Carving out success: identifying factors associated with metabolic and bariatric surgery outcomes

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Food and health literacy

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Food and health literacy in patients awaiting metabolic-bariatric surgery

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Abstract

Introduction

Specialized lifestyle programs for patients undergoing metabolic-bariatric surgery (MBS) are provided to facilitate adjustment and adherence to a healthy lifestyle after surgery. However, pre-program food and health literacy in MBS patients are often unknown. In the general population, approximately three-quarters of people exhibit sufficient health literacy. This study aimed to examine food and health literacy of patients awaiting MBS and to identify patient specific factors associated with these literacies.

Methods

Patients awaiting MBS completed questionnaires on food literacy (Self-Perceived Food Literacy scale) and health literacy (European Health Literacy Survey Questionnaire-16) at the start of a preoperative lifestyle program. Linear and logistic regression analyses were used to identify associations between multiple variables and preoperative food and health literacy.

Results

Among 216 patients, the preoperative mean food literacy score was 3.49±0.44, on a five-point scale. Furthermore, 96.3% of patients showed sufficient health literacy, with scores of 13 or more out of 16. Patients with sufficient health literacy had higher food literacy scores (β 0.508; 95% CI: 0.208 – 0.809, p<.001).

Conclusion

This study among people living with obesity awaiting MBS suggests that food literacy is comparable, and health literacy is higher than in the general population. These findings emphasize the complexity of the aetiology of obesity, due to factors that extend beyond food and health literacy.

Introduction

According to international guidelines, lifestyle adjustment forms the cornerstone for the treatment of obesity [1, 2]. It is essential for the effectiveness of treatments, whether applying conservative methods involving cognitive and behavioral treatments, utilizing obesity management medication like GLP-1 agonists, or opting for metabolic-bariatric surgery (MBS) in cases of severe obesity. Therefore, most bariatric centres offer perioperative lifestyle programs that focus on behavioural change, nutritional knowledge, dietary skills, physical activity, and psychological support [3-5]. However, it remains uncertain whether patients undergoing MBS have adequate nutritional and health literacy skills, which are assumed conditional for behavior change in the context of obesity.

Previously, the assessment of these skills was challenging, but two emerging concepts—food literacy and health literacy—now enable measurement through validated questionnaires. Food literacy is defined as "*a collection of interrelated knowledge, skills and behaviours required to plan, manage, select, prepare and eat food to meet needs and determine food intake*" [6]. Health literacy, which has evolved over time, is now described as "*the degree to which individuals have the ability to find, understand, and use information and services to inform health-related decisions and actions for themselves and others*" according to the CHC's 2020 definition [7]. It is important to understand that food and health literacy include more than just knowledge. They also involve skills and behaviours, including the ability to apply this health information effectively. For example, food literacy involves knowing how to prepare a meal using more than five fresh ingredients, and health literacy includes assessing the reliability of media sources. These examples illustrate the practical application of both literacies in everyday actions.

Prior research in the general population suggests a link between better food and health literacy and healthier eating habits [8-10]. During the validation process of the Self-Perceived Food Literacy scale, (SPFL) used in this study, the SPFL showed a positive correlation with self-control and a negative correlation with impulsiveness. Participants who demonstrated higher food literacy reported consuming fruits, vegetables, and fish more frequently and in larger portions compared to those with lower food literacy levels [8]. Additionally, another study found that higher SPFL scores were associated with better overall diet quality [11]. Limited health literacy has been linked to several health-related outcomes, including poor general health, increased mortality, elevated health costs and reduced medication compliance

[12-14]. Furthermore, it was also found that limited health literacy is associated with unhealthy lifestyle behaviours [15]. Limited health literacy is more prevalent in specific demographic groups, such as those with a lower socioeconomic status and minority groups [12, 16]. Furthermore, low alphabetical and numerical literacy may also contribute to limited health literacy [17].

To our knowledge, food literacy has not previously been investigated in patients awaiting MBS. Health literacy in patients awaiting MBS has been studied a few times and was found to be adequate in most patients [18-21]. There were associations between patients' race/ethnicity and their health literacy [18], as well as an inverse relationship between higher preoperative BMI and health literacy scores [19].

Despite existing research on food and health literacy in diverse populations, a significant knowledge gap remains, particularly on food literacy within the specific group of patients awaiting MBS [22]. Therefore, this study aims to examine food and health literacy in patients awaiting MBS and to identify patient-specific factors associated with these literacies.

