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Cross addiction in patients who underwent bariatric surgery: a systematic review

Adição cruzada em pacientes que realizaram cirurgia bariátrica: uma revisão sistemática

Adición cruzada en pacientes que se sometieron a cirugía bariátrica: una revisión sistemática

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ABSTRACT:

Introduction: Bariatric surgery is the most effective intervention for severe obesity. The transfer of addiction after bariatric surgery involves the potential development of new addictive behaviors in individuals who have undergone the procedure. This phenomenon, also referred to as cross addiction, has gained attention in scientific literature. Understanding these occurrences is crucial for informing clinical practices and health policies concerning bariatric surgery and post-operative care. **Objective**: To analyze the relationship between remission of food dependence and the emergence of addictions after bariatric surgery through the produced scientific evidence. **Method**: Systematic review conducted in Biblioteca Virtual em Saúde (BVS), PubMed and Scopus, using the keywords "Cross Addiction", "Bariatric Surgery" and similar terms collected from the Medical Subject Headings (MeSH). The inclusion criteria were experimental and observational studies published between 2012 and 2022 in English, Portuguese or Spanish that discuss about cross addiction in patients that

have undergone bariatric surgery. Studies that did not fulfill the inclusion criteria and duplicate articles were excluded. Two independent researchers selected the articles. **Results**: Most studies evidenced a positive relationship between cross-addiction and bariatric surgery. Patients reported significant increment in substance use and cross addiction. Still, some studies observed no relationship between previous food addiction and postoperatively substance abuse or other disorders. Limitations of the reviewed studies include variability of samples, diversity in the measurement of cross-dependence, focus on alcohol, and limited consensus on psychological and psychiatric criteria for the surgery. **Conclusion**: The theory of addiction transfer has not been fully validated and remains a point of discussion. Further research, methodological standardization, and defined protocols are imperative to improve our understanding of this phenomenon.

Keywords: obesity, bariatric surgery, cross-dependence, addiction transfer, cross addiction.

RESUMO:
Introdução: A cirurgia bariátrica é a intervenção mais eficaz para a obesidade grave. A transferência de dependência após a cirurgia bariátrica envolve o potencial desenvolvimento de novos comportamentos viciantes em indivíduos que passaram pelo procedimento. Esse fenômeno, também conhecido como adição cruzada, tem recebido atenção na literatura científica. Compreender essas ocorrências é crucial para informar práticas clínicas e políticas de saúde relacionadas à cirurgia bariátrica e ao cuidado pós-operatório. **Objetivo**: Analisar a relação entre remissão da dependência alimentar e o surgimento de vícios após a cirurgia bariátrica por meio das evidências científicas produzidas. **Método**: Revisão sistemática realizada na Biblioteca Virtual em Saúde (BVS), PubMed e Scopus, utilizando as palavras-chave "Cross Addiction", "Bariatric Surgery" e termos similares do Medical Subject Headings (MeSH). Os critérios de inclusão foram estudos experimentais e observacionais publicados entre 2012 e 2022 em inglês, português ou espanhol que discutam sobre dependência cruzada em pacientes submetidos à cirurgia bariátrica. Estudos que não atenderam aos critérios de inclusão e artigos duplicados foram excluídos. Dois pesquisadores independentes selecionaram os artigos. **Resultados**: A maioria dos estudos evidenciou uma relação positiva entre a cross-dependência e a cirurgia bariátrica. Os pacientes relataram um aumento significativo no uso de substâncias e na cross-dependência. No entanto, alguns estudos não observaram nenhuma

relação entre a dependência alimentar prévia e o abuso de substâncias ou outros distúrbios no pós-operatório. Limitações dos estudos revisados incluem a variabilidade das amostras, a diversidade na medição da cross-dependência, o foco no álcool e a falta de consenso nos critérios psicológicos e psiquiátricos para a cirurgia. **Conclusão**: A teoria da transferência de vícios não foi totalmente validada e continua sendo um ponto de discussão. Mais pesquisas, padronização metodológica e protocolos definidos são imperativos para melhorar nossa compreensão acerca desse fenômeno.

Palavras-chave: obesidade, cirurgia bariátrica, dependência cruzada, transferência de vício, vício cruzado.

