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Evidence of the validity and reliability of the Digital Silhouette Scale for Body Image Assessment in Bariatric Surgery

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Abstract

Introduction Body image assessment in the preoperative period of bariatric surgery is fundamental for identifying perceptual distortions, levels of dissatisfaction, and expectations regarding treatment outcomes. Traditional physical instruments, however, present limitations for individuals with severe obesity, in addition to accessibility barriers for in-person application.

Objective This study aimed to investigate the test-retest reliability and gather validity evidence of the digital version of the Expanded Silhouette Scale for Grade V Obesity (ESS-2-D) in bariatric surgery candidates.

Methods This is an observational study with a quantitative approach and longitudinal design, conducted at two evaluation points (T1 and T2). Temporal stability was analyzed using the intraclass correlation coefficient (ICC), Pearson correlations, and paired t-test.

Results A total of 58 adults enrolled in a public bariatric surgery program participated in the study, with a mean BMI of 54.6 kg/m² (SD = 10.5), evaluated at two time points with an interval of 7 to 14 days. The results indicated good to excellent reliability levels for the main scale indicators (ICC between 0.74 and 0.99, Pearson's r between 0.59 and 0.98), with no significant differences between test and retest in the Student's t-test.

Conclusion Measures of body image distortion, body dissatisfaction, and body idealization showed high temporal stability. The experimental variable of surgical expectation (Exp-BI) demonstrated moderate agreement with the expected BMI after 12 months of surgery, providing initial evidence of validity based on the relationship with external measures. The findings support the ESS-2-D as a valid, reliable, and accessible instrument for assessing body image and preoperative expectations in individuals with severe obesity, with potential clinical application and also in longitudinal research in the context of bariatric surgery and pharmacological treatment of obesity.

Keypoints

- The ESS-2-D demonstrated good to excellent test–retest reliability for all major body image indicators in bariatric surgery candidates.
- Digital administration preserved the accuracy of body image assessment while expanding accessibility for remote and longitudinal evaluations.
- The novel expectation-of-outcome indicator (Exp-BI) showed meaningful associations with anticipated postoperative BMI, providing preliminary validity evidence.
- The ESS-2-D offers a practical tool for assessing body image distortion, dissatisfaction, idealization, and treatment expectations in severe obesity.

Introduction

Body image is a central construct in the understanding of obesity and in pre operatory assessment for surgeries, particularly in surgical contexts in which fast and significant body changes are part of the therapeutic process, as in bariatric surgery. Accumulated evidence indicates that the way an individual perceives and evaluates their own body is associated both with decision-making regarding treatment, as well as psychological adaptation to results, influencing outcomes such as satisfaction, well-being, and quality of life [1–4]. In this sense, the systematic assessment of body image assumes a strategic role in longitudinal follow-up and in the production of scientific knowledge in the area of body image and bariatric surgery [5, 6].

From a psychometric perspective, measuring body image presents specific challenges, since the construct encompasses perceptual and attitudinal components that interact dynamically and change throughout life, requiring instruments capable of producing theoretically coherent, stable, and accurate scores over time [5, 7, 8]. Among the available assessment methods, silhouette scales have been widely used for its ability to operationalize central indicators of body image, such as perceptual accuracy and body dissatisfaction, through simple visual stimuli, such as drawings of human silhouettes [9].

These instruments allow the estimation of discrepancies between perceived and desired body size, as well as comparisons between perceived body size and objective indicators, such as body mass index (BMI) [10]. However, many silhouette-based measures have been developed for non-clinical samples and have limited coverage of extreme BMI ranges, which restricts their applicability in severely obese populations who are candidates for bariatric surgery [11–13].

