ELSEVIER

Surgery for Obesity and Related Diseases 18 (2022) 957–963

SURGERY FOR OBESITY AND RELATED DISEASES

Review article

# Current state of the definition and terminology related to weight recurrence after metabolic surgery: review by the POWER Task Force of the American Society for Metabolic and Bariatric Surgery

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Received 2 April 2022; accepted 17 April 2022

**Abstract** Bariatric surgery continues to be the most reliable treatment for the disease of obesity. Despite excellent results, some patients experience weight recurrence with or without concomitant recurrence of comorbidities. There is currently no standard definition for clinically significant weight recurrence after bariatric surgery so that patients and clinicians have a platform from which to plan treatment. The Post-Operative Weight Recurrence (POWER) Task Force was formed by the American Society for Metabolic and Bariatric Surgery to address this aspect of the disease of obesity. This article reviews the literature of existing definitions for weight recurrence and their limitations. Furthermore, the term *weight recurrence* is introduced to replace weight regain or recidivism, and the term *nonresponder* is introduced to replace inadequate weight loss after surgery. (Surg Obes Relat Dis 2022;18:957–963.) © 2022 American Society for Bariatric Surgery. Published by Elsevier Inc. All rights reserved.

*Keywords:* Bariatric surgery; Insufficient weight loss; Weight recidivism; Weight recurrence; Weight regain

Obesity is a decades-long and continuing pandemic. From 2000 to 2018, the prevalence of obesity in the United States increased from 30.5% to 42.4% [1]. Worldwide, obesity trends are following a similar pattern [2–4]. When a population transitions from food scarcity to abundance, obesity rates rise because of poor health policies and education [5]. Obesity rates are rising not only between generations but also among generations, indicating a faster rise in obesity rates [6].

Wang et al. [7] used the National Health and Education Examination Survey data set to project the prevalence of obesity and its costs. They estimated that 86% of Americans

This is an article from the American Society for Metabolic and Bariatric Surgery Post-Operative Weight Recurrence (POWER) Task Force.

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https://doi.org/10.1016/j.soard.2022.04.012

will be overweight or obese by 2030. The National Center for Health Statistics, in 2015, estimated that 72% of Americans were overweight or obese [8], making the prediction of Wang et al. likely to be accurate. Wang et al. further predicted that one fourth of Americans will be severely obese by 2030.

Bariatric surgery remains the most effective way to lose weight and maintain weight loss for patients with the disease of obesity [9]. Surgical weight loss is also the most effective method of improving weight-related co-morbid conditions. Weight recurrence (WR) after bariatric surgery can lead to the return of weight-related co-morbidities [9]. Those involved in treating patients with obesity are aware of the chronic nature of the disease and have seen it recur despite valiant efforts on the part of patients and healthcare providers. Despite this, neither a common definition for WR nor a common set of treatment guidelines for WR has been agreed on. In order to get to the goal of an effective treatment, an accurate definition of WR is needed.

WR can occur after primary bariatric operations with an estimated incidence of 9%–91% depending on the definition [10]. Because there has been no standardized definition of WR, and therefore, the true incidence is not known, the ability to correlate its impact with clinical outcomes such as resolution or recurrence of co-morbidities, quality of life, and patient satisfaction is limited. Likewise, research into WR and treatment algorithms are haphazard because of the lack of a standard definition.

The International Bariatric Club surveyed its members on various definitions, including "regaining to a weight to surpass a BMI [body mass index] of 35 [kg/m$^2$]," "any weight increase," "an increase of >10 kg from nadir," and others. The authors found no consistency among the club's expert members [11]. They concluded that there is a dire need for a standardized definition.

A literature review revealed no standard definition of WR after bariatric surgery [12]. Definitions varied based on the timing of the WR, mathematical parameters used for weight loss and recurrence, and amount of WR [13]. The lack of consensus on the definition of WR has been a fundamental issue in developing research protocols for this problem as well as treatment plans. The Post-Operative Weight Recurrence (POWER) Task Force was formed at the direction of the Executive Council of the American Society for Metabolic and Bariatric Surgery (ASMBS) to help address this problem.