RESUMEN:
Introducción: Cirugía bariátrica es la intervención más efectiva para obesidad severa. Transferencia de dependencia después de cirugía implica desarrollo potencial de nuevos comportamientos adictivos. Este fenómeno, conocido como adición cruzada, ha recibido atención en literatura científica. Comprender estos hechos es crucial para informar la práctica clínica y la política de salud relacionada con la cirugía y atención posoperatoria. **Objetivo**: Analizar la relación entre remisión de adicción a la comida y aparición de adicciones después de la cirugía bariátrica a través de la evidencia científica. **Método**: Revisión sistemática realizada en la Biblioteca Virtual en Salud (BVS), PubMed y Scopus, utilizando las palabras clave "Cross Addiction", "Bariatric Surgery" y términos similares del Medical Subject Headings (MeSH). Criterios de inclusión fueron estudios experimentales y observacionales publicados entre 2012 y 2022 en inglés, portugués o español que discutan la dependencia cruzada en pacientes sometidos a cirugía bariátrica. Se excluyeron estudios que no cumplieron con los criterios de inclusión y artículos duplicados. Dos investigadores independientes seleccionaron los artículos. **Resultados**: La mayoría de los estudios evidenciaron una relación positiva entre la cross-dependencia y la cirugía bariátrica. Los pacientes informaron un incremento significativo en el uso de sustancias y la cross-dependencia. Aun así, algunos estudios no observaron ninguna relación entre la adicción alimentaria previa y el abuso de sustancias u otros trastornos después de la operación. Las limitaciones de los estudios revisados incluyen la variabilidad de las muestras, la diversidad en la medición de la cross-dependencia, el enfoque en el alcohol y la falta de consenso en los criterios psicológicos y psiquiátricos para la cirugía. **Conclusión**: La teoría de transferencia de adicción no ha sido completamente validada y sigue siendo un punto de discusión. Más

investigación, estandarización metodológica y protocolos definidos son imprescindibles para mejorar nuestra comprensión de este fenómeno.

Palabras clave: obesidad, cirugía bariátrica, dependencia cruzada, transferencia de adicción, vicio cruzado.

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Introduction

Obesity is a multifactorial chronic disease that causes severe damage to the patient's physical and mental health [1]. Currently, bariatric surgery is the most effective intervention for severe obesity, providing increased quality of life from significant and sustained weight loss and improvement of associated clinical comorbidities [2, 3]. According to the new guidelines published in 2022, metabolic and bariatric surgery (MBS) is recommended for individuals with body mass index (BMI) ≥ 35 kg/m2, regardless of the presence, absence, or severity of comorbidities, and for individuals with metabolic disease and BMI of 30 to 34,9 kg/m2 (class I obesity). Even without metabolic disease, MBS should also be considered an option in cases of class I obesity unresponsive to nonsurgical treatment. The predominant surgical techniques for MBS are roux-en-Y gastric bypass

(RYGB) and sleeve gastrectomy, using minimally invasive surgical approaches [4].

Despite the effectiveness of MBS in the treatment of severe obesity, the patient may present neurophysiological, psychological, and behavioral dysfunctions postoperatively. In this sense, an increasing number of studies have provided information about the relationship between obesity, eating behavior and addiction. It is known that both obesity and drug dependence are mediated by common neurobiological substrates [1, 5]. Binge eating disorder (BED) and food addiction are prevalent problems among MBS candidates and have similarities with other addictions, since food, alcohol, drugs, and other substances enhance dopamine release and activate the mesolimbic reward system, which plays an important role in brain physiology [6].

In addition, eating disorders and substance abuse also have similar behavioral characteristics, such as impulsivity, which refers to the inability to inhibit automatic behavior with a tendency to prefer immediate rewards despite future consequences [5]. Impulsivity plays a similar role in both loss of control overeating and the development or relapse of substance abuse. Therefore, it is a significant predictor of the psychosocial state post-surgery, considering the evidence of difficulty in impulse control after surgery, leading to an associated increase in substance use disorders in the postoperative period [1, 5].

