding of the biological and psychosocial mechanisms underlying the late increase in alcohol consumption, allowing for a more accurate understanding of which patient profiles are at higher risk of developing Alcohol Use Disorder (AUD) after

surgery. This, in turn, will make it easier to identify vulnerable candidates early on, supporting the implementation of more individualized and timely preventive intervention strategies.

Another relevant aspect to consider relates to the strong female predominance within the sample, which reflects the demographic reality of bariatric surgery demand. Although the literature frequently points to a higher relative risk among men, the growth of new cases of problematic consumption in women underscores the need for future investigations to analyze these trajectories from a gender-sensitive perspective, ensuring that the female population is not overlooked in the prevention of post-bariatric AUD.

Furthermore, it would also be interesting to expand the association between preoperative loss of control over eating and substance use to include additional measures such as assessments of impulsivity, emotional regulation strategies, and other psychopathologies. So, to wrap up, it would also be valuable for future research to adopt mixed methodological approaches, combining longitudinal quantitative data with exploratory qualitative studies.

This methodological integration would give a direct voice to patients, enabling a detailed understanding of their subjective perspectives regarding behavioral transitions and the emotional triggers underlying the resurgence of addictive habits over time.

Conclusion

This study was designed with the purpose of investigating a clinically relevant and timely topic, through the longitudinal analysis of the evolution of addictive behaviors and loss of control over eating in patients who underwent bariatric surgery over a period of thirty-six months.

So, based on the results obtained and through their analysis, it is possible to say that the post-operative period is a dynamic and heterogeneous journey. The trajectory of alcohol consumption shows interesting results with a "U"-shaped pattern, marked by a

sharp initial drop followed by a gradual increase observed in the later stages of follow-up, especially from twenty-four and thirty-six months. In contrast, tobacco use remained remarkably stable throughout the period, suggesting that it responds to dependency mechanisms with temporal dynamics different from those seen with alcohol. At the same time, although surgery leads to a notable initial remission in terms of loss of control over eating, the data show a gradual return of these episodes in the long term, approaching the levels recorded in the pre-surgery baseline.

Given these findings, one might say that one of the most striking contributions of this research lies precisely in the analysis of the relationship between these behaviors. Contrary to what might be expected from the addiction transfer perspective, the presence of loss of control over eating in the preoperative period did not prove to be a predictor of future alcohol or tobacco use. Thus, these results suggest that the risk of post-operative addiction occurs independently of previous eating behavior, challenging the assumption of a direct swap of addictions.

These conclusions thus show that the risk of frequent alcohol consumption appears later on, making it clear that there is a need for post-surgery follow-up that goes beyond just monitoring weight or diet. Indeed, it is crucial to integrate a preventive and multidisciplinary approach that includes regular mental health screening, paying special attention to the period of greatest vulnerability, which mainly occurs from the second to third year onwards.

So, to wrap up, this study, by focusing on a longitudinal and prospective perspective, aims to help deepen the understanding of the post-bariatric journey. From the data collected and analyzed, it is clear that, while bariatric surgery is an effective therapeutic tool for severe obesity on a physical level, long-term stability requires ongoing psychological support that is attentive to the complexities of the changes happening in these patients' lives, promoting not just weight loss but also their overall well-being.

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Attachments

Table 4. *Analysis of Individual Transitions of Addictive Behaviors at Different Assessment Times*

Varibles	N	Started, n(%)	Stopped, n (%)	McNemar	p
Alcohol					
Pré vs 6 meses	270	6	89	70,78	< ,001
Pré vs 12 meses	295	11	74	45,22	< ,001
Pré vs 18 meses	312	11	77	48,01	< ,001
Pré vs 24 meses	323	22	78	30,25	< ,001
Pré vs 36 meses	188	11	35	11,5	< ,001
6 meses vs 12 meses	248	33	8	14,05	< ,001
6 meses vs 18 meses	234	31	7	13,92	< ,001
6 meses vs 24 meses	230	45	7	23,33	< ,001
6 meses vs 36 meses	127	32	5	18,27	< ,001
12 meses vs 18 meses	261	17	18	0	1
12 meses vs 24 meses	258	27	18	1,42	0,233
12 meses vs 36 meses	143	20	6	6,5	0,011
18 meses vs 24 meses	286	32	23	1,16	0,281
18 meses vs 36 meses	162	22	7	6,76	0,009
24 meses vs 36 meses	186	21	13	1,44	0,23

Tobacco					
Pré vs 6 meses	270	6	8	-	0,791
Pré vs 12 meses	295	11	9	-	0,824
Pré vs 18 meses	312	10	6	-	0,454
Pré vs 24 meses	322	7	8	-	1
Pré vs 36 meses	188	5	7	-	0,774
6 meses vs 12 meses	248	6	2	-	0,289
6 meses vs 18 meses	234	4	3	-	1
6 meses vs 24 meses	230	3	3	-	1
6 meses vs 36 meses	127	3	4	-	1
12 meses vs 18 meses	261	2	5	-	0,453
12 meses vs 24 meses	258	2	5	-	0,453
12 meses vs 36 meses	143	3	3	-	1
18 meses vs 24 meses	285	3	2	-	1
18 meses vs 36 meses	162	5	2	-	0,453
24 meses vs 36 meses	185	2	2	-	1

LOCE					
Pré vs 6 meses	269	4	77	64	< ,001
Pré vs 12 meses	295	21	73	27,67	< ,001
Pré vs 18 meses	258	16	59	23,52	< ,001
Pré vs 24 meses	233	17	40	8,49	0,004
Pré vs 36 meses	146	14	19	0,49	0,486
6 meses vs 12 meses	248	22	4	11,12	< ,001
6 meses vs 18 meses	193	14	4	-	0,031
6 meses vs 24 meses	155	14	2	-	0,004
6 meses vs 36 meses	88	11	1	-	0,006
12 meses vs 18 meses	207	13	14	0	1
12 meses vs 24 meses	170	10	12	-	0,832
12 meses vs 36 meses	105	12	10	-	0,832
18 meses vs 24 meses	201	12	12	-	1
18 meses vs 36 meses	123	13	11	-	0,832
24 meses vs 36 meses	143	17	10	1,33	0,248