In the Brazilian context, the Brazilian Silhouette Scale (BSS) for Adults represented a relevant methodological advance by basing its figures on photographs of individuals with previously known BMI values [12]. However, the upper BMI limit contemplated in the original scale restricted its use in clinical contexts involving more severe obesity. In order to overcome this limitation, the Expanded Silhouette Scale for Grade V Obesity (ESS-2) was developed, which expanded the number of silhouettes and extended the BMI coverage to values equal to or greater than 50 kg/m² and 60 kg/m², which correspond to grade IV and V obesity, respectively. Initial psychometric studies provided favorable evidence regarding the psychometric adequacy of the ESS-2 for assessing body image in clinical samples of candidates for bariatric surgery [14].

In parallel, the increasing incorporation of digital technologies in psychological assessment has driven the adaptation of traditional instruments to computerized formats. Digitized versions broaden accessibility, favor the standardization of stimulus presentation, and enable remote and longitudinal assessments [6]. Test-retest reliability is a fundamental indicator of temporal stability, especially for instruments intended for clinical monitoring or longitudinal research. International guidelines in psychological assessment emphasize that digital adaptations of instruments must present their own psychometric evidence, especially regarding reliability and validity [15].

Given this scenario, the present study aims to investigate the test-retest reliability of the Digital Version of the Expanded Silhouette Scale for Grade V Obesity (ESS-2-D), as well as to gather validity evidence based on its relationship with theoretically related external measures. Specifically, it is hypothesized that the ESS-2-D scores will exhibit high temporal stability between Time 1 (T1) and Time 2 (T2), expressed by high ICC coefficients and Pearson correlations. Additionally, it is expected that the measures derived from the digital scale will consistently associate with relevant external variables, such as BMI measured on a scale, in accordance with theoretical assumptions from the literature on body image, supporting the interpretability of the scores and the suitability of the instrument for clinical use and in research with individuals with severe obesity.

Materials

Questionnaire on sociodemographic data and health conditions.

The questionnaire was developed for use in this research and aims to obtain information about the participants, such as age, sex, race, education level, economic class, and medical history, health problems (blood pressure, diabetes, sleep habits, cardiopulmonary function, etc.).

Anthropometric data.

Each individual had their weight and height recorded (Reported BMI) and weight measured using scales available in the research rooms, without shoes or heavy objects or clothing. Height was obtained using an anthropometer attached to a wall without baseboards, with the person standing upright against the surface, so that their eyes and ears formed parallel horizontal lines. In this way, the standards for measuring weight and height were followed for the calculation of the Actual BMI.

Expanded Silhouette Scale for Grade V Obesity (ESS-2).

This is an expanded version of the scale initially developed in Brazil by Kakeshita (2009) for Grade V Obesity, aiming to assess perception and dissatisfaction related to body image. Image distortion (or perceptual accuracy) was measured considering the difference between the perception of the current silhouette and the actual BMI. Dissatisfaction with the image will be measured through the difference between the silhouette assessed as current and the desired one. In the present study, we added the assessment of the individual's expectation of weight loss with the surgical treatment of obesity [14].

Digital Version of the Expanded Silhouette Scale for Grade V Obesity (ESS-2-D).

The silhouette scale used in this study consists of the Digital Version of the Expanded Silhouette Scale for Grade V Obesity (ESS-2), adapted for digital. The scale is displayed on a website developed by a programmer, with the silhouettes in ascending order, viewable on a mobile phone or computer without altering their dimensions. Figure 1 shows how the participant views the instrument.

Figure 1

Presentation of the items of the Silhouette Scale in an Expanded Version for Grade V Obesity (ESS-2-D) for digital use.

Note

The first question is about the participant's weight and height, followed by instructions on the scale. The silhouette figures are initially presented centered on silhouette number 1, and the participant must scroll with their finger or mouse for the other figures to appear. At the end, 50 silhouettes (25 for each gender) are also presented, representing BMIs from 12.5 to 72.5 kg/m² for the chosen gender.

