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How much do we know about the factors that affect the adherence to post-bariatric surgery treatment? A systematic review

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ABSTRACT

Introduction: Adherence to treatment (ADT) after bariatric surgery (BS) is paramount for success. However, little is known about the factors that predict it.

Objective: This systematic review analyzed the extent of recent knowledge about the factors that affect behavioral aspects of ADT post-BS.

Methodology: The search was conducted in accordance with the PRISMA statement. It was performed in Web of Science, MedLine and PsycInfo, covering from 2007 to January 2021. After verification of compliance with the selection criteria, the retained studies were further evaluated for their quality.

Results: Eleven studies were analyzed. Although little more than 80% showed adequate quality, certain deficits were identified, mainly regarding external and internal validity. The most widely used behavioral indicator of ADT was attendance at follow-up appointments (63.6%), and only a study included more than one indicator. The predictors were classified into five groups: sociodemographic, psychological, medical, nutritional, and physical activity-related. The largest number of articles examined variables of the first two types, however, it is not possible to identify consistency in terms of the predictors analyzed.

Conclusions: Despite the problem that non-ADT after BS represents, few studies focus on this topic. Therefore, it is urgent to orient efforts towards systematization, since the findings should form the basis for the design of evidence-based interventions that help improve ADT in these patients.

KEYWORDS

Treatment adherence, Bariatric surgery, Obesity surgery, Predictor factors, Behavioral factors

ABBREVIATIONS

AFV: Attendance at follow-up visits.

BMI: Body mass index.

BS: Bariatric surgery.

DA: Data analysis.

PA: Physical activity.

WL: Weight loss.

INTRODUCTION

Along with weight loss (WL), bariatric surgery (BS) has shown excellent results in treating chronic diseases[1-3]. Unfortunately, outcomes vary considerably, and substantial efforts have been made to understand what factors predict them. Emerging research suggest that one of the main predictors of post-BS success is adherence to treatment (ADT)[4-5].

These patients require to make considerable behavioral changes that help maintain WL. For example, to improve their diet, not only in terms of quantity and quality, but particularly

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strengthening self-regulation on their eating behavior[6-7]. It is also necessary to engage in physical activity (PA) and, depending on the surgical procedure, to take dietary supplements. Therefore, it is important that patients maintain clinical follow-up after BS[8-9].

Mounting evidence suggests that ADT promotes both successful WL and less weight regain[10-12]. However, it is notorious that the main interest has been focused on identifying the factors that influence surgical success, defined as WL[13-14]. Nevertheless, it should be emphasized that the behavioral aspects inherent to ADT (e.g., attendance at consultations and compliance with the indications) are those that underlie WL or weight regain. Therefore, if the central purpose of post-CB treatment is to encourage patients to make changes in their lifestyle and, based on this, to prevent weight regain, it is essential to know what factors influence the behavioral aspects of ADT. Taking this into account, the objective of this research was to analyze the extent of recent knowledge about the factors that affect behavioral aspects of ADT in patients post-BS.

METHODOLOGY

The search was performed on January 5th, 2021, in the databases Web of Science, Medline and PsycInfo, covering from January 2007 to January 2021. The research included the following keywords: (adherence OR compliance OR barriers) AND (bariatric), considering title or abstract. The search was conducted in accordance with the principles of the PRISMA statement[15].

Data sources and searches

The eligibility of the articles was based on the following criteria. Inclusion: 1. Full text available in English; 2. The objectives should include the identification of factors that predict ADT; 3. Only longitudinal studies; and 4. As a dependent variable, the study should include at least one ADT behavioral parameter. Exclusion: 1. Dissertations, conferences, reviews, or meta-analyses; 2. Case, cross-sectional or qualitative studies; and 3. Reserach that included only non-behavioral parameters of ADT (e.g., WL, weight regain).

The duplicate records were removed. Later, two independent reviewers screened the titles and abstracts to identify potentially-relevant studies. The full texts that met the criteria were obtained and reviewed, also independently, by two of the researchers. When disagreements between reviewers occurred, the decision was based on the judgment of a third reviewer.

