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ORIGINAL CONTRIBUTIONS

Impact of Excess Skin from Massive Weight Loss on the Practice of Physical Activity in Women

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Abstract
Background Over 70 % of people who undergo bariatric surgery (BS) develop excess skin (ES). The physical and psychosocial consequences of ES may become a barrier to the practice of physical activity (PA), which is highly recommended to optimize the results of BS. The purpose of this study was to evaluate the impact of ES on the practice of PA in women who have undergone BS.
Methods Questionnaires administered to 26 women having undergone BS 2±0.2 years before (BMI=29.1±0.8 kg/m^2) evaluated the impacts of ES, the practice of PA, physical self-perception, and physical exercise beliefs. We also used the 6-min walking test and muscular endurance tests to evaluate physical fitness and photographs with anatomical markers to quantify ES.
Results Of the women, 76.9 % declared mobility limitations due to ES during the practice of PA and 45.2 % stated avoiding PA because of ES which caused flapping and unwelcome stares from others. The women who stated that they avoided PA because of ES had significantly lower physical self-perception and physical fitness and reported experiencing more embarrassment during PA despite no significant difference in the magnitude of ES (p=0.06), BMI, daily life inconveniences, and energy expenditure compared to those women who did not avoid PA.
Conclusion Although ES after BS is a barrier to the practice of PA for some women, it does not in itself prevent the regular practice of PA. The main reason women with ES avoid PA seems to have less to do with the magnitude of ES itself and more with psychosocial inconveniences.

Keywords Obesity · Bariatric surgery · Exercise · Self-concept

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Introduction

Class II and III obesity, as defined by body mass indices (BMIs) of ≥35 and 40 kg/m^2, respectively, has dramatically increased over the past decade in North America [1, 2]. Bariatric surgery is currently the most effective treatment available to achieve and maintain weight loss in this population [3–5]. Massive weight loss after bariatric surgery is associated with improvements in overall mortality; obesity-related comorbidities; psychosocial status (self-esteem, depressive symptoms, body image, social relations, and employment); and health-related quality of life (HRQoL) [3–7].

Unfortunately, bariatric surgery is not without risk and is often a cause for disappointment. Indeed, over 70 % of patients who undergo bariatric surgery experience excess skin (ES), most often on the abdomen, arms, thighs, and breasts [8–10]. In addition to hygiene problems including itching, rashes, and ulcerations [9, 11], ES can also cause negative psychosocial consequences linked to body image and deteriorated HRQoL [8, 12–14]. Post-bariatric surgery body image is a source of shame, disappointment, and humiliation for many patients [15]. ES is also associated with back and neck pain as well as functional limitations [8, 9, 13, 14]. However, further studies are needed to complete our understanding of the impact of ES on daily life inconveniences, functional limitations, and the practice or avoidance of physical activity (PA).

The regular practice of PA after bariatric surgery is recommended to optimize and maintain weight loss [16, 17] as well as HRQoL, health, and physical fitness [18–21]. The American College of Sports Medicine national guidelines on PA and public health recommend a minimum of 150 min per week of moderate or higher-intensity PA in bouts of at least 10 min to promote and maintain health [22]. In addition, the International Association for the Study of Obesity stated that prevention of weight regain, in formerly obese individuals, requires at least 60 min per day of moderate intensity activity [23].

To our knowledge, two studies [8, 9] thus far have investigated the impact of post-bariatric surgery ES on the practice of PA, showing that subjects experienced both physical and psychosocial difficulties due to ES [9]. Paradoxically, subjects who exercised at least three times a week reported a significantly lower degree of inconvenience than those who exercised less [8].

ES, therefore, can represent a physical, social, and/or psychological barrier to the practice of PA. Because recommendations are not always met by patients after bariatric surgery [24–26], we wanted to assess the relative role of ES as a contributing factor to the avoidance of regular practice of PA.

Thus, the main purpose of this transversal pilot study was to evaluate the impact of ES on the practice of PA in women having undergone bariatric surgery. Because women declare more dissatisfaction and inconveniences with ES than men [8, 9], our study focused on women. This study also attempts to assess the relationship, if any, between the degree of ES and daily life inconveniences.

Materials and Methods

Population

Subjects were recruited at the Sherbrooke University Hospital Center between February and August 2012. The study was duly approved by the Institutional Research Ethics Review Board (project reference no. 11-190), and each subject provided written informed consent prior to her participation in the study. The study group included 26 women, aged 18 years and over, having undergone bariatric surgery at least 1 year prior to their participation in the study, with stable weight in the 3-month period preceding participation (<5 kg of weight variation) and a weight loss of at least 20 % of their weight at bariatric surgery. Subjects had no medical contraindication to practice PA, were able to complete the 6-min walking test (6MWT), and had no uncontrolled neuropsychiatric illness. We contacted 72 potential subjects, 41.6 % of which refused to participate for a variety of reasons—no time (50 %), lived too far (40 %), not interested (10 %)—and another 22.2 % of which were excluded because of unstable weight (56.2 %), functional limitations (25 %), or because they had lost <20 % of their pre-bariatric surgery weight (18.8 %).

