# The Impact of the Preoperative Red Blood Cell Distribution Width Value on Weight Loss Estimation After Sleeve Gastrectomy

**Kamil Erozkan**
Ege University Hospital, Ege University School of Medicine
**Ozgur Firat**
Ege University Hospital, Ege University School of Medicine
**Batuhan Demir**
Ege University Hospital, Ege University School of Medicine
**Safa Vatansever**
Ege University Hospital, Ege University School of Medicine
**Taylan Ozgur Sezer** ( taylansezer@yahoo.com.tr )
Ege University Hospital, Ege University School of Medicine
**Sinan Ersin**
Ege University Hospital, Ege University School of Medicine

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# Abstract

### Purpose

Morbid obesity is a common health problem. One of the most effective methods for losing weight is surgery. There are many studies to predict weight loss after surgery and these studies generally preferred inflammatory parameters, especially C-reactive protein. We aimed to evaluate whether RDW has a predictive impact on weight loss after obesity surgery.

### Methods

This was a single-institution retrospective study. The lowest weight and BMI were determined and %EBMIL and %EWL were calculated. Multiple linear regression analysis was used to determine the variables affecting the %EBMIL and %EWL values. In univariate analysis between dependent and independent variables and descriptive and clinical characteristics, variables with a p-value of <0.25 were considered as confounding factors. Surgery of patients with %EMBIL ³ 50% and %EWL ³ 25% was considered

### Results

Hundred and ten patients were included in the study. The %EBMIL values of patients with RDW>14.5% were 10.51 units lower than patients with RDW≤14.5%. The %EWL values are 5.17 units lower. In the evaluation of successful surgeries, the probability of failure for those with RDW>14.5% is 10.93 times higher for %EBMIL and 21.55 times for %EWL.

### Conclusion

Preoperative RDW value can be used as a predictor of weight loss and surgical success after sleeve gastrectomy. It can provide an idea about whether the patient will lose enough weight and the success of the surgery. This study will shed light on larger studies that will examine the effect of inflammatory parameters on weight loss after bariatric surgery.


# Introduction

Morbid obesity is a common health problem all over the world [(1)]. Many treatment methods for morbid obesity have been applied from past to present and it is a challenge to predict which treatment method will be successful. Bariatric surgery is a major surgery. sometimes can cause serious complications even though providing weight loss [(2)]. Although not as much as the future mortality and morbidity of obesity, bariatric surgery can sometimes cause mortality and morbidity [(2,3)]. In addition, a clear predictive value showing how much benefit the operation will provide has not yet been revealed.

There are many studies to predict weight loss, and these studies generally preferred inflammatory parameters [(4,5)]. Another inflammatory parameter is erythrocyte distribution width (Red Cell Distribution

Width - RDW). RDW is considered as an indicator of both chronic inflammation and oxidative stress [6,7]. Many studies have been reported that RDW is a prognostic parameter in many diseases. In our study, we aimed to evaluate whether RDW has a predictive impact on weight loss after obesity surgery.

# Material And Methods

This was a single-institution retrospective study. Ethics committee approval was obtained. Patients evaluated by the Bariatric Surgery Council between June 2011 and June 2019, eligible for surgery and underwent sleeve gastrectomy due to morbid obesity, were included in the study. Data were obtained by scanning electronic patient files. Patients who were referred to medical treatment, who underwent a bariatric surgical procedure other than sleeve gastrectomy, and who underwent revision surgery were excluded from the study.

Baseline variables to be evaluated statistically; age, gender, comorbidity status, preoperative body mass index (BMI) and follow-up were determined. The independent variables were determined as preoperative CRP value, preoperative RDW value, and other hemogram parameters that we think may affect weight loss such as neutrophil/lymphocyte ratio (NLR) and lymphocyte/monocyte ratios (LMR). Dependent variables were determined as % excess BMI loss (%EBMIL) and %excess weight loss (%EWL). At least two-year follow-ups were taken into account. It was recorded whether the patients came to regular follow-up. In these two years, the lowest weight and BMI were determined and %EBMIL and %EWL were calculated with these values.

Data were evaluated in the statistical package program of IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA). Multiple linear regression analysis was used to determine the variables affecting the %EBMIL and %EWL values. In univariate analysis between dependent and independent variables and descriptive and clinical characteristics, variables with a $p$-value of <0.25 were considered as confounding factors. Binary Logistic Regression Analysis was used to determine the variables that affect the "failure" status for %EBMIL and %EWL. A value of $p<0.05$ was considered statistically significant.