## Methods

A PubMed literature search, in peer-reviewed journals, was conducted using the following keywords: "weight regain and bariatric," "insufficient weight loss and bariatric," and "weight recidivism and bariatric." Three hundred and eighty-five articles were identified. Articles were selected for further review that addressed WR in primary bariatric surgery patients, especially ones that included a definition of WR or insufficient weight loss (IWL). Sixty-four articles were selected to guide the discussion of an appropriate definition of WR. Although IWL articles were reviewed, the focus was on WR.

## Results

Review of the literature revealed a variety of definitions [14] and methods for assessing WR, usually focusing on patient or technical factors as the cause. Lauti et al. [14] found that weight recurrence varied between 5.7% at 2 years and 75.6% at 6 years depending on the definition employed. Furthermore, they found that the studies reporting WR or IWL were usually small and uncontrolled.

Some examples of definitions of WR are as follows [13,15–22]: (1) increase of 10 kg from nadir weight; (2) increase of 25% excess weight loss (EWL) from nadir weight; (3) increase in body mass index (BMI) of >5 kg/m$^2$ from nadir weight; (4) WR to a BMI of 35 kg/m$^2$; (5) any amount of WR after remission of type 2 diabetes; (6) any amount of WR; (7) weight from nadir to 5 years postoperatively expressed as a change in BMI or percent total weight loss (%TWL) or change in percent excess BMI lost or %EWL; (8) patients who regained >10% of their lowest postoperative weight 2 years after a Roux-en-Y gastric bypass (RYGB); (9) at 2 years after an RYGB, WR defined as ≥15% of 1-year postoperative weight; and (10) at 2 years after a sleeve gastrectomy (SG), WR of 5 kg from nadir weight.

Authors tend to report WR in either absolute or relative terms. Those who report in absolute terms use various units to describe the recurrence, such as kilograms or BMI. Those who report in relative terms define WR as it relates to postoperative nadir weight, or the relationship between the maximum weight lost before WR is measured. Table 1 provides a complete list of definitions.

Some examples of definitions of IWL (Table 2) are as follows: (1) 1 year after SG and RYGB, weight loss ≤50% EWL, and (2) <20% TWL over time.

## Discussion

Multiple authors have written definitions of WR after bariatric surgery, but no one definition has been accepted to be the standard. This has created confusion in understanding WR and has created a barrier to effective treatment. In the same way that *SOARD* has arrived at TWL as the accepted definition and research endpoint for describing response to therapy (in line with the nonoperative weight loss literature), a standard definition for WR is needed to streamline the discussion [23].

Many studies that focus on revisional strategies group patients with IWL and WR together. Although it is true that both these groups require a treatment strategy to achieve