From this perspective, the current literature discusses the theory of "addiction transfer" or "cross-dependence", in which the preoperative food addiction is replaced by another addictive behavior (e.g., alcohol and drug abuse), as the physical restrictions of MBS prevent the patient from consuming excessive amounts of food to cope with psychological issues [2, 3]. MBS, by redirecting addictive behavior, shows the complexity of the interconnection between the neurobiological systems that regulate these behaviors. This "behavioral replacement" is mainly discussed in relation to the development of alcohol use disorder (AUD) after the operation, especially by RYGB, which is associated with changes in alcohol metabolism and pharmacokinetics, with consequences in increased sensitivity to the effects of alcohol, in addition to neurophysiological and behavioral changes mentioned, which have the similar pathophysiological nature as food addiction [5 - 7].

However, the mechanisms of "addiction transfer" in relation to MBS are not yet fully elucidated and the causal relationship is not fully established [2, 3]. Therefore, in view of the conflicting evidence in the literature and the scarcity of review studies on "addiction transference", there is a need to review and synthesize the available studies on the subject. Thus, the present systematic review aimed to assess whether the remission of food addiction in patients undergoing bariatric surgery is associated with the increase or onset of other addictions. This analysis primarily focuses on substance addiction, particularly AUD, as although addictions unrelated to substances, such as gambling, buying-shopping, and internet compulsions, are also possible in the postoperative period, they are sparsely described in the literature. Thus, it will be possible to contribute to the description of post-MBS behavioral changes and provide initiative for future studies.

Methods

Protocol design and registration

This systematic literature review was conducted according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The protocol of this review was registered in the International Register of Systematic Reviews (PROSPERO), under the number CRD42022347723.

Eligibility criteria

Inclusion criteria: experimental and observational studies published between 2012 and 2022 in English, Portuguese or Spanish that discuss about cross addiction in patients that have undergone bariatric surgery.
Exclusion criteria: studies that do not fulfill the inclusion criteria and duplicate articles.

Information sources and search strategies

The search strategy was established using the keywords "Cross Addiction", "Bariatric Surgery", and similar entry terms collected from the Medical Subject Headings (MeSH), between 1st and 31st of August of 2022. The research was carried out by two independent authors in three databases: Biblioteca Virtual em Saúde (BVS), PubMed and Scopus.

Study selection and data extraction

Duplicate articles were eliminated manually, without using software. For the study selection and data extraction, two independent researchers selected the articles by title and abstract, according to the inclusion and exclusion criteria. Then, the researchers discussed comparing the number

of documents that remain. In case of any disagreement, a third researcher was consulted to resolve the discordances. After this step, the articles selected were completely read and relevant findings were extracted and summarized into tables to facilitate the analysis and comparison of data.

Quality analysis

The evaluation of the quality of the studies was performed by adapting the Loney et al. [8] scale and ARHQ Methodology Checklist for Cross Sectional/Prevalence Study (2015) [Table 1].

Results

Initially, 450 studies were retrieved: 163 from BVS, 167 from PubMed and 120 from Scopus. 175 of them were duplicates. After the screening of titles, 127 of them were selected. Then, 85 were excluded by the abstract screening for not meeting the eligibility criteria. The other 42 studies were completely read and 13 of them, which fulfilled the inclusion and exclusion criteria, were selected for the research. The selection process is presented in the flow diagram [Figure 1]. The studies evaluated were consistent with the research question, and their quality was confirmed by the evaluation of the quality of the studies was performed by adapting the Loney et al. [8] scale and ARHQ Methodology Checklist for Cross Sectional/Prevalence Study [Table 1]. The studies selected for this review are easy for the reader to comprehend and employ appropriate and illustrative tables and graphs that facilitate understanding.

The selection of articles resulted in a significant majority of cohort studies (69.23%). The other study designs were cross-sectional study (n = 2), prospective study (n = 1) and retrospective study (n = 1). The studies were mostly carried out in the United States of America (53.85%). Denmark, Brazil, Turkey, Ireland, Germany, and Portugal are the other countries that also conducted the studies found in our sample. 69.23% studies followed their patients pre- and post-operatively. One study did not follow its patients postoperatively, and three studies did not follow their patients preoperatively.

We compared characteristics of the analysis sample such as age and sex. Our analysis concluded that the study sample ranged from 8 to 13,430 participants. Furthermore, the average percentage of male participants in these studies was 24.94%; the lowest percentage of males in the studies was 9.8%, and the highest was 50%. Finally, the mean age ranged from 28 to 48.7 years old.