This application was carried out in an asynchronous format and without the presence of an evaluator at two distinct times, with an interval of 7 to 25 days (T1 and T2). The instrument consists of 50 silhouettes (25 for each sex) with silhouette figures that encompass the BMI range of 12.5 to 72.5 kg/m², and the proportion of increase in BMI from one figure to another is 2.5 kg/m². Participants were asked to answer, in the following sequence: 1) “Point out the silhouette that best represents your body currently” (Cur-BI), 2) “Point to the silhouette that best represents the body you desire” (Des-BI), 3) “Point to the silhouette that best represents the body that is considered ideal for your gender (in general, by society)” (Ideal-BI) and 4) “Point to the silhouette that best represents the body you expect to have at the end of 12 months after bariatric surgery” (Exp-BI). Body dissatisfaction is measured by calculating the discrepancy between reported body size and desired body size (Cur-BI - Des-BI), while body image distortion was assessed by calculating the difference between the participant's reported body size (measured by self-reported BMI) and the body size that the participant perceived as their current size in the silhouette (Cur-BI - BMI-Silhouette). Body idealization was measured through the discrepancy between the silhouette chosen as current and that considered the ideal silhouette by society (Cur-BI - Ideal-BI), while expectations regarding surgery were calculated

through the difference between the body size that the participant perceived as current in the figures and that which they expect and imagine having at the end of 12 months after bariatric surgery (Cur-BI - Exp-BI).

Methods

This is an observational study with a quantitative approach and longitudinal design, conducted at two evaluation points (T1 and T2). The sample consisted of patients followed up in a bariatric surgery program at a university hospital located in Brazil, a reference center for the treatment of severe obesity. Individuals aged 18 years or older, with a body mass index (BMI) greater than 30 kg/m², consistent with obesity according to World Health Organization criteria, and enrolled in the program were included in the study. Participants who had previously undergone bariatric surgery, as well as pregnant women or individuals who reported pregnancy in the six months prior to data collection, were excluded.

Sample recruitment was carried out after the care teams had been previously informed about the study and encouraged to invite patients who met the criteria when they attended nursing consultations. After the invitation to participate in the research and completion of the Informed Consent Form, a detailed explanation of how to access and answer the digitized scale online asynchronously and without the presence of the evaluator was sent via messaging application.

The sample size calculation for the study sought to follow the distribution of obesity prevalence in the Brazilian adult population according to data from the Ministry of Health [16] through the Food and Nutrition Surveillance System. To obtain test-retest reliability evidence, the ESS-2-D response was requested at two distinct times (T1 and T2), with an interval of 7 to a maximum of 25 days between assessments (Mean = 13.30 days, SD = 4.85, Minimum = 7, Maximum = 25 days). To obtain validity evidence, Body Mass Index (BMI) was measured through self-report, scale and anthropometer, and compared with the BMI of the silhouette figure indicated as current, to verify the accuracy of body perception.

Results

The sample consisted of 58 participants with obesity, 45 women and 13 men, all users of the Brazilian Unified Health System (SUS) and candidates for bariatric surgery at a university hospital. The participants were enrolled in outpatient follow-up and pre-operative preparation activities, including multidisciplinary groups focused on surgery.

The characteristics of the sample, as well as results of the descriptive statistics, are presented in Table 1 and were obtained from the sociodemographic questionnaire (see Materials section). The age ranged from 20 to 65 years among all participants, with a mean of 43.6 years (SD = 10.8). There was a predominance of females (77.6%), single participants (50.0%), and individuals who self-identified as white (67.9%). Regarding education, 51.8% of the sample had completed high school or higher education. Regarding body mass index, the actual BMI, objectively measured using a scale and anthropometer, had a mean of 54.6 kg/m² (SD = 10.5), with values ranging from 34.6 to 93.1 kg/m². Self-reported BMI, in turn, showed an average of 54.5 kg/m² (SD = 10.9), with a range between 34.4 and 93.1 kg/m².