Table 1
Summary of the published weight recurrence and associated definitions

| Definitions published | Term being defined with references |
|---|---|
| >10 kg from nadir weight | WR [13,14] |
| >25% EWL from nadir weight | WR [14] |
| >5 BMI points from nadir weight | WR [23] |
| WR to a BMI of 35 kg/m$^2$ | WR [14] |
| Any WR after remission of type 2 diabetes | WR [14] |
| Any WR | WR [14] |
| WR 5 yr postoperatively from the nadir weight, expressed as change in BMI or %TWL or change in excess BMI lost or % EWL | WR [14] |
| Two yr s/p RYGB, patients who regained >10% of their lowest postoperative weight | WR [16] |
| Two yr s/p SG, WR of 5 kg from nadir weight | WR [13] |
| EWL <50% after reaching EWL >50% | WR [11] |
| Lack of maintenance of TWL >20% | WR [26] |
| Percentage of weight regained over nadir weight in 30 days from nadir (mild = .5%; moderate = .5–1%; severe ≥1%) | WR [22] |
| Progressive weight regain that occurs after achievement of an initial successful weight loss defined as EWL >50% | WR [11] |
| BMI >35 kg/m$^2$ | WR [14,23] |
| BMI >30 + EWL <50% | WR [29] |
| BMI >35 + EWL <50% | WR [30] |
| Increase of >15% total weight from nadir | WR [31] |
| 36-mo WR: (36-mo weight − nadir weight)/nadir weight × 100%<br>48-mo WR: (48-mo weight − nadir weight)/nadir weight × 100% | WR [20] |
| Current weight − lowest weight in postoperative time as a percent − age relative to the lowest weight<br>Significant WR = %WR ≥15% | WR [32] |
| WR was evaluated relative to the amount of weight loss relative to nadir | WR [17] |
| WR/weight loss and WR/nadir at each subsequent weight measurement relative to the elapsed time since nadir | WR [17] |
| Primary nonresponse (1NR): inability to achieve adequate weight loss after surgery<br>Secondary nonresponse (2NR): excessive WR after initial adequate weight loss after surgery | Primary nonresponder [33]<br>Secondary nonresponder [33] |
| Progressive weight regain that occurs after achievement of an initial successful weight loss defined as EWL >50% | WR [11] |
| WR calculated from the minimum recorded weight<br>Percent WR = (5-yr recorded weight − minimum recorded weight × 100)/(preoperative weight − minimum recorded weight) | WR [11,14,35] |
| >10% of the lowest postoperative weight | WR [16] |
| >15% of maximal EWL | WR [34] |
| >20% of weight loss after achieving goal weight loss<br>Goal weight loss defined as 15% TWL after SG, 25% TWL after RYGB<br>Adequate weight loss (AWL) = achieved goal weight loss without the WR<br>Nonresponders never achieve goal weight loss | WR [7] |
| 2 yr s/p RYGB with successful weight loss defined as ≥50% EWL in 1–2 yr postoperatively<br>WR defined >15% of the 1-yr postoperative weight | WR [15] |
| S/p RYGB, all patients must have achieved nadir weight in the following time periods: 1–2 yr, 2–3 yr, 3–4 yr, 4–5 yr, 5–6 yr, and >6 yr postoperatively. WR is evaluated relative to weight loss | WR [17] |
| >10 kg weight gain from lowest postoperative weight | WR [13] |

SG = sleeve gastrectomy; RYGB = Roux-en-Y gastric bypass; EWL = excess weight loss; TWL = total weight loss; IWL = insufficient weight loss; WR = weight regain/recurrence; s/p = status post; NR = nonresponders; AWL = adequate weight loss.

Table 2
Summary of the published insufficient weight loss and associated definitions

| Definitions published | Term being defined with reference |
|---|---|
| EWL <50% 18 mo postoperatively | IWL [11] |
| EWL <50% from preoperative weight | IWL [36] |
| <20% TWL over time | IWL [37] |

EWL = excess weight loss; TWL = total weight loss; IWL= insufficient weight loss.

successful weight loss, it is becoming apparent that these outcomes likely should be attributed to different factors; that is, WR and IWL are different problems, and the patients should be treated differently. Patients with IWL may have earlier negative impacts or may have predetermined biologic or genetic resistances to the salutary effects of bariatric surgery. In contrast, patients who experience WR appear to respond well to the initial metabolic effects of surgery but may have issues related to long-term maintenance of weight control, and those issues may be behavioral or metabolic/genetic. In addition, while both IWL and WR are affected by psychosocial factors, those factors can differ greatly in each group and in patients within groups [24].

In the literature, it is often the case that IWL is used interchangeably with WR. As an initial step in clarifying the definitions, this practice should be discarded. The second step would be to have accurate definitions of both terms. Using oncology terminology is helpful for the description of postoperative weight gain. WR would replace weight regain because it accurately describes the phenomenon as a disease-related process, like cancer recurrence, instead of as a patient-related process, which weight regain implies. IWL may be comparable to the cancer treatment paradigm of nonresponder. It would, in fact, be useful to adopt similar terminology because it has a known distinction in cancer literature when compared with patients who have recurrent cancer. For obesity treatment, the term *surgical nonresponse* would be appropriate as a replacement for IWL. Patients with surgical nonresponse often have more aggressive disease and, by definition, are recalcitrant to initial efforts. We will separate the definitions of WR and IWL in order to accentuate the distinction even though some definitions of WR sprung from a definition of IWL, as in the following example.

