

# Predicting screening factors for an obesity team's decision: a large retrospective cohort study

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## Research Article

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# Abstract

**Background** The magnitude of the effect of bariatric surgery depends on the willingness and the ability of patients to adapt a healthier lifestyle. Therefore, it is worthwhile to know how to select patients for surgery and/or preoperative interventions.

**Aim** To investigate the predictors for a disapproval at the time, direct approval or a prehabilitation programme for bariatric surgery candidates after multidisciplinary evaluation.

**Methods** Data on the SQ-48 total score, the RAND-36 total score, the general screening questionnaire, age, Body Mass Index (BMI), and the result of the multidisciplinary consultation were collected from all patients who participated in the screening process between February 2017 and February 2020. A multinomial logistic regression analysis was performed.

**Results** Of the 2,063 included patients, 627 (30.4%) were approved for surgery, 1,275 (61.8%) received an preoperative trajectory advise and 161 (7.8%) were denied. Eleven variables appeared to be significant predictors for the result of the multidisciplinary consultation; gender, age, BMI, RAND-36 total score, SQ-48 total score, bingeing score, craving score, consciously eating, psychological help score, excessive drug use in the past and the impulsiveness score.

**Conclusion** Although the predicting model might not be applicable to other centres, it could attribute to enhance patient selection and thereby improve healthcare logistics.

## Introduction

Bariatric surgery is the only morbid obesity treatment with proven long-term results [1–3]. However, the magnitude of the effect of surgery depends on the willingness and the ability to adapt a healthier lifestyle. According to the interdisciplinary European guidelines on metabolic and bariatric surgery, patients eligible for bariatric surgery should follow an interdisciplinary assessment [1]. This assessment should be conducted by a team consisting of a surgeon, a dietitian, a psychologist and a nurse. It should be part of the preoperative evaluation, as a possible candidate for surgery must be psychological and physical ready to make the required lifestyle changes for sustainable weight loss. The challenge for the multidisciplinary obesity team is to select patients with morbid obesity who are most likely to adhere to the necessary adjustments. Although this evaluation is widely accepted and practiced, there is no standardized assessment procedure described in international guidelines [1–3].

In addition to an evaluation, some bariatric centres provide a preoperative prehabilitation programme concerning exercise, diet and/or psychological interventions. The positive effects of exercise and diet programmes have been described in the enhanced recovery after surgery guidelines, such as reduced postoperative complications and reduced liver volume. However, the evidence is insufficient to standardize prehabilitation before bariatric surgery in clinical practice guidelines [3]. Additionally, a recent 12-year follow-up study showed that patients who were denied for surgery by the obesity team never

sought weight loss surgery again although they eventually would qualify based on National Institutes of Health consensus criteria [4]. On the other hand extensive preoperative nutritional and psychological evaluation does not prevent the risk of weight regain [5, 6].

In order to enhance the screening process and thus patient selection for an additional programme, the aim of this retrospective cohort study was to investigate the predictors for disapproval at the time, approval or a prehabilitation programme for bariatric surgery candidates after multidisciplinary evaluation.

## Materials And Methods

In this retrospective cohort study, all patients with no prior bariatric treatment and who completed the preoperative screening process between February 2017 and February 2020 were extracted from the hospital database after informed consent. This screening starts with an educative session, after which patients receive login information for an eHealth platform on which e-learning, informational videos and three screening questionnaires were provided: the Symptom Questionnaire 48 (SQ-48), the RAND-36, and a general screening questionnaire (GSQ) (supplementary material S1) [7–9]. The 46-item GSQ is a non-validated general screening questionnaire regarding eating behaviour, quality of life and intoxications. The SQ-48 focuses on symptoms of psychopathology in seven subscales: anxiety, depression, somatization, social phobia, agoraphobia, aggression and cognitive problems. The other two subscales measures vitality and functioning at work. The total score of the SQ-48 was calculated adding all the subscales without the work subscale, wherein a higher score indicates more symptoms of psychopathology [7].

The RAND-36 measured the experienced health-related quality of life and comprises 9 domains scoring from 0 to 100 in which higher scores indicate a better quality of life [8]. A validated Dutch translation was used and performed according to the original protocol [10]. Lastly, because a higher RAND-36 total score indicates a better quality of life, it was negatively recoded and therefore matched with the direction of the SQ-48 total score.