Tabel 1

Descriptive statistics and frequency table of the sample (N = 58 subjects, 45 women and 13 men)

Age	**N**	***μ***	***Mdn***	***SD***	**Min**	**Max**
	58	**43.6**	**44.0**	**10.8**	**20.0**	**65.0**
BMI- reported	58	54.5	54.3	10.5	34.4	93.1
BMI- actual	58	54.6	53.4	10.5	34.6	93.1
Education	**% of Total**	**Marital status**	**% of Total**	**Colour/race**	**% of Total**	
Incompleted elementary school	21.4%	Single	50.0%	Black	12.5%	
Elementary school graduate	12.5%	Married	21.4%	White	67.9%	
Incompleted high school	14.3%	Divorced	8.9%	Brown	19.6%	
High school graduate	26.8%	Widower	3.6%			
Incompleted college	8.9%	Stable union	16.1%			
College graduate	16.1%					
Note. μ = mean; Mdn = median; SD = standard deviation; Min = minimum value; Max = maximum value.						

To assess temporal stability and test-retest reliability evidence, the Intraclass Correlation Coefficient (ICC) was used, as it is an appropriate indicator for examining the consistency of continuous measures obtained in repeated assessments (absolute agreement type; two-way random sampling model; (17). Complementarily, Pearson's correlation coefficient was used, which provides information on the degree of linear association between scores obtained at different times and allows for discussion with other studies that used this statistical test. Additionally, the paired-samples Student's t-test was performed to verify the existence of systematic differences between the means obtained at the assessment times. Results indicated there were no statistically significant differences between the scores of T1 and T2, reinforcing the temporal stability of the measure. During data collection, one omission of response regarding ESS-2-D was recorded in T1 and eight omissions of response in T2. Despite these omissions, the available sample size proved adequate for carrying out the proposed analytical procedures.

Based on cutoff points proposed by Koo and Lee (2016), according to which values of ICC inferior to 0.50 indicate poor reliability, values ranging from 0.50 to 0.75 indicate moderate reliability, from 0.75 to 0.90 indicate good reliability, and values superior to 0.90 indicate excellent reliability, it was observed that the coefficients obtained in the present study varied from 0.74 to 0.99, which characterizes reliability levels that can be considered good to excellent.

Reported BMI remained stable in the course of time (ICC = 0.99 [IC 95% = 0.985–0.995]; F (49.0, 49.6) = 116, p = 0.00; r = 0.98, p < 0,001; t test n.s.), suggesting that there was no perceived change in body status among participants between T1 and T2. The stability of the reported BMI reduces the risk that possible changes in silhouette scores will be attributed to actual weight changes, as often happens with patients in the postoperative period following surgery. It is therefore expected that such stability should not be generalized to the postoperative period, in which rapid and clinically significant changes in BMI are expected in a short period of time, with potential repercussions on both self-report and body image perception, indicating the need for longitudinal studies that explore the sensitivity of the scale to body changes over time.

The responses selected for each of the four items on the scale — corresponding to the variables Cur-BI, Des-BI, Ideal-BI, and Exp-BI — also showed good temporal stability in the test-retest interval, as presented in Table 2. These

findings are consistent with the results reported by Kakeshita et al. (2009), who identified satisfactory evidence of reliability of the Brazilian Silhouette Scale (BSS) in a non-clinical sample (mean BMI = 28.77 kg/m²), with Pearson correlation coefficients ranging between r = 0.60 and r = 0.92, in addition to the absence of statistically significant differences in the paired t-test for these same variables.

Tabel 2

Descriptive statistics, Pearson correlation, ICC, t-test, and Shapiro-Wilk for test-retest reliability assessment (T1 x T2) (N = 57 subjects, men and women)

Test (T1) X Retest (T2) (n)	***μ* T1 (57)**	***SW* T1 (57)**	***μ* T2 (50)**	***SW* T2 (50)**	**r**	**ICC**	**t Student**
IMC Relatado	54.64	0.96	54.86	0.92*	0.98*	0.99*	n.s.
Cur-BI	17.7	0.94*	17.5	0.93*	0.87*	0.93*	n.s.
Des-BI	9.18	0.95*	8.80	0.96	0.59*	0.74*	n.s.
Ideal-BI	6.23	0.97	5.98	0.96	0.69*	0.81*	n.s.
Exp-BI	9.28	0.96	8.82	0.91*	0.70*	0.82*	n.s.
Body Image Distortion	0.57	0.96	0.28	0.96	0.85*	0.92*	n.s.
Body Dissatisfaction	8.59	0.97	8.56	0.97	0.88*	0.94*	n.s.
Body Idealization	11.54	0.95*	11.54	0.96	0.85*	0.92*	n.s.
Treatment Expectations	8.49	0.97	8.70	0.93*	0.66*	0.80*	n.s.