Assessment of studies quality

A modified version of the Downs and Black checklist[16] was used. This tool consists of 18 items aimed at assessing four aspects: 1) reporting: hypothesis/objective clearly described, 2) confounding, 3) bias, and 4) external validity. This analysis was performed by two judges, but in case of disagreement, a third reviewer participated.

RESULTS

The initial search yielded 2,870 records; however, after duplicates were removed and all the filters were applied, 11 articles remained (see Figure 1).

Description

Source

Most of the studies were conducted in America (54.5%), mainly in the United States (36.7%); while from Latin America only one study was identified[17] (see Table 1).

Methods

Regarding the design of the studies, most were prospective (63.6%). Sample size varied widely, from 42 to 13,320 participants (*Me*= 212). The age was from 14 to 91 years, with means between 38.8 and 46.4 (*M*= 40.0). All studies included men and women, with a clear overrepresentation of women (63%-90%). In addition, the studies focused on adults, except one that only included adolescents[18]. As to the surgical procedure, only four studies (36.7%) specified that was laparoscopic. Gastric bypass was the most frequent (63.6%); however, in two of these studies, they mixed patients who underwent some other procedure, such as gastric banding[19] or sleeve gastrectomy[20].

The most widely used behavioral indicator of ADT was attendance at follow-up appointments (63.6%), followed by PA (27.3%), and diet (18.2%). It should be noted that only a study included more than one behavioral indicator[21]. ADT varied from a simple division from adherent to non-adherent, based on the number of follow-up visits, or just the number of visits to completed by the patients, to written scales asking about their diet or the PA, to a more complex questionnaire based on certain guidelines patients were supposed to follow. However, in addition to examining a behavioral indicator of ADT, four studies included WL (36.7%).

Quality assessment

The scores ranged from 68.4% to 88.2% (*M*= 79.6%); however, only five studies scored over 80%[17,19,21,25-26]. The deficits were centered on six of 18 items. Two correspond to external validity (*In terms of selection, the participants are representative of a population*; *In terms of confounders, the participants are representative of a population*); one to internal validity (*In terms of confounders, the main analyzes were adequately adjusted*); two to description of participants (*Participant characteristics are clearly described; Characteristics of patients lost to follow-up been described*);