# Results

Hundred and ten patients who met the criteria were included in the study. Demographic data, preoperative BMI values, and comorbidity status of the patients are given in Table 1. The rate of surgeries considered “successful” was 87.3% for %EBMIL and 85.5% for %EWL.

Baseline variables associated with %EBMIL were age, $BMI_0$ and regular follow-up ($p$=0.002, $p$<0.001, $p$=0.006, respectively). Baseline variables associated with %EWL were age, regular follow-up, and comorbidity ($p$=0.002, $p$=0.001, $p$=0.029, respectively). The %EWL values of patients with obesity-related comorbidity were lower than those without comorbidity. LMR, CRP and RDW values of female patients were higher than male patients ($p$=0.010, $p$=0.019, $p$=0.020, respectively). In the analyzes performed

between baseline variables and dependent and independent variables, it was thought that variables with $p<0.25$ might be a confounding factor, and these variables were included as confounding factors in the regression analyses.

No statistically significant relationship was found in the results of univariate analysis between dependent and independent variables. In comparisons between dependent and independent variables, variables with $p<0.25$ were included in the regression models.

The results of the multiple linear regression analysis performed by controlling the effects of the baseline variables are given in Table 2. RDW was found to be effective on %EBMIL and %EWL (Table 3). The %EBMIL values of patients with RDW>14.5% were 10.51 (95% confidence interval: 2.61-18.40) units lower than patients with RDW≤14.5%. The %EWL values are 5.17 (95% confidence interval: 1.55-8.79) units lower. In the evaluation of successful surgeries, the probability of failure for those with RDW>14.5% is 10.93 times higher for %EBMIL and 21.55 times for %EWL.

# Discussion

In obesity treatment, weight loss is limited with methods such as diet, exercise and medication, and long-term treatments increase the cost. In addition, regain of weight in the following period renders these treatment methods ineffective. There is no chance of permanent and effective treatment other than surgery [(8)].

Obesity surgery is major surgery. For this reason, the patient to be operated on should be chosen well. Surgical treatment of patients should be managed by a multidisciplinary team. Patients who will benefit from surgery should be well-identified. For this purpose, many studies have been carried out in recent years on the predictive factors of weight loss and comorbidities.

In our study, we evaluated whether RDW is a predictive value for weight loss and successful surgery. In the evaluation of weight loss, %EBMIL and %EWL values were considered. These values are the two most common parameters used to evaluate weight loss in bariatric surgery. While making the calculations, the reference BMI was taken as 25 $kg/m^2$. 25 $kg/m^2$ is the reference value accepted in studies on bariatric surgery in the past and is the cutoff value between healthy and overweight people in the World Health Organization (WHO) obesity classification [(9-11)].

In our study, comorbidities were evaluated in three groups as "none, obesity-related comorbidity, and other comorbidities". In univariate analysis, no significant correlation was found between %EBMIL and comorbidity, but a significant correlation was found between comorbidity and %EWL. We would expect comorbidity to be effective for both weight loss parameters.

Most of the patients had regular follow-ups. The rate of patients who came to regular follow-up was 89.1%. The rates of %EBMIL and %EWL of these patients were determined as 78% and 36%, respectively.

Due to these statistically significant rates, it has been observed that the rate of weight loss may be higher in patients with regular follow-up.

In the predictive factors evaluated in terms of weight loss, inflammatory parameters were generally emphasized. There are many studies conducted with NLR and LMR values, especially CRP [12,13]. In one study, statistical analysis of the effect of CRP on predicting weight loss was done with %EWL [14]. Even if the weight of the patients is the same, preoperative body mass indexes may be different. For this reason, we found it more appropriate to evaluate with %EBMIL and %EWL. With our statistical analysis, we found that CRP had no effect on predicting weight loss.

In the study of Bulur et al., it was shown that NLR decreased after sleeve gastrectomy [15]. This rate, which is considered an inflammatory parameter, did not show a statistically significant relationship when evaluated with weight-loss parameters in our study. Although it has been shown in another study that this rate decreases with weight loss, statistical analysis on weight loss estimation has not been performed [16]. In addition, the effect of LMR on weight loss was not statistically significant in our study.