Most studies indicated a positive relationship between bariatric surgery and cross-addiction. The cohort study conducted in Denmark in 2020 demonstrated that the risk of developing AUD is 6 to 7 times higher in patients who underwent bariatric surgery when compared to non-surgery controls, and that this risk is evident in both sexes [9]. Conason et al. [10] concluded that patients reported significant increases in the frequency of substance use such as a composite of drug use, alcohol use, and smoking, hereinafter referred to as a composite substance use 24 months after surgery. A cohort study conducted in the USA showed that 83.3% of the sample identified addiction substitution in terms of substance use etiology themes [11].

Some articles have studied the relationship between eating disorders and AUD. The cohort study conducted in Brazil with 46 patients indicated that 16.7% of patients diagnosed with binge eating disorder (BED) before bariatric surgery developed AUD during the follow-up period after surgery (12 years on average). However, 27.3% of patients without BED before surgery developed AUD in the same follow-up period. These two frequencies showed no statistically significant difference [12]. In Turkey, a cross-sectional study with 203 participants concluded that 22% of patients who had food addiction before bariatric surgery were at risk of substance use [13]. In addition, patients who endorsed pre-surgical problems with High-Sugar/Low-Fat foods were at greater risk for new onset substance use disorder in the post-surgical period [14].

On the other hand, the prospective study conducted in Germany concluded that preoperative eating disorders were not associated with the increase or emergence of problematic alcohol use or other disorders, such as hypersexual discord and exercise dependence [2]. Burgos et al. [15] argued that replacing food consumption in large quantities with substances that offer pleasure and satisfaction can contribute to greater alcohol consumption after surgery; however, 24.2% of patients reported alcohol consumption in the preoperative period and 9.4% of patients reported alcohol consumption in the postoperative period. Finally, Koball et al. [16] observed no relationship between food addiction and current substance abuse.

Wong et al. [17] demonstrated that the prevalence of high-risk drinking increased from 13.4% before to 22.7% 1 year after bariatric surgery. Furthermore, new high-risk drinkers appeared more likely to report lower cognitive restraint scores and higher scores for emotional and uncontrolled

eating at baseline and had greater improvements in disordered eating scores post-surgery.

Other analyzed studies in our sample addressed cross-addition to other substances. Vidot et al. [18] concluded that increased marijuana use since surgery and recent use were associated with higher scores on the eating disorder subscales. Besides, a cohort study developed in the United States with 201 participants demonstrated that 8% (n = 16) of the patients developed AUD within three years postoperatively, 43,8% (n = 7) of whom had no history of AUD. Of all participants, 11% experienced a non-AUD substance disorder prior to or following the bariatric surgery, among which is mentioned cannabis, stimulant and cocaine disorders. 2 participants with post-operative non-AUD substance use disorders; one of them reported abuse/dependence of sedatives/hypnotics/anxiolytics both prior to and after surgery, while the other one reported opioid dependence only after surgery [3]. The results of the studies are summarized in the Table 2.

The fourteen instruments mentioned encompasses a diversity of psychological and diagnostic evaluations. It is important to point out that the validity of these instruments varies according to the context and populations evaluated [Table 3].

In general, approximately 62% of the analyzed studies were consistent with the possibility of addiction transfer in patients undergoing bariatric surgery, by associating the improvement in eating behavior with a heightened risk of developing substance dependencies after surgery, with alcohol being the primary addiction under investigation [3, 9-11, 13, 14, 17, 19]. One of these studies also observed a relationship between the remission of food addiction post-surgery and an increased risk of internet addiction [13]. However, the remaining studies were not consistent with the hypothesis of addiction transfer, either because they did not observe an increase or onset of other addictions after surgery [15] or because they did not associate this increase or onset with preoperative food addiction [2, 12, 16, 18]. Regardless of the associations found, the findings in the current literature provide only preliminary evidence for larger studies to draw more precise conclusions [3, 17, 18].

Discussion

This study performed a systematic review to comprehensively evaluate the potential correlation between MBS and the emergence of addictive behaviors, such as AUD, gambling, compulsive buying and internet

compulsions. The analysis encompassed studies conducted in seven different countries, including the United States of America, Denmark, Brazil, Turkey, Ireland, Germany, and Portugal. Given the diverse sociodemographic characteristics of those populations, such as gender, ethnicity, years of education, economic status and BMI, the need to conduct more studies on cross-addiction after bariatric surgery in Brazil is highlighted.