Methods

Patient and data selection

In this prospective cohort study, patients were invited to participate when they were eligible for MBS after screening according to the IFSO criteria and started a preoperative lifestyle program at the Nederlandse Obesitas Kliniek (NOK, Dutch Obesity Clinic) locations in Amsterdam, Beverwijk and Hoogeveen. The invitation was sent to patients within their first week of enrolment in the preoperative lifestyle program. Patients with a documented history of any type of MBS or those who failed to complete the preoperative questionnaires despite three reminders were excluded. The process of patient inclusion continued until the desired sample size (200 completed questionnaires) was achieved. This study is part of a prospective cohort study that incorporates follow-up assessments up to two years after MBS.

This study was approved by the Medical Research Ethics Committees United, located in Nieuwegein, The Netherlands (reference number W22.073).

Standard treatment

All patients were screened for MBS eligibility by a multidisciplinary team, following the latest International Federation for the Surgery of Obesity (IFSO) criteria and nutritional guidelines [23]. All patients awaiting MBS were enrolled in a pre- and postoperative counselling program at the NOK, which is identical across all locations. This program is led by a multidisciplinary team consisting of a medical doctor, dietician, psychologist and exercise expert. Most patients participate in a group counselling program. Individual guidance is only provided when group sessions are not feasible, for example, due to a language barrier or specific psychological disorders. The group counselling program comprises a total of 17 sessions, with five sessions in the five weeks prior to MBS and twelve sessions throughout the first postoperative year. Following the first year, patients attend annual follow-up sessions up to five years post-surgery.

Questionnaires

Following enrolment in the study, all participants were provided with the questionnaires through Castor EDC, an electronic study management program [24]. The initial questionnaire was a self-developed questionnaire, including two questions: educational level and ethnic background (assessed by the birth country of the patient and their parents). The level of education was categorized into three groups: higher education (university or higher vocational education), intermediate education (senior general secondary and pre-university education, senior secondary vocational education, or secondary vocational education), and the lower education group (lower vocational education, primary education, or no diploma).

The assessment of food literacy in this study was conducted using the SPFL, which comprises 29 items [8]. The scale has been rewritten into simpler language to align with the Common European Framework of Reference (CEFR) at level B1 [8]. This questionnaire, validated in the Dutch population, assesses the self-perceived food literacy among adults, with respect to healthy eating. Its validation included individuals with underweight, normal weight, overweight, and obesity [8]. The scoring of the SPFL is conducted using a five-point Likert scale, where a score of five represents "Yes, always" and a score of one indicates "No, never" and vice versa for the eight questions that are subjected to reversed scoring. The scores are reported as the mean score, ranging from a minimum of one to a maximum of five, wherein a higher score corresponds to a higher level of food literacy. There is no predefined threshold to classify scores as either indicative of sufficient or limited food literacy.

The European Health Literacy Survey Questionnaire (HLS-EU-Q16) was used to evaluate health literacy. The HLS-EU-Q16 is a validated, modified version derived from the original HLS-EU-Q47 tool consisting of 16 items [25]. Although the original questionnaire was not initially developed based on the CEFR-level B1, it has been rewritten by researchers from the Erasmus MC in Rotterdam, The Netherlands, to align with this language proficiency level. The CEFR-level B1 version of the questionnaire was utilized in this study and the scoring method for HLS-EU-Q16 has been applied according to the guidelines [25]. It is scored on a four-point Likert scale, where a score of one represents the lowest level of health literacy and a score of four the highest level. To simplify the scoring process, the scores are transformed into a binary format. Scores of one "very difficult" and two "difficult" are assigned a value of zero, while scores of three "easy" and four "very easy" are assigned a value of one. The individual scores are then summed, and three categories are established based on the total score. A score ranging from 0 to 8 indicates inadequate health literacy, a score of 9 to 12 indicates limited health literacy and a score from 13 to 16 indicates sufficient health literacy [25].

Other measurements

Height and weight were measured at preoperative screening and at the start of the preoperative lifestyle program, as part of standard care at the NOK. Baseline characteristics, including gender, age, type of surgery, and associated medical conditions, were obtained from the electronic patients' records at the NOK.

Statistical analysis

Continuous data were reported as mean ± standard deviation for normally distributed data, and as median (interquartile range) for non-normally distributed data. Categorical data were presented as number (percentage). To investigate the factors associated with the preoperative level of food literacy, univariate linear regression analyses were conducted. For continuous variables, when linearity assumptions were not met, log transformation was applied. If linearity was still not achieved, quadratic or higher-order terms were added. In cases where the assumptions were not met even after these transformations, the variables were categorized based on quartiles and included in the model. The results were reported as β-coefficients with corresponding 95% confidence intervals (CI). To assess the factors associated with health literacy, univariate logistic regression analyses were performed (sufficient versus insufficient health literacy). The results were presented as odds ratios (OR) with corresponding 95% CI.