Another inflammatory parameter that we think may have an effect on weight loss in bariatric surgery is RDW. RDW is a measure of the change in the size of erythrocytes, reflecting the degree of anisocytosis on the peripheral smear to the complete blood count. Numerous observational studies have linked mortality and morbidity to a high RDW for many diseases. These diseases are cardiovascular and cerebrovascular events, venous thromboembolism, malignancies, sepsis, chronic obstructive lung disease, chronic kidney disease and liver diseases. However, RDW can only be an indicator of other negative prognostic factors such as age, comorbidities, or physiological stress [17-19]. The relationship between a high RDW value and increased mortality and morbidity has not been fully revealed. Patho-physiologically, RDW is considered to reflect inflammatory status, oxidative stress and nutritional deficiencies [19]. It is often thought that inflammation and oxidative stress affect RDW by altering erythrocyte hemostasis. In addition, it was found that the risk of metabolic syndrome and related long-term mortality were higher in those with high RDW [20]. Another study stated that RDW height is not secondary to inflammation, but RDW increases as a result of a low-calorie diet applied during bariatric surgery [9].

Since RDW is a value that can be affected by anemia, anemia was evaluated both within the comorbidity groups and alone. There was no significant relationship between anemia and weight loss parameters. Independent of anemia, the RDW value could be used to predict weight loss rates and treatment success.

RDW values were grouped as ≤14.5% and >14.5%. While making this grouping, previous studies on diseases affected by inflammatory parameters were taken into consideration [21-24]. And also, the reference range for the RDW value of our hospital is 11.5-14.5. However, since we did not have a patient with an RDW value below 11.5, RDW was analyzed in two groups. Similar to the studies in the literature, surgery of patients with %EMBIL ³ 50% and %EWL ³ 25% was considered successful [25,26].

After the linear regression analysis, it was observed that the %EBMIL and %EWL were higher in the patients whose RDW values were 14.5 and below in the preoperative period. In these patients, it is an indication that more weight loss has occurred. Patients with an RDW greater than 14.5 have a higher possibility of surgical failure, both for the %EBMIL and %EWL. As a result of these analyzes, when the effect of all other parameters was zeroed, it was observed that the preoperative RDW value was alone effective on weight loss and surgical success, depending on whether it was below or above 14.5.

There are few studies in the literature that investigated the use of RDW in obesity surgery. Our results are similar to the study of Wise et al. [10]. However, successful and unsuccessful surgeries and other inflammatory parameters were also evaluated in our study. Also, our follow-up time is longer. In this way, the maximum value of %EBMIL was taken into account, not the values in the short follow-up period. In addition, not only %EBMIL but also %EWL were calculated for weight loss. Weight loss rates were not evaluated with a single parameter.

It should be kept in mind that RDW can be affected by inflammatory parameters, as well as many other parameters such as anemia and hemorrhage. Vaya et al. [9] reported that elevated RDW in patients with obesity does not reflect systemic inflammation because it is not associated with other inflammatory markers. Parameters affecting inflammation such as CRP, NLR, LMR, RDW values and anemia status were included in our study. However, inflammatory parameters are not limited to these. It should also be noted that RDW may also be affected by other factors. Achieving weight loss after surgery is difficult to predict based on a single biochemical value alone. It is also important for these patients to pay attention to their diet in the postoperative period, do sports and come to their follow-ups regularly. Although regular follow-up was evaluated in our study, we did not have objective data to evaluate other parameters. These conditions can be considered as a shortcoming of the study.

# Conclusion

In conclusion, preoperative RDW value can be used as a predictor of weight loss and surgical success after sleeve gastrectomy. It is a new preoperative biomarker that can provide clinically useful prognostic information. In this way, in the preoperative period, it can provide an idea about whether the patient will lose enough weight and the success of the surgery.

However, there is no significant relationship between CRP and NLR values and weight loss. Only RDW value can be used predictively. The mechanism between RDW and weight loss is unclear. However, this study will shed light on larger studies that will examine the effect of inflammatory parameters on weight loss after bariatric surgery.

# Declarations

### Conflict of Interest

All authors state no competing financial interests.

### Authors' Contributions

Study conception and design: Kamil Erozkan, Ozgur Firat

Acquisition of data: Kamil Erozkan, Batuhan Demir

Analysis and interpretation of data: Kamil Erozkan, Safa Vatansever

Drafting of manuscript: Kamil Erozkan, Ozgur Firat, Batuhan Demir, Safa Vatansever, Taylan Ozgur Sezer

Critical revision of manuscript: Kamil Erozkan, Ozgur Firat, Taylan Ozgur Sezer, Sinan Ersin