Personal Characteristics

The socio-demographic profile, comorbidities, and weight history of each subject were self-reported in a questionnaire. Weight before bariatric surgery was collected from medical charts. Two separate questions addressed subject's relative satisfaction regarding their bariatric surgery and their desire to undergo plastic surgery for their ES.

Anthropometrics, Body Composition, and ES Measures

Height was measured using a standard stadiometer to the nearest 0.1 cm and weight with a calibrated scale (Tanita TBF-310®) to the nearest 0.1 kg. BMI was calculated using weight (in kilograms) divided by squared height (in square meters). The "anthropometric classification of body contour deformities after massive weight loss" was used to grade ES on the abdomen, upper arms, and medial thighs [27] (Fig. 1). For grade classification, each subject was photographed in standing position with anatomical structure markers. Two investigators analyzed the photographs and established a consensual ES grade for each. In order to further quantify ES, photographs were also used to attribute a percentage score (Fig. 1).

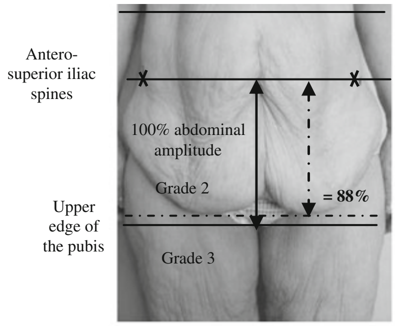
Impact of ES on Daily Life Activities and Mobility

Subjects were asked to point out the localization of their ES on a frontal and dorsal body sketch by circling affected areas. Subjects were then asked to assess the impact of their ES on their daily life activities using a visual analogue scale, consisting of a 100-mm horizontal line, ranging from no inconvenience at all (0 mm) to the worst inconvenience possible (100 mm). The total inconvenience score is the mean of the scores obtained for the abdomen, upper arms, and medial thighs. Subjects were also asked whether ES, or other factors such as pain, affected their mobility when they practiced PA or sports. When subjects reported any such limitation, they were asked to carefully describe the affected movements as well as the causes of the limitation. Subjects were also asked whether they avoided PA or sports because of ES and or any other reasons.

Physical Fitness

The 6MWT, which has been validated previously in obese and overweight populations [28, 29], was performed by each subject

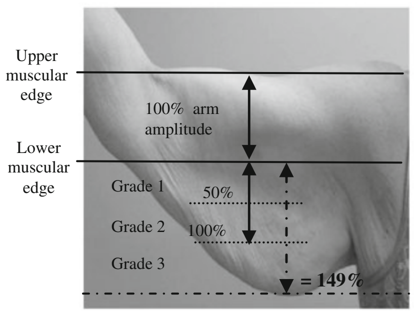
A- Excess skin-abdomen = grade 2, 88%



Grade 1: ES remains above the inguinal ligament.
Grade 2: ES is below the inguinal ligament but does not surpass the upper 3rd of the thigh.
Grade 3: ES is located within the middle third of the thigh.
Grade 4: ES is within the lower third of the thigh.
Grade 5: ES is below the knee.

The 100% amplitude was represented by the distance between the antero-superior iliac spines and the upper edge of the pubis. The % calculated ES is identified from photographs using the distance between the antero-superior iliac spines and the lower limit of ES. In this example, ES represents 88% of the 100 % amplitude.

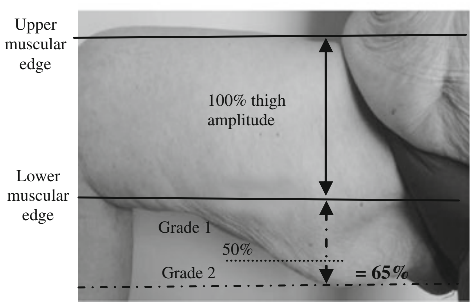
B- Excess-skin arm = grade 3, 149%



Grade 1: ES surpasses up to 50% of the arm amplitude.
Grade 2: ES is greater than 50% and up to 100% of the arm amplitude.
Grade 3: ES is greater than 100% and up to 150% of the arm amplitude.
Grade 4: ES is greater than 150% and up to 200% of the arm amplitude.

The 100% amplitude for the upper arm was represented by the distance between the upper edge and the lower edge of the muscle mass. The % calculated ES is identified from photographs using the distance between the lower muscular edge and the lower limit of ES. In this example, ES represents 149% of the 100 % amplitude.

C- Excess-skin thigh = grade 2, 65%



Grade 1: ES surpasses up to 50% of the thigh amplitude.
Grade 2: ES is greater than 50% and up to 100% of the thigh amplitude.
Grade 3: ES is greater than 100% and up to 150% of the thigh amplitude.
Grade 4: ES is greater than 150% and up to 200% of the thigh amplitude

The 100% amplitude for the medial thigh was represented by the distance between the upper edge through the lower edge of the muscle mass. The % calculated ES is identified from photographs using the distance between the lower muscular edge and the lower limit of ES. In this example, ES represents 65% of the 100 % amplitude.