Figure 1. Flowchart for article selection

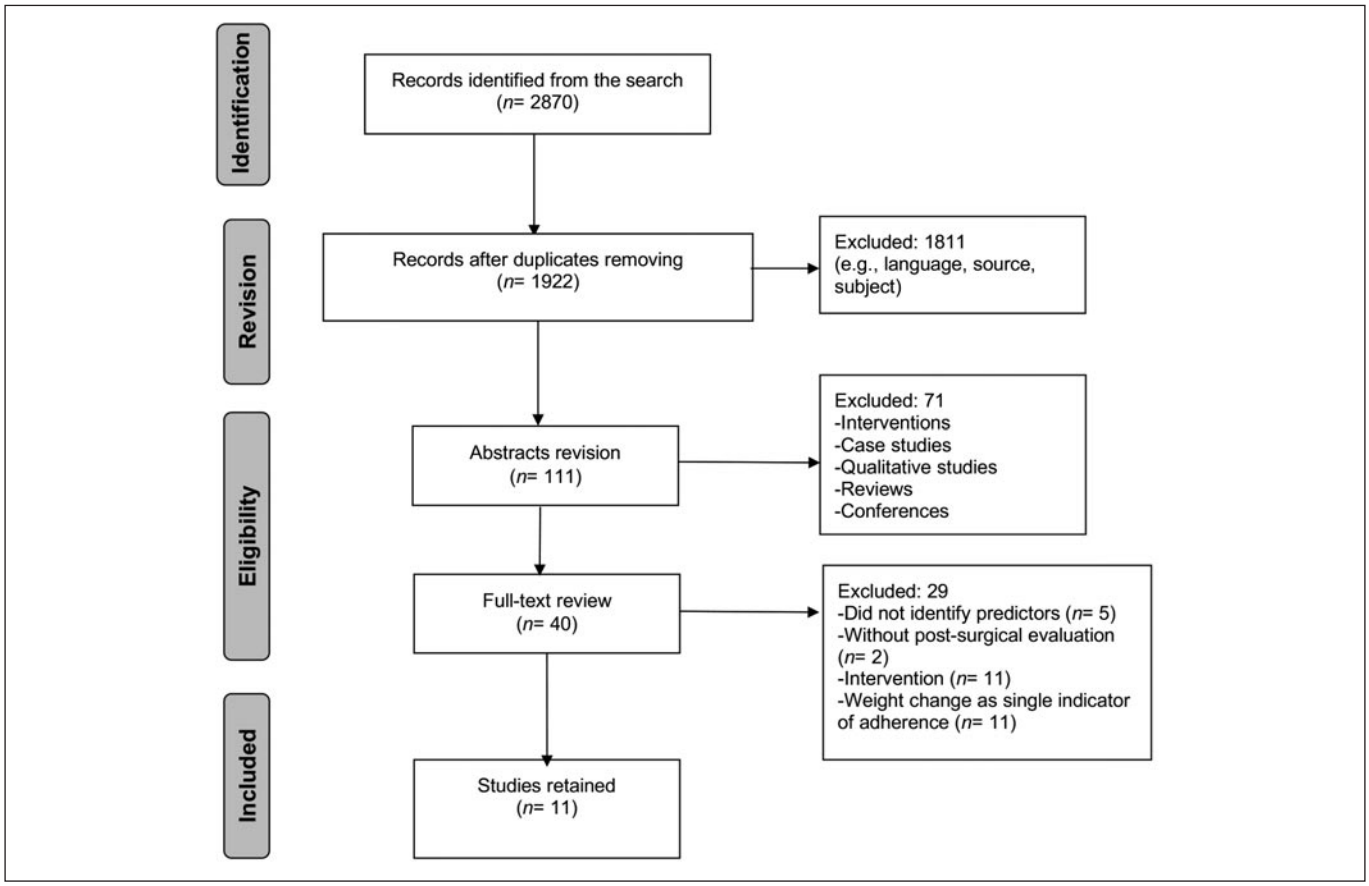

Table 1. Reviewed articles summary

Source	Methodology	Results
Dixon[27] Australia	Prospective 204 patients (80% female); age: 42.9 years (*SD*= 10.4). Adjustable gastric banding *IV.* Readiness to change *DV* WL, AFV, surgical complications *DA.* Multiple linear regression	Pre-BS readiness to change failed to predict WL, AFV, or surgical complications at 24 months.
Hunt[23] USA	Prospective 212 patients (79% female); age: 41.2 years (*SD*= 10.5). Technique not specified *IV.* Attitude, subjective norms, and perceived behavioral control towards exercise *DV.* PA, exercise intention *DA.* Multiple linear regression	The three IV predicted exercise intentions at four stages (T1= pre-BS to 13 days post-BS; T2= 6 weeks to 3 months; T3= 6-9 months; and T4≥ 12 months). Perceived behavioral control predicted self-reported PA (Time 1, 3, and 4).
Wouters[19] Netherlands	Retrospective 42 patients (90% female); age: 38.8 years (*SD*= 8.0). Gastric banding and gastric bypass *IV.* Demographics, BMI, PA, barriers and perceived benefits of exercise *DV.* PA *DA.* Multiple linear regression	Pre-BS: perceiving less benefit from exercise and exercise confidence were negative PA predictors at 24 months. Post-BS (12 months): PA and perceived benefits of exercise were positive predictors at 24 months, while BMI and fear of injury were negative predictors.

Notes. AFV= Attendance at follow-up visits, BMI= Body mass index, BS= Bariatric surgery, DA= Data analysis, DV= Dependent variables, IV= Independent variables, PA= Physical activity, WL= Weight loss.