Note. *μ* T1 = test means; *μ* T2 = retest means; *SW* T1 = Shapiro–Wilk, normality test in the test; *SW* (T2) = Shapiro–Wilk, normality test in the retest; r = Pearson correlation coefficient; ICC = Intraclass correlation coefficient between test and retest; Student's t = paired t-test between test and retest; n.s. = not significant; *p < 0.05.

To date, the adaptation of the ESB for digital use proposed by Freire and Fisberg (2017) has not shown evidence of test-retest reliability, considering no longitudinal evaluation was conducted. In turn, the physical version of the ESS-2 (Bertoletti et al., 2025) reported Pearson correlations between r = 0.46 and r = 0.63 in the total sample. The study by Bertoletti et al. (2025) was also the first to report evidence of temporal stability for body image distortion scores (r = 0.62) and body dissatisfaction (r = 0.61). In this context, the results of the present study indicate that adapting the ESS-2 to the digital format may have contributed to a significant increase in the temporal stability of these scores, which achieved substantially higher coefficients (ICC = 0.92, r = 0.85 and ICC = 0.94, r = 0.88, respectively).

In the adaptation for Digital use of the ESS-2 (ESS-2-D), it was observed satisfactory agreement between the body image indicator referring to the current silhouette (Cur-BI) and the Body Mass Index (BMI) measured objectively, through the intraclass correlation coefficient (ICC = 0.73). This result provides evidence of the instrument's validity, in line with the classic criterion for validating silhouette scales, which is based on the correlation between the silhouette indicated as current and the BMI obtained by direct anthropometric measurements, with an appropriate value above 0.70 [18].

Body image distortion had a virtually null average in the digital version (μ = 0.28), with silhouette 17.7 being chosen on average, corresponding to a BMI range of 51.25 to 53.74 kg/m², values close to the BMI reported by the sample. This result corroborates a study that used the Brazilian Silhouette Scale by Kakeshita et al. (2009) in bariatric surgery participants at different surgical periods, from the preoperative period to 120 days postoperatively, and verified high accuracy at these different surgical times [19]. In the preoperative period, presenting an average Body Mass Index (BMI) of 44.6 kg/m², the participants selected, on average, silhouette 14.2, a value that corresponds precisely to the BMI range of 43.75 to 46.24 kg/m². At 120 days after bariatric surgery, the accuracy of self-perception was preserved: despite weight reduction to an average BMI of 35.1 kg/m², the average silhouette chosen was 10.8, which corresponds to the range of 33.75 to 36.24 kg/m². Therefore, the results indicate that the perceptual body image faithfully reflected the actual weight loss during the evaluated period, demonstrating that the patients were able to visually recognize the changes in their physical dimensions.

The scrolling presentation mode, in which silhouettes progressively increase in size and obscure smaller ones, can reduce perceptual biases, considering that studies with eye tracking and head tracking indicate that body image distortion on the silhouette scale is associated with an attentional pattern of gaze dispersion towards idealized bodies, often associated with thinness [20, 21]. The study by Fischer et al. (2020) also compared the paper silhouette scale with personalized 3D avatars in Virtual Reality (VR) and found no statistically significant differences between the two methods in body image distortion and body dissatisfaction indices. These findings suggest that the digital format can be an accessible, economical, and scalable way to assess body image, mitigating perceptual biases present in face-to-face assessment. By controlling the visual progression of silhouettes, the tendency for gaze dispersion and automatic focus on ideal models is reduced, promoting a more accurate estimate of real body size.