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# Tables

**Table 1:** Descriptive and Clinical Characteristics of the Patients

| Variables | Statistics |
|---|---|
| **Sex**, *n* (%) | |
| Male | 27 (24.5) |
| Female | 83 (75.5) |
| **Age**, (*year*) | |
| *mean*±*sd* | 39.8±11.3 |
| *M* (*min-max*) | 40.0 (17-68) |
| **$BMI_0$**, ($kg/m^2$) | |
| *mean*±*sd* | 47.24±5.12 |
| *M* (*min-max*) | 46.17 (35.62-59.16) |
| **Comorbidity**, *n* (%) | |
| None | 28 (25.5) |
| Obesity-related | 70 (63.6) |
| Others | 12 (10.9) |
| **Regular Follow-up**, *n* (%) | |
| No | 12 (10.9) |
| Yes | 98 (89.1) |
| **Anemia**, *n* (%) | |
| No | 105 (95.5) |
| Yes | 5 (4.5) |
| **CRP** | |
| *M* (*IQR*) | 0.92 (0.99) |
| **NLR** | |
| *M* (*IQR*) | 2.03 (1.14) |
| **LMR** | |
| *M* (*IQR*) | 4.36 (1.89) |
| **RDW** | |
| *M* (*IQR*) | 13.80 (1.73) |
| **RDW**, *n* (%) | |

| | |
|---|---|
| ≤14,5 | 76 (69.1) |
| >14,5 | 34 (30.9) |
| **%EBMIL** | |
| *mean*±*sd* | 76.5±21.8 |
| *M* (*min-max*) | 76.4 (34.4-135.8) |
| **Surgical Success with EMBIL**, *n* (%) | |
| Successful | 96 (87.3) |
| Failure | 14 (12.7) |
| **Total weight loss** | |
| *mean*±*sd* | 35.1±9.2 |
| *M* (*min-max*) | 34.8 (17.4-54.2) |
| **Surgical Success with TWL**, *n* (%) | |
| Successful | 94 (85.5) |
| Failure | 16 (14.5) |

*sd*: standard deviation, *M*: Median value, *IQR*: Interquartile range

**Table 2:** Correlations of %EBMIL and %TWL values with NLR, LMR and logCRP

| | **EBMIL** | **TWL** |
|---|---|---|
| | *mean*±*sd* | *mean*±*sd* |
| **NLR** | *rho*=-0.019; *p*=0.848 | *rho*=-0.026; *p*=0.787 |
| **LMR** | *rho*=-0.103; *p*=0.282 | *rho*=-0.058; *p*=0.545 |
| **logCRP** | *r*=-0.168; *p*=0.079 | *r*=-0.094; *p*=0.331 |
| **RDW** | | |
| ≤14.5 | 79.2±20.2 | 35.9±8.6 |
| >14.5 | 70.6±24.4 | 33.4±10.2 |
| Test statistics | *t*=1.938; *p*=0.055 | *t*=1.322; *p*=0.189 |

*r*: Pearson correlation coefficient, *rho*: Spearman correlation coefficient, *sd*: standard deviation, *t*: Indepent samples *t* test

**Table 3:** Multiple Linear Regression Analysis Results for variables affecting %EBMIL and %TWL values

| | Regression Coefficients* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *β* | *se* | *zβ* | *t* | *p* | 95.0% Confidence Interval for *β* | |
| | | | | | | *Lower Bound* | *Upper Bound* |
| **Model-1: EBMIL** | | | | | | | |
| Constant | 163.45 | 17.22 | | 9.490 | <0.001 | 129.28 | 197.63 |
| RDW | Reference | 3.98 | -0.223 | -2.640 | 0.010 | -18.40 | -2.61 |
| ≤14.5 | -10.51 | | | | | | |
| >14.5 | | | | | | | |
| Variables included in the model: RDW, logCRP | | | | | | | |
| Model Summary: $F$=7.604; $p$<0.001; $R^2$=0.434; *Adj* $R^2$=0.377 | | | | | | | |
| **Model-2:TWL** | | | | | | | |
| Constant | 34.70 | 7.90 | | 4.393 | <0.001 | 19.03 | 50.38 |
| RDW | Reference | 1.83 | -0.261 | -2.835 | 0.006 | -8.79 | -1.55 |
| ≤14.5 | -5.17 | | | | | | |
| >14.5 | | | | | | | |
| Variables included in the model: RDW | | | | | | | |
| Model Summary: $F$=4.810; $p$<0.001; $R^2$=0.327; *Adj* $R^2$=0.259 | | | | | | | |

*Adjusted for sex, age, $BMI_0$, comorbidity, regular follow-up, anemia