After these questionnaires were completed, patients returned for consultations with a obesity nurse, psychologist, dietitian and a physiotherapist. Also, blood samples were taken to screen for vitamin deficiencies. Finally, the patients attended a group-session with a focus on commitment to the required lifestyle adjustments after surgery. Meanwhile, the results of the consultations were discussed by the obesity team according to the IFSO guidelines to determine if a patient was approved for surgery, denied, or required an additional prehabilitation programme by a dietitian and/or psychologist [1].

A direct approval could lead to scheduling for a bariatric procedure using shared decision making, in which patients receive standard information concerning preoperative eating habits and the use of multivitamins. If a preoperative conditioning programme was advised, a patient could refuse and would be referred back to the general practitioner. Or the patient accepted the 3–6 months programme before a

bariatric procedure was scheduled. If the result of the multidisciplinary team consultation was a disapproval at the time, patients were referred back to primary care for conservative treatment.

Patients who dropped out during the screenings process, had previously primary surgery, or had missing data on more than two entire questionnaires were excluded. The focus of this study was investigating the predicting factors of the obesity team's decision to provide guidance for a more efficient bariatric trajectory.

## Data analysis

Depending on normality, differences for continuous variables between multidisciplinary outcome groups were measured using the one-way analysis of variance or the Kruskal-Wallis test. Differences between gender for continuous variables were analysed using the independent t-test or the Mann-Whitney U test, also depending on normality. If normally distributed, continuous variables were presented as mean and standard deviation. Not normally distributed data were reported as median and interquartile range.

A multinomial logistic regression was conducted to analyse factors that were associated with the dependent variable, the multidisciplinary recommendation; accepted for surgery, a preoperative trajectory or denied for surgery. To reduce the number of variables that could be used to build the model, a reliability analysis was carried out for the GSQ. For the RAND-36 and SQ-48 the total scores were used. The continuous variables were converted to a 10-point scale to increase the readability of the model.

To determine significant independent variables from the GSQ, the chi-square test of independence and Cramér's V were used (cut-off point 0.10) in the univariate analysis. The subsequent multivariate multinomial logistic regression analysis was conducted using only significant and clinically relevant variables based on clinical experience (cut-off point  $p < 0.10$ ). Multicollinearity was assessed using the correlation matrix, and stepwise backward elimination to build the model.

Crude odds ratio of the variables were calculated, and adjusted odds ratio for the multivariate model. Statistical analyses were performed using SPSS software (version 26). Significance levels were set for  $p$  value  $< 0.05$ . Missing values were at random, no imputation method was used as percentage missing was  $< 5\%$ .

## Results

In total 2,304 patients were extracted from the hospital database, of which 241 were excluded due to missing data on more than two questionnaires ( $n = 188$ ) or applied for revisional surgery ( $n = 53$ ). The remaining 2,063 patients were used in the main analysis of which 627 (30.4%) patients were approved for surgery, 1,275 (61.8%) received a preoperative trajectory advise. The remaining 161 patients (7.8%) in the disapproved group were significantly heavier and younger, there was also a difference in gender between groups with the highest percentage female in the approved for surgery group ( $p < 0.001$ ) (Table 1).

Table 1  
Patient characteristics for multidisciplinary recommendation.

	Approved for surgery	Preoperative trajectory	Denied for surgery	P
Number of patients (%)	627 (30.4%)	1275 (61.8%)	161 (7.8%)	
Age, mean, years (SD)	44.4 (10.9)	42 (12.0)	41.3 (13.7)	.001*
Weight, median, kg (IQR)	117 (108–130)	120 (111–135)	120 (110.5–133)	.001
Body mass index, median, kg/m <sup>2</sup> (IQR)	40.9 (38.6–43.8)	41.4 (39.4–44.5)	42.3 (39.7–45)	.001
Percentage female, %	80.8	72.4	77	.001**
P value for Kruskal–Wallis test				
* One-way analysis of variance				
** Chi-square				

Following the reliability analysis, 10-point scales were made out of individual measured items such as the binge score, psychological help score, craving score and impulsiveness score. The final multinomial logistic regression model comprised 11 variables, representing a  $\chi^2$  of 331.641 ( $p < 0.001$ ) indicating the model fits the data significantly better than a model without predictors (Table 2).