Finally, it should be noted that the Exp-BI variable was not evaluated in previous studies, having been included exclusively in the present work. Due to its experimental and innovative nature, it is necessary to present validity evidence to support the interpretation that this indicator actually measures expectations regarding the results of bariatric surgery. To this end, the sociodemographic questionnaire included a question about the participant's expected weight 12 months after surgery. When comparing the BMI corresponding to this expectation with the Exp-BI variable, a moderate agreement was observed between the measures (ICC = 0.55; 95% CI = 0.222–0.742; F(51.0; 44.6) = 2.34; $p < 0.001$), as well as a moderate magnitude positive correlation ($p = 0.40$; $p < 0.003$).

Individuals seeking bariatric surgery tend to project high expectations regarding the procedure's outcomes, especially concerning the magnitude of weight loss, potentially overestimating its effects with unrealistic expectations [22, 23]. Evidence indicates that, after 12 months, the average body weight loss is around 29.5% (SD ± 9.0%) for the sleeve technique and 31.9% (SD ± 8.1%) for gastric bypass [24]. Given this scenario, the systematic assessment of expectations in the preoperative period is crucial to identify possible discrepancies between patients' projections and scientifically observed clinical parameters. Aligning these expectations throughout the preparatory process can contribute to preventing frustration and feelings of failure when the imagined weight is not achieved, reinforcing the importance of psychoeducational strategies that emphasize gains in health, functionality, and quality of life, beyond outcomes in body image [25].

Recently, a machine learning-based calculator was developed to estimate individual weight loss trajectories up to five years after bariatric surgery, considering the surgical technique employed [26]. When combined with the BMI corresponding to the silhouette selected as a representation of the expected body at the end of 12 months (Exp-BI), this tool enables the operationalization and measurement of surgical expectations [27]. In a context of scarcity of instruments that measure preoperative expectations in bariatric surgery, unrealistic expectations can be objectively

identified from the discrepancy between the silhouette expected by the patient and the outcome estimated by the calculator, in light of the standard deviation of the predicted population mean [28]. These findings constitute evidence of the validity of the ESS-2-D based on its relationship with external measures, reinforcing the relevance of interpreting Cur-BI as a measure of perceptual accuracy and Exp-BI as an indicator of expectations regarding the weight outcomes of bariatric surgery.

This study provides consistent evidence of test-retest reliability and validity of the digital version of the Expanded Silhouette Scale for Grade V Obesity (ESS-2-D) in candidates for bariatric surgery. The results indicate adequate temporal stability of the scores and coherent associations with relevant external measures, supporting the interpretability of the dimensions of body image distortion, body dissatisfaction, and body idealization. The inclusion of the surgical expectation indicator (Exp-BI) proved clinically relevant, showing an association with the expected BMI after 12 months post-bariatric surgery, expanding the scale's clinical potential for identifying preoperative expectations. The ESS-2-D is thus configured as a valid, stable, and applicable tool for assessing body image and expectations related to bariatric surgery.

As for limitations of this study, the characteristics of the sample stand out, composed exclusively of candidates for bariatric surgery, with a predominance of women and self-declared white participants. Future studies should encompass greater body diversity in the sample and investigate the sensitivity of the ESS-2-D to the rapid and clinically significant body changes observed after bariatric surgery, add validity evidence with external measures of body dissatisfaction, and examine its applicability in other clinical groups and its ability to discriminate body image distortions in populations with eating disorders, such as anorexia nervosa, as well as in non-clinical and community samples.

Declarations

Funding Statement

None.

Required consent statements

All participants were fully informed about the objectives, procedures, risks and benefits of the study and provided free and informed consent form before being included in this research.

Declarations Competing interests

The authors declare no competing interest.