Table 1 continuatión. Reviewed articles summary

Source	Methodology	Results
Sockalingam[25] Canada	Prospective 132 patients (79% female); age: 43.8 years (*SD*= 10.0). Gastric bypass *IV.* Demographics, BMI, depression, relational styles, distance between home and hospital *DV.* AFV (1, 3, 6 and 12 months) *DA.* Multivariate logistic regression	Pre-BS avoidant relationship style was a negative predictor of AFV appointments at 12 months.
Sysko[18] USA	Prospective 101 patients (72% female); age: 15.8 years (*SD*= 1.1). Laparoscopic gastric banding *IV.* Demographics, BMI, distance from clinic, depression, quality of life, eating disorders *DV.* AFV *DA.* Multiple linear regression, logistic regression	Depression and loss of control over eating negatively predicted adherence.
Aarts[24] Netherlands	Prospective 105 patients (81% female); age: 45.0 years (*SD*= 9.1). Laparoscopic gastric bypass *IV.* BMI, medical variables, mental health history, anxiety, depression, attachment (anxious and avoidant) *DV.* WL and dietary adherence *DA.* Multiple linear regression, logistic regression	History of mental health, anxious attachment, anxiety and depression (pre-BS) predicted less dietary adherence at 6 and 12 months.
Khorgami[22] USA	Retrospective 2,658 patients (77% female); age: 41.2 years (*SD*= 12.5). Gastric bypass *IV.* Demographics, BMI, comorbidities *DV.* AFV *DA.* Logistic regression	Sex (female), age (older), BMI (higher pre-BS) and ethnicity (Hispanic) were positive attendance predictors at 24 months; whereas hypertension and apnea were negative.
Marek[26] USA	Retrospective 498 patients (73% female); age: 46.4 years (*SD*= 11.6). Gastric bypass *IV.* Demographics, body weight, behavioral and emotional dysfunction *DV.* WL and AFV *DA.* Multiple linear regression (path-analysis)	Age (older), pre-BS weight and hypomanic activation predicted lower WL at 12 months; while antisocial behaviors predicted lower AFV.
Bergh[21] Norway	Prospective 230 patients (78% female); age: not specified. Gastric bypass *IV.* Demographics, pre-BS WL, diet and WL history, WL goal, expectations of change after surgery, snacking frequency, nighttime eating, alcohol consumption, self-efficacy, self-esteem, body satisfaction, emotional regulation, anxiety, depression, resilience, and social satisfaction *DV.* WL, diet adherence, PA *DA.* Multiple linear regression	At 24 months, Pre-BS predictors of dietary adherence were: diet history (years) and willingness to limit food intake, as well as lower tendency to nighttime eating. Pre-BS predictors of increased PA were: PA and planning to perform PA. Pre-BS predictors of WL were: younger age, as well as greater WL and frequency of snacking.
Larjani[20] Canada	Prospective 388 patients (81% female); age: 44.9 years (*SD*= 11.1). Laparoscopic gastric bypass (92%) and gastric sleeve *IV.* Demographics, distance to consultation, comorbidities *DV.* AFV *DA.* Multivariate logistic regression	Employment (part-time or full-time) as opposed to being unemployed or retired was a predictor of AFV at 24 months.
Dantas[17] Brazil	Retrospective 13,320 patients (72% female); age: 40.0 years (*SD*= not specified). Laparoscopic gastric bypass and gastric sleeve *IV.* Demographic, medical, medical practice characteristics (e.g., health professional, distance) *DV.* AFV *DA.* Multiple linear regression	History of absenteeism, non-bariatric appointment, distance 20-50 km from the clinic, waiting time greater than 1 week, and appointment time in the afternoon were predictors of nonattendance at 17 months.

Notes. AFV= Attendance at follow-up visits, BMI= Body mass index, BS= Bariatric surgery, DA= Data analysis, DV= Dependent variables, IV= Independent variables, PA= Physical activity, WL= Weight loss.

and remaining item to the description of statistical analyses (*Actual probability values been reported*).

Outcomes of studies

The ADT predictors were classified into five groups: sociodemographic, medical, nutritional, PA-related, and psychological (see Table 1).

The sociodemographic aspects were examined in eight of the studies, but only four substantiated their relevance. Thus, it was found that being female, older, Hispanic[20], and employed[21] predicted higher attendance at post-BS follow-up appointments. While, waiting time, hour of the day, previous history of absenteeism, type of appointment (with a particular specialist), distance between home and clinic, and month of the year (other than summer) predicted non-attendance[17].

Medical aspects, with respect to comorbidities, were examined in two studies, but showed to be relevant in only one. It was reported that both apnea and hypertension predicted lower attendance at post-BS follow-up appointments[22].