Table 2  
Multinomial logistic regression for the multidisciplinary recommendation

95% CI for Odds Ratio					
	B (SE)	Lower	Odds ratio	Upper	P
Preoperative counselling vs approved for surgery					
Intercept	-3.017 (0.62)				.001
Age (years)	-0.018 (0.005)	0.974	0.983	0.992	.001
Gender (female/male)	0.745 (0.135)	1.617	2.106	2.743	.001
Body mass index (kg/m <sup>2</sup> )	0.045 (0.012)	1.022	1.046	1.070	.001
RAND36 total score (0–10)	0.122 (0.036)	1.052	1.130	1.213	.001
SQ-48 total score (0–10)	0.191 (0.052)	1.094	1.210	1.339	.038
Binging score (0–10)	0.055 (0.027)	1.003	1.057	1.113	.001
Psychological help score (0–10)	0.068 (0.019)	1.032	1.071	1.111	.001
Craving score (0–10)	0.102 (0.033)	1.038	1.107	1.181	.002
Consciously eating (yes/no)	0.284 (0.112)	1.065	1.328	1.655	.012
Excessive drug use (yes/no)	0.397 (0.461)	0.603	1.488	3.670	.388
Impulsiveness (0–10)	0.085 (0.026)	1.034	1.089	1.146	.001
Denied for surgery vs approved for surgery					
Intercept	-7.287 (1.075)				.001
Age (years)	– .023 (0.009)	0.961	0.977	0.994	.007
Gender (female/male)	0.799 (0.249)	1.366	2.224	3.620	.001

		95% CI for Odds Ratio			
Body mass index (kg/m <sup>2</sup> )	0.059 (0.020)	1.021	1.061	1.103	.003
RAND36 total score (0–10)	0.123 (0.073)	0.981	1.131	1.305	.090
SQ-48 total score (0–10)	0.525 (0.087)	1.426	1.691	2.004	.001
Binging score (0–10)	0.129 (0.049)	1.033	1.138	1.253	.009
Psychological help score (0–10)	0.175 (0.030)	1.123	1.191	1.263	.001
Craving score (0–10)	0.094 (0.061)	0.974	1.099	1.239	.126
Consciously eating (yes/no)	0.172 (0.207)	0.791	1.188	1.782	.406
Excessive drug use (yes/no)	1.188 (0.551)	1.113	3.279	9.661	.031
Impulsiveness (0–10)	0.117 (0.046)	1.028	1.124	1.230	.010

The crude odds obtained from the univariate analyses differed from the adjusted ratio from the model for all variables except for age and Body Mass Index (BMI). The adjusted ratio for each group are represented in Fig. 1.

### Preoperative trajectory versus direct approval for surgery

The adjusted odds ratio of the model with direct approval for surgery as reference category showed that the odds of receiving a preoperative trajectory is 2.1 times higher for males and 1.3 times higher if a patient did not eat consciously (Table 2). For every 5 unit increase in BMI the odds increases with 25%, and every 10 unit increase in age the odds are 15.8% lower to receive a preoperative trajectory instead of direct approval for surgery. Regarding eating behaviour, for every unit increase in the binging score the odds increase with 5.7% and for the craving score the odds increase with 10.7%.

For every unit increase in SQ-48 score, RAND-36 score and impulsiveness score the odds increases with 21%, 13% and 8.9% respectively. Patients who received psychological help or used psychotropic medications and therefore scored higher on the psychological help score elevated their odds with 7.1% Only the use of excessive drugs in the past did not significantly predict if patients were more likely to be administered a preoperative trajectory compared to direct approval. To predict the odds ratio for preoperative counselling compared to direct approval group Eq. 1 applies.

## Denied for surgery versus direct approval for surgery

The adjusted odds ratio of the model with direct approval for surgery as reference category shows that the odds of being denied for surgery is 2.2 times higher for male individuals and 3.3 times higher for patients who excessively used drugs in the past (Table 2). For every 5-unit increase in BMI the odds increases with 34%, and every 10 unit increase in age the odds are 20.8% lower to be denied for surgery compared to direct approval. For the bingeing score, every unit increase in bingeing the odds increase with 13.8%. For every unit increase in SQ-48 score, psychological help score and impulsiveness score the odds increases with 69%, 19.1% and 12.4% respectively. The variables RAND-36 total score, consciously eating and the craving score did not significantly predict if patients were rather denied for surgery compared to direct approval. To predict the odds ratio for denied for surgery compared to direct approval group Eq. 2 is applicable.

## Discussion

A multinomial logistic regression model was built using three screening questionnaires and basic characteristics from 2,063 patients to investigate the predicting factors for the obesity team's decision: approval for surgery, denial at the time or a preoperative prehabilitation programme. Eleven variables appeared to be significant predictors, i.e., gender, age, BMI, RAND-36 total score, SQ-48 total score, bingeing score, craving score, consciously eating, psychological help score, excessive drug use in the past and the impulsiveness score. All variables were positively correlated with a higher odds for receiving a prehabilitation advice or being denied for surgery compared to the direct approval group, except for age.