The statistical analyses were carried out using IBM SPSS Statistics for Mac, version 27.0. A p-value of less than 0.05 was considered statistically significant.

Results

Study population

A total of 500 consecutive patients were invited to participate in the study between June 2023 and December 2023. Of the invited patients, a total of 291 individuals agreed to receive baseline questionnaires. Of these, 216 participants (74%) completed the questionnaires and were subsequently included in the study. The median age of the study population was 44.0 [21.0] years, with 80.1% of the participants being female (Table 1). Most patients had an intermediate level of education.

Table 1 Baseline characteristics of the included study population. Presented as mean ± standard deviation, median [interquartile range] or number (%).

	Included population
	(n=216)
Age at screening, years	44.0 [21.0]
Sex	
Female	173 (80.1)
Body mass index, kg/m²	42.5 [7.2]
Preoperative screening	42.5 [7.3]
Start preoperative counselling program	
Associated medical problems	
Hypertension	59 (27.3)
Type II diabetes	24 (11.1)
Dyslipidemia	25 (11.6)
Sleepapnea	41 (19.0)
Osteoarthritis	27 (12.5)
Country of birth	
The Netherlands	170 (78.7)
Other	46 (21.3)
Level of education	
Higher education	64 (29.6)
Intermediate education	135 (62.6)
Lower education	17 (7.8)
Type of perioperative counselling	
Group	198 (91.7)
Individual	18 (8.3)

Food and health literacy

Preoperative mean food literacy score was 3.49±0.44 (Table 2). Health literacy scores indicated sufficient (≥13 out of 16 points) in 208 patients (96.3%), limited health literacy (9-12 points) in five patients (2.3%), and inadequate health literacy (≤8 points) in three patients (1.4%). The distribution of scores within each category is also detailed in Table 2. Due to the small sizes of the limited and inadequate health literacy groups, for further analysis, these groups were combined into a single "insufficient" group. Patients with sufficient health literacy skills exhibited a significantly higher food literacy score compared to those with insufficient health literacy skills (β 0.508; 95% CI: 0.208 – 0.809, p<0.001, Table 3).

Table 2 Preoperative food and health literacy scores. Presented as mean ± standard deviation or number (%).

	Included population
	(n=216)
Food literacy score	3.49 ± 0.44
Health literacy score categories	
Sufficient	208 (96.3)
Limited	5 (2.3)
Inadequate	3 (1.4)
Total health literacy score	
3	1 (0.5)
5	1 (0.5)
8	1 (0.5)
9	1 (0.5)
10	1 (0.5)
11	2 (0.9)
12	1 (0.5)
13	16 (7.4)
14	28 (13.0)
15	39 (18.1)
16	125 (57.9)

Associations with food literacy

The results of the univariate regression analyses revealed several significant associations. Females demonstrated a significantly higher food literacy score compared to males (β 0.202; 95% CI: 0.059 – 0.346, p=0.006, Table 3). Furthermore, patients with hypertension had a lower food literacy score compared to patients without hypertension (β -0.152; 95% CI: -0.281 – -0.023, p=0.021). However, age, preoperative

BMI, level of education, country of birth, type of perioperative counselling and other associated medical problems did not show significant associations with preoperative food literacy.

Table 3 Food literacy scores for different predictors, using univariate linear regression, presented as β-coefficient [95% confidence intervals].

Independent variables	Intercept	Univariate model	P-value
Age at screening, quartiles			
< 33 years	3.553	Ref.	
33-44 years		-0.115 [-0.276 – 0.045]	0.158
44-54 years		-0.112 [-0.275 – 0.052]	0.179
> 54 years		-0.039 [-0.206 – 0.129]	0.651
Sex			
Male	3.323	Ref.	0.006
Female		0.202 [0.059 – 0.346]	
BMI start preoperative counselling, quartiles			
< 39.4 kg/m^2	3.482	Ref.	
39.4-42.49 kg/m^2		0.047 [-0.118 – 0.213]	0.573
42.49-46.66 kg/m^2		-0.028 [-0.192 – 0.137]	0.741
> 46.66 kg/m^2		-0.006 [-0.171 – 0.159]	0.945
Baseline health literacy score			
Insufficient (limited+inadequate)	3.504	Ref.	
Sufficient		0.508 [0.208 – 0.809]	<0.001
Associated medical problems			
Hypertension	3.529	-0.152 [-0.281 – -0.023]	0.021
Type II diabetes	3.507	-0.170 [-0.354 – 0.013]	0.069
Dyslipidemia	3.493	-0.051 [-0.232 – 0.131]	0.583
Sleepapnea	3.506	-0.095 [-0.243 – 0.052]	0.205
Osteoarthritis	3.480	0.059 [-0.117 – 0.234]	0.510
Country of birth			
The Netherlands	3.472	Ref.	
Other		0.062 [-0.079 – 0.204]	0.386
Level of education			
Higher education	3.522	Ref.	
Intermediate education		-0.037 [-0.166 – 0.093]	0.576
Lower education		-0.169 [-0.401 – 0.064]	0.155
Type of perioperative counselling			
Group	3.482	Ref.	
Individual		0.037 [-0.174 – 0.247]	0.730