MBS and Cross-Addiction

The results found diverge on risk factors for cross-dependence and on clinical and psychiatric aspects for approval of surgery. There is no consensus in the literature as to the psychological and psychiatric criteria for exclusion of candidates for the procedure. There are also no clear predictive factors for good or poor prognosis [20]. Moreover, it is evidenced that many individuals do not undergo longitudinal psychiatric treatment after bariatric surgery, which hinders the diagnosis and subsequent treatment of cross-dependence. We reiterate the importance of standardizing the psychiatric and psychological assessment instrument for bariatric surgery candidates.

Additionally, it is pointed out that the neurochemical events associated with binge eating would be very similar to those of other compulsive behaviors, such as alcohol abuse or compulsive gambling [21], which confirms the relevance of pre and postoperative assessment to avoid this cross substitution. In this context, although a better definition of the food addiction behavioral model is needed, it is known that it was built based on behavior and subjective experiences related to food consumption that resemble the criteria for substance use disorder [22].

Therefore, public policies related to the prevention of addiction in patients undergoing bariatric surgery should be considered to understand the patient's perception and create interventions that minimize pre- and post-operative substance abuse [23]. Preventive strategies should encompass comprehensive preoperative education, rigorous psychological assessment, and ongoing postoperative follow-up. One intervention modality is motivational interviewing, in which there is collaborative communication between health professionals and patients to reinforce motivation and lifestyle changes, which increases behavioral adherence to postoperative guidelines [24]. Collaboration among healthcare professionals, bariatric surgeons, psychologists, and therapists can aid in developing more effective assessment and intervention guidelines to

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identify and address any form of transfer addiction promptly after bariatric surgery. This will ensure the mental health and well-being of individuals who have undergone this intervention, contributing to better long-term outcomes.

In this context, emotional eating deserves attention for several reasons, especially because individuals who engage in this action usually eat in response to psychological distress rather than the physiological signs of hunger. According to Litwin et al. [25], emotional eating can be explained by a maladaptation of the emotional regulation model, establishing that increased negative emotions trigger emotional eating, which acts as a means of reducing these unpleasant emotions, offering a temporary distraction, accompanied by a feeling of comfort and relief from negative feelings, and stress reduction [26]. In this way, public policies aimed at providing specific psychological care over a longer period in the preoperative period for patients with this condition could reduce addictions acquired in the postoperative period.

In conclusion, although many studies indicate a positive relationship between bariatric surgery and cross-dependence, the causal relationship regarding this hypothesis is not yet established in the literature, and several factors contribute to the discrepancy of results regarding this hypothesis.

Limitations and bias

Variability of samples. The total number of participants varied significantly between studies, from small samples of 8 participants to larger samples of 13430 people. Notably, none of the studies had a higher percentage of male patients when compared to female patients. Therefore, not only the scarcity of data for analysis, but also the lack of standardization due to the heterogeneity of the samples because of the different demographic profiles (with various biopsychosocial implications for patients and consequently for the data obtained) of the groups studied, are important limitations in finding evidence to answer the proposed question.

Diversity in the measurement of cross-dependence. A significant portion of studies are based on patient-reported measures, since they are questionnaires carried out during the clinical interview, which are subject to bias [5]. Also, there is a methodological diversity used in the studies, considering different selection criteria, assessment tools, and patient follow-up protocols.

Focus on AUD. Much of the data collected in this review are related to the transfer of food addiction to alcohol, but it is necessary to emphasize that there are few studies and instruments that investigate the transfer to other compulsions, whether substance-related or not [3]. Only 15% of the studies (2 studies) investigated the cross-addiction to other addiction behaviors other than substance use disorder, such as gambling, buying-shopping, and internet addiction. Broadening the focus of studies beyond alcohol-related disorders and investigating other potential post-surgical dependencies is pivotal for a more comprehensive understanding of the phenomenon.

Influence of the social, family, and professional spheres. It is known that these spheres influence not only on the psychological condition of patients who are candidates for or have already undergone bariatrics, but also on the development of compulsive disorders associated with drug use or the consumption of hyper-palatable foods. There is evidence in the literature of an association between a history of sexual abuse and obesity [27], as well as evidence showing an association between sexual abuse and the development of AUD [28], reaffirming social vulnerability as an aspect directly related to the development of compulsive behaviors that have wide-ranging repercussions in other areas of life, especially family and professional life. Furthermore, in one of the studies analyzed, patients reported frustration after surgery because it did not have the expected positive reverberations, especially in those who usually had an emotional relationship with food [19]. Despite the paramount importance of these spheres in the psychology of patients undergoing surgery, there is still little research that studies this relationship, and most of the existing studies are controversial in terms of their results.