The Reinhold classification has been used to determine unsuccessful weight loss. This defines IWL as %EWL $\leq$50% and/or BMI $\geq$35 kg/m$^2$. A definition for WR has often been extrapolated from these criteria to mean % EWL $\leq$50% after achieving %EWL >50% and/or BMI >35 kb/m$^2$ after achieving a BMI <35 kg/m$^2$ [25].

Categorizing WR and IWL definitions into discrete categories allows us to evaluate the merits and shortcomings of each attempted definition. The main categories found in our literature review included (1) EWL percentage or absolute; (2) TWL; (3) BMI; (4) absolute change in weight (in kilograms or pounds); (5) percentage of WR from nadir weight; (6) percentage of WR from total weight loss since surgery; and (7) miscellaneous definitions that were identified as not commonly used beyond that reference.

Using a definition based on %EWL has the benefit of being generalizable to a broad range of the literature because many authors have used this metric to report their outcomes. In addition, many surgeons use projections based on %EWL to provide their patients with expectations of successful surgery. However, %EWL has been set aside recently in place of %TWL because of the latter's better-proven correlation with clinical outcomes [20]. Moreover, there is significant variability among patients in how much %EWL is needed to achieve improvement of co-morbidities. This makes it difficult to define how much %EWL or recurrence is of clinical significance.

Grover et al. [26] proposed that 20% TWL be used to define a successful operation. These authors advocate for this because TWL is used to describe weight loss in the medical literature and would be consistent across all treatment modalities. This group also found that more than 97% of surgical patients reached this benchmark at some point postoperatively and that 70% of patients were still at >20% TWL at 10 years.

Using change in BMI as a metric is problematic because this is seldom used in the current literature and therefore not generalizable. Although BMI change does correlate well with clinical outcomes and risk of co-morbidity development, it is unclear what change in BMI is required to achieve these clinical goals. By extension, increase in BMI or being above a certain BMI has not been clearly correlated with recurrence of co-morbidities.

Some studies have used *any* WR as a definition that would prompt intervention. This is obviously problematic for many reasons. It is too broad and will include even patients who maintain good resolution of their co-morbidities. Voorwinde et al. [19] showed that adding this definition can change the incidence of WR from 16% to 87%. It also would mix those with minimal recurrence with those suffering from a severe amount of recurrence, which makes it difficult to stratify treatment strategies, although one might envision a WR staging system to deal with degrees of WR. It is also common to have some small amount of weight fluctuation even in patients considered to have successful initial weight loss and long-term success with weight maintenance. Finally, the patient may not

believe that some amount of weight gain after surgery is a problem needing treatment.

Using a weight-based definition of WR is very limiting. First, this requires choosing a cut-off weight gain, for example, 10 kg increase from nadir. Because there is no agreed-on amount of weight that is clinically significant, any value would be equally irrelevant. In addition, using percentage weight loss or gain is more relevant because it allows comparison of those with low initial BMIs with those with higher starting weights.

Definitions based on %TWL are more up to date with reporting of outcomes following bariatric surgery. Because the purpose of reporting and evaluating WR is to determine its clinical impact, using a well-agreed-on metric is beneficial. Again, however, it is still debatable what degree % TWL is required to be considered successful surgical weight loss and therefore what percentage of weight gain should be considered significant WR. In recent studies, emphasis has been placed on using a WR definition relative to either nadir weight or to weight loss from preoperative weight.

Definition of percentage weight regain as compared with nadir weight is calculated as

Weight regain = (current weight – nadir weight)/(nadir weight × 100)

A WR definition relative to nadir weight at a point in time correlates with an individual's relative state of positive energy balance that underlies the process of weight regain [26,27].

In most studies, there is no clear definition of nadir weight. Some studies consider nadir weight to be the lowest weight achieved at 12, 15, or 18 months. Others consider nadir weight to be the lowest weight achieved without a designated time period. Because weight loss after bariatric surgery can come in waves with plateaus, periods of rapid weight loss, and sometimes even mild steady gain, it is difficult to use the metric of nadir weight without confining it to a specific amount of time postoperatively.