BMI: Body Mass Index

Associations with health literacy

Univariate logistic regression analyses illustrated that females had higher odds of having sufficient health literacy skills compared to males, with an OR of 4.333 [1.038 – 18.089] p=0.044 (Table 4). The presence of type II diabetes and dyslipidaemia prior to surgery reduced the likelihood of having sufficient health literacy, with odds ratios of 0.188 [0.042 – 0.844] p=0.029 and 0.198 [0.044 – 0.887] p=0.034, respectively. No significant associations were found between health literacy and age, preoperative BMI, level of education, country of birth, type of perioperative counselling or other associated medical problems.

Table 4 Odds ratio for sufficient versus insufficient (limited+inadequate) preoperative health literacy scores using univariate logistic regression analysis, presented as odds ratio [95% confidence interval]. The non-sufficient group is used as reference category.

Independent variables	Univariate model	P-value
Age at screening	0.981 [0.926 – 1.040]	0.522
Sex		
Male	Ref.	0.044
Female	4.333 [1.038 – 18.089]	
Preoperative BMI	0.950 [0.852 – 1.058]	0.349
Associated medical problems		
Hypertension	0.618 [0.143 – 2.672]	0.519
Type II diabetes	0.188 [0.042 – 0.844]	0.029
Dyslipidemia	0.198 [0.044 – 0.887]	0.034
Sleepapnea	0.375 [0.086 – 1.636]	0.192
Osteoarthritis	-*	
Country of birth		
The Netherlands	Ref.	
Other	0.434 [0.100 – 1.889]	0.266
Level of education		
Higher education	Ref.	
Intermediate education	1.279 [0.296 – 5.524]	0.742
Lower education		
Type of perioperative counselling		
Group		
Individual	Ref.	
	0.250 [0.047– 1.341]	0.106

* All individuals within the osteoarthritis and low education group exhibited sufficient health literacy, making the analysis not feasible.
BMI: Body Mass Index

Discussion

The aim of this study was to investigate the food and health literacy of people awaiting MBS, and to identify patient-specific factors associated with these literacies. The results show that 96.3% of patients awaiting MBS had sufficient health literacy. On a five-point scale measuring food literacy, the patients achieved an average score of 3.49 ± 0.44. Additionally, patients with sufficient health literacy demonstrated higher food literacy scores. Females demonstrated higher scores in both food literacy and health literacy, compared to males. Preoperative BMI, age, country of birth, and level of education were not associated with food or health literacy scores.

In this study, preoperative mean food literacy score was 3.49±0.44. By comparison, in previous Dutch cohort studies with individuals across the BMI spectrum (from underweight to obesity), the average food literacy score of the general population was 3.83 ± 0.41 and 3.37 ± 0.47, and a group of dieticians scored 3.99 ± 0.30 [8] [9]. Both studies also used the SPFL questionnaire so, when considering that the mean scores overlap within two times the standard deviation, the average food literacy scores of our and the general population appear similar.

Our data shows 96.3% of patients awaiting MBS have adequate health literacy skills, contrasting with previous studies using the same questionnaire reporting 60.9-78.7% [20, 21]. Methodological differences, like digital survey distribution in our study versus face-to-face in others, could skew results due to potential selection bias among those with lower digital literacy. Consequently, this might have led to an overestimation of the proportion of patients with sufficient health literacy in our cohort.

The current study showed higher health literacy scores compared to a previous study in the general Dutch population, where only 75.5% showed sufficient health literacy [26]. This could be due to the fact that patients in the current study recently sought help for their obesity, leading them to perceive themselves as having sufficient health literacy. Furthermore, this cohort likely includes individuals who are more proactive in seeking medical help, which potentially introduces a bias towards higher perceived health literacy. Additionally, evidence suggests a self-selection bias, as patients with better literacy are more likely to undergo MBS [18, 20].