Lack of psychosocial approach. Another important aspect that may be responsible for biases in the analysis of data related to the prognosis of patients who have undergone surgery is the psychiatric comorbidities present preoperatively. Conditions related to the mental state such as anxiety, depression and eating disorders are not only more prevalent in patients who are candidates for bariatric surgery, but also significantly affect their lifestyle habits, especially eating habits [29]. In one of the studies analyzed, 75% of patients who had already undergone bariatric surgery and were being treated for substance abuse reported observing a link between the development of chemical dependency and psychological problems that were already present before surgery and had not been resolved. In addition, four other etiologies were cited by most patients,

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including cross-addiction, an increase in the intensity of the effect of substances and the increased availability of pain medications [11]. However, despite the association between psychological weaknesses and the development of an addiction post-surgery, these aspects still need to be more clearly studied, facing significant limitations such as the difficulty in establishing an adequate control group with a significant number of patients, as well as the broad spectrum of disorders associated with drug addiction that prevents the generalization of the results for all patients who have undergone bariatrics. These aspects lead to a low number of studies focusing on the psychosocial aspects of bariatric patients and their relationship with the development of addictions.

Limited consensus. The combination of these confounding factors with the lack of uniformity in pre- and post-operative assessment calls for caution in analyzing cross-dependence in all its complexity and reinforces the need for more rigorous methodologies.

Conclusion

The emergence of substance-related or non-substance-related addictions after bariatric surgery is a multifaceted and complex issue. While many studies indicate a positive relationship between bariatric surgery and cross-addiction, the theory of "addiction transfer" has not been fully validated and remains a point of discussion. The methodological disparities among the studies conduce to the discrepancies in the results, as well as the difference between the populations studied in terms of sociodemographic characteristics, sample size and follow-up time. This review highlights the need for further research, methodological standardization, and defined protocols to improve our understanding of “addiction transfer”.

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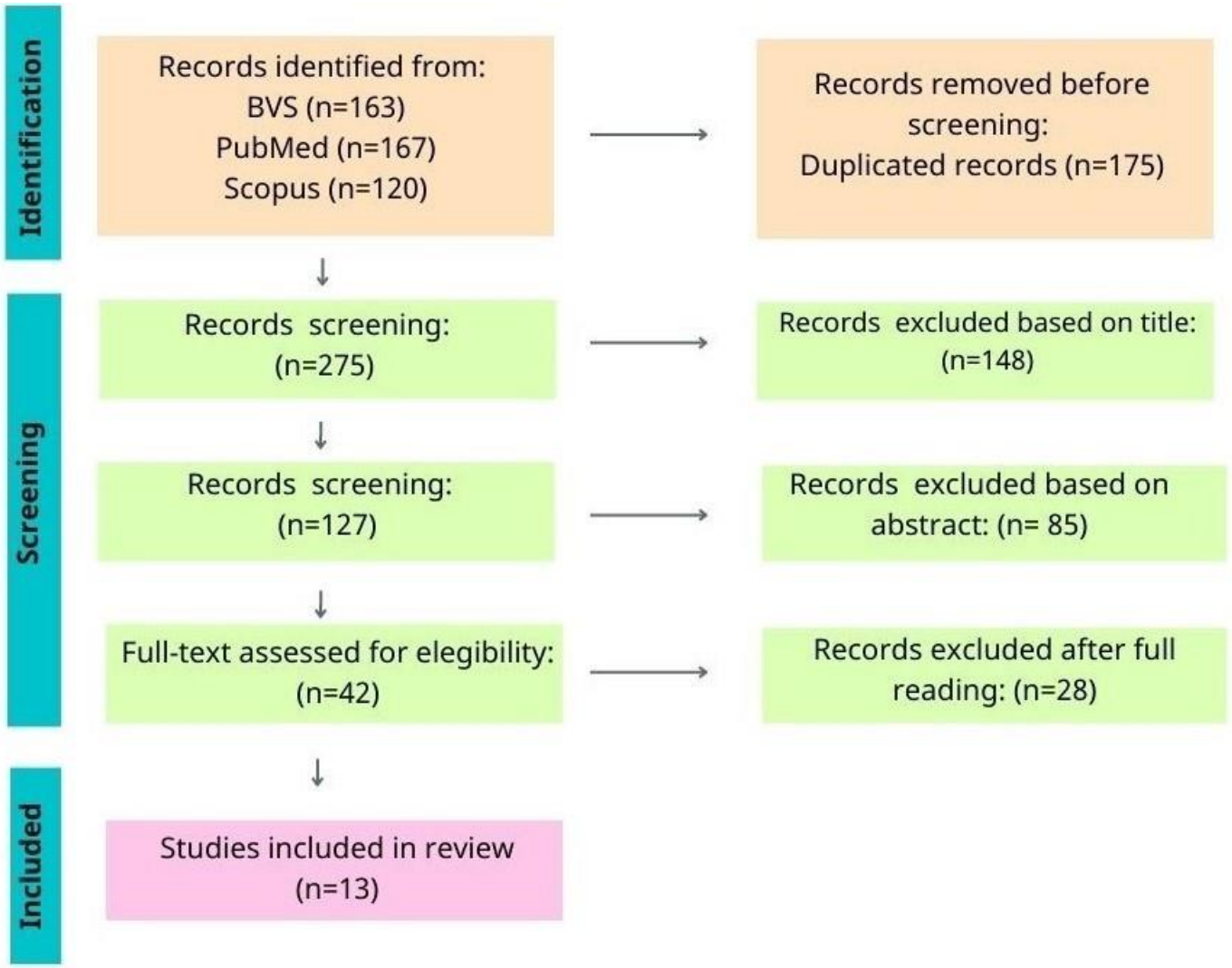