Men had a significantly higher chance for either a preoperative programme advice or refusal for surgery. This finding is consistent with that of Wee et al. who examined patients' consideration for surgery and showed that weight loss was more desired by women than men and therefore women might be more motivated [11]. Furthermore, compared to women, men were less likely to have accurate weight perception, weight dissatisfaction and attempted weight loss [12].

In our study, denied patients were significantly heavier and younger (Table 1). Despite being statistically significant, it is debatable if the absolute difference is clinically relevant. The predictive model also showed that younger and heavier participants had a higher chance of being denied for surgery or advised a preoperative programme. Age and preoperative BMI as predictive factors in bariatric surgery remains controversial. For instance, Ahmed et al. stated that younger bariatric patients had a lower risk of 6-months postoperative complications [13]. Other studies also showed that older age was associated with less successful weight loss one year after surgery [14, 15]. On the other hand, Altieri et al. reported that patients between 30 and 50 years of age and with higher preoperative weights may be more successful in losing weight in a 3 to 6-months during preoperative weight loss programme with behavioural modifications and nutrition counselling [16]. Also, higher preoperative weights appeared to be positively correlated to postoperative weight loss up to 60 months [17]. On the contrary, other authors found that



greater preoperative BMI was negatively associated with postoperative weight loss up to 135 months [6, 14].

Current drug abuse is a contra-indication for bariatric surgery, prior abuse is less obvious [1]. Tedesco et al. showed that patients with substance abuse achieve equivalent weight loss at 6 and 12 months postoperative compared to patients without alcohol or drug abuse [18]. A review of 2019 by Kanji et al. supported this belief, but it may contribute to increased substance abuse after bariatric surgery [19]. New-onset abuse is also evident after surgery, the follow-up in our centre favourably endures for 5 years [20, 21]. In our model, the odds of being denied for surgery was 3.3 times higher for patients who abused drugs in the past compared to patients who did not.

The variables concerning eating behaviour were scores on bingeing, craving, impulsiveness and whether patients ate consciously. Higher scores were all associated with lower chances of a direct approval. Although eating disorders are a contra-indication for surgery, it seemed as simple as a negative answer to the question 'do you eat conscious?' as it increased the odds with 30% for a preoperative programme [1].

Likewise was the influence of the predicting variables regarding psychological help and the SQ-48, higher scores per unit increased the odds for disapproval with 19.1% and 69% respectively compared to direct approval for surgery. Probably because the obesity team understands that the presence of psychopathology predicts less BMI reduction and estimated weight loss 5 years after surgery [22]. Surprisingly, the RAND-36 score did not significantly predict the odds of being denied for surgery. This finding was unexpected as health-related quality of life is one of the motivating factors for seeking bariatric surgery [23]. Its influence is most likely overruled by the other variables, as the univariate analysis showed an increase probability of 52% for every increase in the RAND-36 score. This suggests that the eleven variables should only be considered together within this model, not as independent factors.

It remains debatable how to imply this predicting model in clinical practice. Every patient should be screened when referred for a bariatric procedure, however a denial at the time could be a misjudgement and there is no consensus for the use of a preconditioning programme [1, 4, 24]. Nevertheless, many obesity centres administer an additional programme but it remains a challenge to what extend and by which professional the screening for bariatric surgery should consist of. In that case, this model could improve the screening process logistics. For example, patients could receive extended standard preoperative education, could be guided by more experienced healthcare professionals or receive more postoperative guidance.

Several limitations apply to the results. The odds were calculated based on the decision of our unique multidisciplinary team and therefore limiting generalizability. Furthermore, the GSQ has not been validated yet nor is the use of the SQ-48 questionnaire standard for the obesity centers in the Netherlands [25–27]. Nevertheless, the elements from these questionnaires and therefore comparable demands for bariatric surgery are likely to be universal. Another limitation was the content of the prehabilitation

programme as well as the possibility for conservative treatment after denial. Lastly, the model has not been validated yet prospectively or in other settings. This study design is planned by the authors.

## Conclusion

A multinomial logistic regression was built using three screening questionnaires and basic characteristics from 2,063 patients to investigate the predicting factors for the obesity team's decision. Although the exact model might not be applicable to other bariatric centres, the elements found are likely to be universal. This predictive model could attribute to enhance patient selection and thereby improve healthcare logistics.