The self-reported nature of both questionnaires used in this study may be sensitive to social desirability. Since patients in the current study had already undergone screening, were eligible for MBS, and were participating in the preoperative counseling program, their responses to the questionnaires did not influence the indication for MBS. Nonetheless, some patients might have felt compelled to provide responses they perceived as supportive of their decision to pursue surgery or to justify MBS as their last resort after attempting other lifestyle changes, potentially influencing their answers towards more socially desirable responses.

This study found no significant correlation between BMI categories and food or health literacy scores. Previous research in patients undergoing MBS showed mixed results, with one study finding no BMI-nutrition literacy association [27] and another study observing an inverse BMI-health literacy association [19]. Studies in the general population also show conflicting results: some report lower food or health literacy linked to higher BMI, [28, 29], while others find no such association between these literacies and BMI [9, 30]. Thus, the relationship between BMI and food or health literacy appears complex or might not exist and needs further exploration through more comprehensive and longitudinal studies.

Previous studies have not examined food literacy in patients awaiting MBS, but one study with a smaller sample size (n=112) found no significant link between sex and nutritional knowledge [27]. In the general population, women often exhibit higher food and health literacy scores compared to men [9, 10, 31, 32], consistent with our findings. This gender gap may stem from societal roles where women typically manage meal planning, shopping, and cooking [33], along with their tendency to be more health-conscious and proactive in seeking health information [34]. Consequently, women may have greater exposure to nutritional and health information and skills, resulting in higher literacy scores.

Lastly, this study found a strong correlation between food and health literacy. Patients with sufficient health literacy had significantly higher food literacy scores than those with insufficient health literacy. This finding aligns with previous research that also demonstrated a positive association between these two forms of literacy [9, 10]. This interrelationship suggests that individuals with insufficient health literacy may face challenges in understanding and making informed decisions regarding healthy eating.

These observations strengthen the understanding that the cause of obesity is multifactorial, with the complex pathophysiology influenced by numerous factors such as genetics, behaviour, the gut microbiome and the external (food) environment, and is not solely the result of low food or health literacy [35-38]. To comprehensively understand the role of food and health literacy in obesity treatment, it is important to distinguish between knowledge, skills, behaviours and behavioural change. As mentioned previously, food and health literacy involve skills and behaviours that go beyond mere knowledge, including the application of information. Additionally, health literacy is just one contributor to health outcomes; other factors such as life skills and executive functions also improve health [39]. Moreover, behaviour is influenced by multiple determinants beyond skills, including attitudes, self-efficacy and social influence such as social support [40, 41]. These factors collectively determine the ability to translate knowledge into actionable behaviours and drive behavioural change, a critical consideration in the context of obesity treatment. Future studies should therefore also examine these additional behavioural determinants.

Strengths and limitations

This study significantly contributes to the understanding of food and health literacy and associated factors in patients awaiting MBS. The strengths of the study include the study size with 216 participants and the use of validated questionnaires at CEFR-level B1, which improves reliability. Nevertheless, certain limitations must be acknowledged. First, selection bias could have occurred because participation was voluntary, favouring individuals who were more confident in their food and health literacy and, therefore, more willing to participate; 26% of patients did not complete the questionnaires despite reminders, potentially favouring the inclusion of those with sufficient literacy. Additionally, digital administration of questionnaires may have introduced selection bias by inadvertently excluding individuals with limited digital literacy. Secondly, the small size of the group with insufficient health literacy (8 patients) necessitates a careful interpretation of the results, as this can strongly influence the correlations with other variables. To reduce such biases in future studies, incorporating printed and voice-assisted questionnaires should be considered, which may also increase completion rates. Lastly, it is important to highlight that although these questionnaires are validated and both better food literacy and health literacy have been linked to healthier diet and lifestyle behaviours (as described in the introduction), they were validated within the general population. Therefore, the results may not be directly applicable, one-to-one, to the study population.

Conclusion

This study of people living with obesity and awaiting MBS suggests that self-reported food literacy is comparable to and health literacy is higher than that of the general population. Women reported greater food and health literacy, and no correlation was found between BMI and these literacies. The findings underline the complexity of obesity as a chronic disease, influenced by many factors beyond food and health literacy. Future studies should also examine additional behavioural determinants, such as self-efficacy, executive functions and life skills, as these are crucial for effectively engaging in health-related behaviours.

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