WR relative to weight loss is a relatively new definition in the literature. Postoperative weight loss is defined as preoperative weight minus the postoperative nadir weight. WR is then defined as

(Current weight − nadir weight)/(preoperative weight − nadir weight × 100)

WR relative to weight loss provides a measurement of long-term weight loss success after surgery [17].

King et al. [28] suggested the definition of WR to be a percentage of maximum weight loss. King's group evaluated Longitudinal Assessment of Bariatric Surgery-2 data to assess some of the preceding definitions with respect to clinically relevant measures of co-morbidities that are active because of underlying obesity. These included diabetes (measured via hemoglobin A1C), low-density lipoprotein levels, blood pressure, and changes in patient perceived quality of life. More than 1400 patients met criteria for accurate nadir weight determination in that study. Their proposed definition is calculated as follows:

Percentage of maximum weight loss = weight recurrence/(maximum weight loss × 100)

*Maximum weight loss = preoperative weight − nadir weight*

Preoperative weight data is defined as being measured weight within 30 days before surgery.

Nadir weight was the lowest weight after surgery, not defined by time. Simply, it was the lowest weight the patient had at any time in the postoperative period. This measure could only be defined retrospectively because at the time of the measurement it would not be known if that weight is the ultimate nadir weight. King's group also advocated that the weight should be measured in a clinical setting and not self-reported by patients to improve standardization.

In addition to the above-noted specifics, collectively, these definition groups all fall short for different reasons. Most suffer from a lack of any attempt at validation. Even articles that compare their findings with those of other studies often suffer from a selection bias because of making the comparison only with publications that share a similar definition. This limits the clinical impact. Many of the studies also did not set a cut-off time for determination of nadir weight or, if they did, had a cut-off time that was too short to properly capture the patient's true nadir.

However, more recent studies have started to use certain definitions more frequently. These include weight regain relative to nadir weight or weight regain relative to weight loss [23,26]. This may be more reproducible and therefore more useful. As more articles continue to use the same definition, accurate outcomes will be measured, and standardization will be achieved. Further studies will be needed to see how these definitions relate to operations performed, outcomes, and resolution of co-morbidities.

*Conclusion and call to action*

Obesity is a chronic disease process. Surgery is the most effective treatment. Fluctuations in postoperative weight and WR are complex phenomena that reflect the chronic nature of the disease of obesity.

The POWER Task Force has identified 2 components of the WR literature that warrant attention. These are the vocabulary associated with postoperative weight changes and the definition of WR itself. The task force has 2 recommendations: First, adopt oncologic terminology for describing treatment and response of obesity both in clinical practice and also in the literature. Some of the changes could be incorporated at the level of the *SOARD* recommendations for authors, which currently recommend only that the word *obesity* not be used as an adjective. Specifically, we suggest the following: (1) use of the term *weight recurrence*

or *excess weight recurrence* instead of weight regain or recidivism or similar terms and (2) use of the term *nonresponse* instead of weight loss failure or inadequate weight loss or similar terms. Second, a concerted and directed effort to arrive at a research-derived definition of clinically significant weight recurrence after metabolic surgery should be made. Because of the wide variation in published definitions, direction of the effort to design research toward a definition might be accomplished through a consensus process.

Promoting a standard definition for WR will advance not just a more uniform and standard reporting by the scientific community but also enhance the timeline and standardization for possible interventions. Use of oncologic terminology including the term *recurrence* instead of *regain* and *nonresponse* instead of insufficient is a disease-centric and more standard nomenclature.

Ultimately, the goal is to find a definition of WR that can be used uniformly in all publications regarding weight loss outcomes after all the different obesity treatments. This definition also should correlate with patients' co-morbidities because that is an important aim of bariatric surgery. Knowing the point at which WR leads to recurrence of co-morbidities and what co-morbidities are more likely to return would help in establishing care pathways for postoperative bariatric surgery patients.

## Disclosures

*The authors have no commercial associations that might be a conflict of interest in relation to this article.*

## Acknowledgments

The authors acknowledge Wendy King and Marina Kurian.

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