Figure 1. Identification of studies via databases

Table 1. Quality of the studies by the adapted Loney et al. (1998) scale and ARHQ Methodology Checklist for Cross Sectional/Prevalence Study (2015)

	Is the study design appropriate to answer the research question?	Was the population clearly described?	Is the sample size adequate?	Are objective, adequate, and standardized criteria used to measure the health outcome? Were standardized and/or validated instruments used?	Have assessments been carried out for quality assurance purposes?	Was the response rate adequate?	Are prevalence or incidence estimates given with confidence intervals and broken down by subgroup?	Were data analysis and presentation adequate?	0-8
Bramming et al.	✓	✓	✓	✓		✓	✓	✓	7
Burgos et al.	✓	✓				✓	✓	✓	5
Conason et al.	✓	✓		✓	✓	✓	✓	✓	6
Dickhut et al.	✓	✓		✓			✓	✓	5
Fowler et al.	✓	✓		✓		✓	✓	✓	6
Freire et al.	✓			✓		✓	✓	✓	5
Ivezaj et al.	✓	✓		✓		✓		✓	5
Koball et al.	✓	✓		✓		✓	✓	✓	6
Mitchell et al.	✓	✓		✓		✓	✓	✓	6
Özkan et al.	✓	✓	✓	✓		✓	✓	✓	7
Vidot et al.	✓			✓			✓	✓	4
Wong et al.	✓	✓		✓		✓	✓	✓	6
Yoder et al.	✓	✓		✓		✓		✓	5

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Table 2. Results of selected studies