Nutritional aspects were examined in a single study, including history of dieting (duration in years), willingness to decrease intake, and less nighttime feeding pre-BS, which predicted greater post-BS adherence to the prescribed diet[21].

PA was examined in only two studies, including doing pre-BS-PA, perceived benefits of exercise[19,21] and planning to be PA[21], which predicted greater adherence to PA-post-BS.

Among the psychological aspects, examined in six of studies, it has been found that attitude, subjective norms and perceived behavioral control towards exercise, all predicted self-reported exercise intentions at each of four operative stages (pre-BS to 13 days post-BS; 6 weeks to 3 months; 6-9 months; and ≥ 12 months). Perceived behavioral control also predicted self-reported exercise behavior at the same time periods[23]. History of mental health, anxious attachment, anxiety and depression (pre-BS) predicted less dietary adherence at 6 and 12 months[24]. Depression and loss of control predicted dropping out from the follow-up[18]. Other psychological variables that showed a negative prediction of attendance to follow-up visits were: avoidant relationship style[25] and antisocial behavior[26]. Conversely, readiness to change (pre-BS) did not predict the attendance[27].

DISCUSSION

The purpose of this study was to take stock of the knowledge obtained on what factors influence the behavioral indicators of adherence to post-BS treatment. The results of this search show an overview of these predictors, that led to four major conclusions.

First, published research on the topic is scarce and inconsistent, insofar as it represents isolated efforts. This is an alarming situation. On the one hand, because of the serious problem that extreme obesity represents for the world's health systems, to the solution of which BS has made a powerful contribution; but, on the other hand, it has also been widely argued that, in the medium and long term, the effectiveness of BS depends on post-BS ADT[4,11,28-29], and it is therefore urgent to reinforce efforts aimed at understanding the factors that influence ADT.

Second, according to the analysis performed, 82% of the studies showed adequate quality, although they could be improved mainly in terms of external validity, internal validity, and characterization of the participants. These aspects should be considered not only in the design of future studies, but also in the preparation of the research reports to be published.

Third, the most studied indicator of ADT has been attendance at post-BS consultations and, to a much lesser extent, adherence to diet or exercise. Although several of the studies also considered WL as a dependent variable, only one included more than one behavioral indicator of ADT[21]. This is apparently in keeping with the still widespread tendency to consider WL as the primary indicator not only of surgical success, but also of post-BS ADT[30-31]. Nevertheless, it is recommended to use more than one measure of ADT to increase the knowledge clinicians and researchers can have upon the subject, to better understand this complex phenomenon and ultimately to improve the adherence itself[32].

And fourth, sociodemographic and psychological aspects have been the most studied. However, given the lack of consistency in this line of research, it is far from being possible to identify concordant evidence among the studies reviewed. Therefore, it is urgent to direct efforts towards the systematization of research on this topic, since its findings will have important clinical implications, as they constitute the basis for the design of evidence-based interventions that help improve ADT in these patients. This is a basic need in the context of the current guidelines for the surgical treatment[29-30], which highlight not only the need for a pre-surgical nutritional and psychological evaluation to define whether or not a patient is a suitable candidate for BS, but also emphasize the importance of all patients receiving a pre-BS educational program, as well as a multidisciplinary post-BS follow-up program, including both nutritional and behavioral counseling.

Finally, it should be noted that this review is not free of limitations. First, the sample was limited to studies that included, on the one hand, at least two moments of measurement (pre-post BS) and, on the other hand, statistical analyses that defined directionality in the relationship between variables, so that others with a correlational scope were excluded. These decisions were in line with the purpose of this study, but undoubtedly had an impact on the small number of articles re-

tained. Another limitation was the inclusion of only studies published in English, leaving out the possibility of research published in other languages; therefore, it would be appropriate to broaden the search and use different databases.

CONCLUSIONS

To influence the therapeutic success of BS in the medium and long term, it is urgent not only to deepen our knowledge of those behavioral factors capable of predicting the ADT of these patients, but also to systematize the research aimed at this. It is from this evidence that health professionals will be able to propose multidisciplinary intervention programs aimed at promoting the maintenance of weight loss resulting from the surgical treatment of obesity.

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