## Declarations

### Author contributions

The manuscript was written by Y.L., A.S, and R.V, with input from S.N and J.Z. The statistical analysis was performed by Y.L. The manuscript was then reviewed and improved by the entire collaboration.

### Additional information

#### *Data availability*

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request

#### *Ethical approval*

No formal ethical approval was necessary in line with legislation on non-WMO research in the Netherlands, and as the accessed data was fully anonymised. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

#### *Competing interests*

The authors declare that they have no competing interest.

#### *Informed consent*

Informed consent was obtained from all individual participants included in the study.

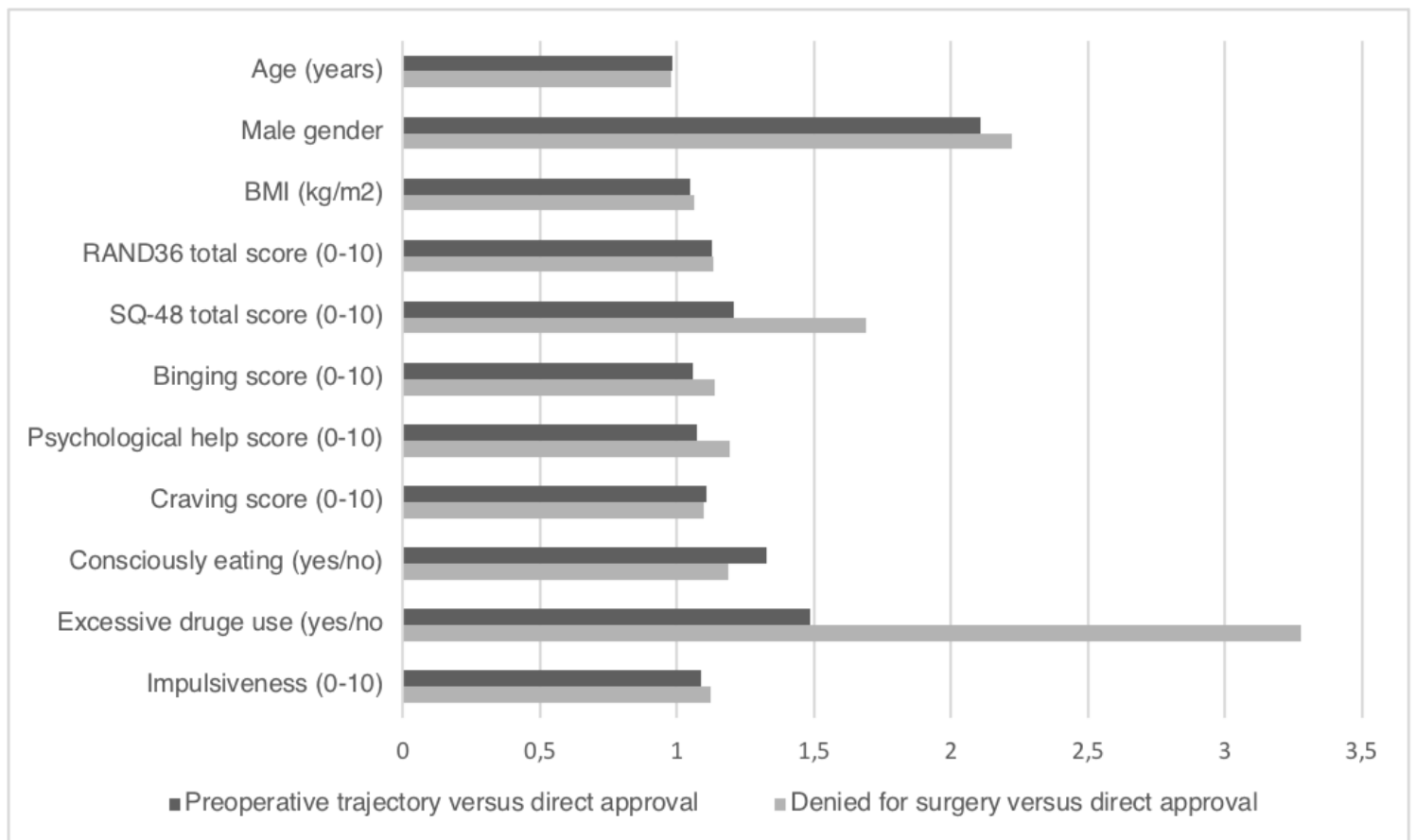
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## Figures



**Figure 1**

Adjusted odds ratio for the multidisciplinary recommendation

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryMaterial.pdf](#)