Author/year	Country	Study design	Number of participants	Age	Male sex (%)	Instruments	Outcomes
Bramming et al./2020	Denmark	Cohort	13430	40.3	22.6	National registers	The risk of alcohol use disorder is 6-7 times higher in patients who had undergone bariatric surgery compared with nonsurgery controls. To explain it, the addiction transfer theory has been proposed.
Burgus et al. /2015	Portugal	Retrospective	276	42	9.8	Electronic medical record data	Surgery was not associated with the emergence of new alcohol drinkers or an increase in the amount or frequency of alcohol consumption.
Conason et al./ 2013	USA	Cohort	155	40	14.8	Compulsive Behaviors Questionnaire	Significant increases in frequency of substance use (drug, alcohol, cigarette smoking) 24 months after surgery. It has been hypothesized that the increased substance use after the operation is due to the symptom replacement theory, because the surgery helps control binge eating but does not treat the psychopathology involved.
Dickhut et al. /2021	Germany	Prospective	125	44.71	16.8	YFAS 2.0, AUDIT, SOGS, s-IAT, PBS, HBI, EDS-21	Preoperative food dependence was not associated with an increase or emergence of problematic alcohol use, gambling disorder, internet-use disorder, buying-shopping disorder, hypersexual disorder and exercise dependence.
Fowler et al. /2014	USA	Cohort	154	48.7	12	MAST-AD; YFAS	Participants who endorsed pre-surgical problems with High Sugar/Low Fat foods and High GI foods were at greater risk for substance use disorder in the post-surgical period.
Freire et al. /2020	Brazil	Cohort	46	41.4	28.3	QEWP-R, AUDIT	There was no significant difference in the frequency of alcohol use disorder between patients with and without binge eating disorder.
Ivezaj et al. /2012	USA	Cohort	24	45.2	25	Interview (based on Grounded Theory)	83,3% of a sample of operated patients in substance abuse treatment identified addiction transfer as the etiology of substance use.
Koball et al. / 2016	USA	Cohort	923	47.9	29	YFAS	No relationship was observed between food adiction and current substance use.
Mitchell et al. / 2015	USA	Cohort	201	48	18.9	SCID, Impulsive Control Disorder Modules, AUDIT	Although there is a risk for developing alcohol use disorder after surgery, there is still a lack of empirical support to endorse the addiction transfer hypothesis.
Ozkan et al. / 2022	Turkey	Cross-sectional	203	32.74	45.3	Substance Abus Proclivity Scale, Patient Information Form, YFAS, Internet Addiction Scale	54.7% of the patients who had food addiction before bariatric surgery were at risk of internet addiction, and 22.0% were at risk of substance use.
Vidot et al. /2016	USA	Cross-sectional	50	28	24	ASI, YFAS, EDE-Q, DEQ	Increased marijuana use since surgery and recent use (within the past year, but not within the past 30 days) were associated with higher scores on the eating disorder subscales and the eating dependence scale. This did not occur with current marijuana use (within the past 30 days).
Wong et al. /2022	USA	Cohort	97	45.2	27.8	Semi-structured interviews	19% of patients who were not high-risk alcohol users developed high risk drinking 1 year after vertical gastrectomy. Patients with improved eating behavior post-surgery were more likely to develop high-risk alcohol use, which supports the addiction transfer hypothesis.
Yoder et al. /2018	Ireland	Cohort	8	48	50	AUDIT, TFEQ-R18	Participants managed the symptoms of their unresolved psychological issues through 'behavioural substitution', that is, drinking alcohol instead of eating.

Table 3. Instruments used in selected studies

	Instruments
Bramming et al.	National registers
Burgos et al.	Electronic medical record data
Conason et al.	Compulsive Behaviors Questionnaire
Dickhut et al.	YFAS 2.0, AUDIT, SOGS, s-IAT, PBS, HBI, EDS-21
Fowler et al.	MAST-AD; YFAS
Freire et al.	QEWP-R, AUDIT
Ivezaj et al.	Interview (based on Grounded Theory)
Koball et al.	YFAS
Mitchell et al.	SCID, Impulsive Control Disorder Modules, AUDIT
Özkan et al.	Substance Abuse Proclivity Scale, Patient Information Form, YFAS, Internet Addiction Scale
Vidot et al.	ASI, YFAS, EDE-Q, DEQ
Yoder et al.	Semi-structured interviews
Wong et al.	AUDIT, TFEQ-R18

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AUDIT: Alcohol Use Disorder Identification Test, **SCID:** Structured Clinical Interview, **YFAS 2.0:** Yale Food Addiction Scale 2.0, **TFEQ-R18:** Three Factor Eating Questionnaire Revised-18, **QEWP-R:** Questionnaire on Eating and Weight Patterns-Revised, **PBS**: Pathological Buying Screener, **s-IAT**: short Internet Addiction Test, **SOGS**: South Oaks Gambling Screen, **HBI** Hypersexual Behavior Inventory, **EDS-21:** Exercise Dependence Scale-21, **EDE-Q:** Eating Disorder Examination Questionnaire, **DEQ:** Disordered Eating Questionnaire, **ASI:** Addiction Severity Index, **MAST-AD:** Michigan Assessment-Screening Test for Alcohol and Drugs