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Figures

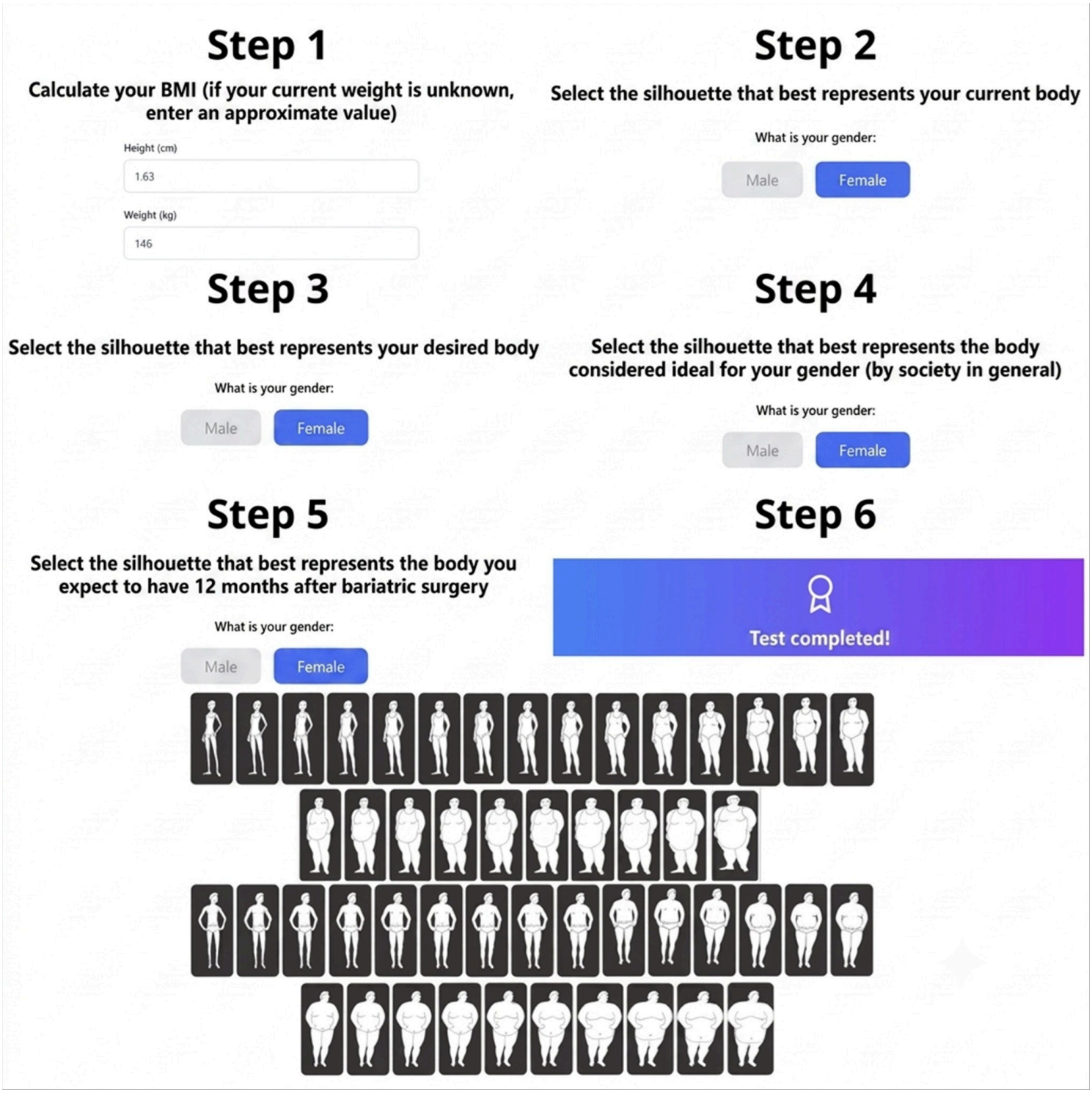


Figure 1

Presentation of the items of the Silhouette Scale in an Expanded Version for Grade V Obesity (ESS-2-D) for digital use.

Note: The first question is about the participant's weight and height, followed by instructions on the scale. The silhouette figures are initially presented centered on silhouette number 1, and the participant must scroll with their finger or mouse for the other figures to appear. At the end, 50 silhouettes (25 for each gender) are also presented, representing BMIs from 12.5 to 72.5 kg/m² for the chosen gender.