Fig. 1 Determination of percentage and grades of excess skin scores based on anthropometric classification of body contour deformities after massive weight loss [27]. *ES* excess skin

in order to evaluate her functional capacity. As recommended by the American Thoracic Society [30], the test was administered on a 30-m indoor course, repeated twice with a 30-min rest between each test, and subjects were instructed to walk as far as they could for 6 min. The distance covered was measured to the nearest meter. The percentage of the theoretical 6MWT distance (6MWTD) reached was calculated using the regression equation (6MWD=868.8−(2.99×age (years))−74.7) developed by Gibbons et al. [31] for the estimation of 6MWTD in healthy individuals aged between 20 and 80 years.

Two different tests were used to assess muscular endurance of the upper and lower limbs: the sit-to-stand test and the arm-curl test. The sit-to-stand test assesses dynamic muscular endurance and dynamic balance [32, 33]. The subjects were asked to stand up and sit down on a chair as many times as possible for 30 s, with the arms crossed on the chest to prevent their use for assistance. The number of full movements completed (buttocks against the chair and full extension of the knees) during the 30 s is recorded as the subject's score for the sit-to-stand test. The arm-curl test was developed and validated in the elderly to assess muscle strength of the upper limbs [34]. Given its convenience and simplicity, we used it to evaluate the dynamic muscular endurance of the biceps in our study population. Subjects were asked to perform as many flexion–extensions as they can within 30 s with their dominant arm using a 2.3-kg dumbbell. The number of full curls completed within 30 s was recorded as the score for the arm-curl test.

PA Practice

PA level was assessed using the International PA Questionnaire-Short Form (IPAQ-SF) [35]. As recommended in the IPAQ guidelines, PA data obtained were computed for metabolic equivalent (MET-min/week) (www.ipaq.ke.se). We used the IPAQ-SF questionnaire to evaluate whether subjects met general health (150 min/week) and weight maintenance (60 min/day=420 min/week) PA recommendations [22, 23]. For this, we multiplied the recommended time of PA in minutes per week by 4 METs. This represents moderate PA energy expenditure according to the IPAQ guideline. Thus, 150 min/week×4METs=1,000 METs/min per week for general health and 420×4 METs=1,680 METs/min per week for weight maintenance. One of the IPAQ-SF questions addresses time spent sitting as an additional indicator of sedentary activity. This, however, was not included in any summary score of PA.

Physical Self-Perception

The Physical Self-Inventory, a validated French-language version adapted from the Physical Self-Perception Profile, was used to assess participant's self-esteem in the physical domain [36, 37]. It includes 25 questions divided into two general scores: general self-esteem and physical self-worth. It is also divided into four subscales to assess perceptions of physical self-worth: physical condition, sport competence, body attractiveness, and physical strength. The answers to each question are expressed on a six-point Likert scale.

Physical Exercise Beliefs

To assess participants' beliefs relative to exercise benefits and the psychological barriers they perceived, we used the Physical Exercise Belief Questionnaire, previously validated in the obese population [38], which focuses on the major psychological barriers toward PA practice encountered by individuals with obesity [39]. This questionnaire, adapted from the Tampa scale for assessing kinesiophobia, consists of 16 questions divided into four areas: benefits of exercise, confidence in athletic ability, barriers to PA related to embarrassment, and fear of injury. The answer to each question is expressed from 1 to 5: 1=strongly disagree, 2=disagree, 3=neutral, 4=somewhat agree, and 5=strongly agree. The French-language translation of this questionnaire was according to the WHO recommendations using back-translation into English by an expert translator [40].

Statistical Analyses

The results are presented as mean values (±standard deviation). The Kolmogorov–Smirnov test showed normal distribution for all sample parameters. Unpaired Student's *t* tests for continuous variables and chi-squared for categorical variables were performed to detect and compare any differences between groups. Correlations were performed using Pearson's correlation test. We also used paired Student's *t* tests to compare the different daily life inconvenience scores per body part. Scores for ES inconveniences, physical self-perception, and physical exercise beliefs were transformed into percentages of maximal score for purposes of analyses. Data were analyzed with SPSS, version 17.0 (SPSS Inc., Chicago, IL). The null hypothesis was rejected at $p<0.05$.

Results

Population

Among the 26 subjects, with a mean age of 45.8 (±1.9) years, 6 (20 %) had no comorbidity, 6 (20 %) had well-controlled psychiatric disorders, and 8 (30.8 %) had medical conditions such as hypertension, sleep apnea, or type 2 diabetes. In addition, 10 (38.5 %) women had medical conditions that could affect practice of PA, such as asthma, osteoarthritis, or fibromyalgia. The majority of women were married or lived with a life partner and 7 (27 %) were divorced. Subjects had a mean household income over 30,000 Canadian dollars, a post-primary education diploma, and almost half reported working full time. Except for one woman who was unsatisfied with her bariatric surgery because of her resulting body image, the 25 other subjects (96.2 %) reported being satisfied, mostly because of improved health, mobility, weight, energy, and HRQoL. All women declared wanting plastic surgery, although the vast majority had financial limitations due to the absence of insurance coverage.

Anthropometric, Body Composition, and ES Measures

The pre- and post-surgery mean BMIs were 48.4±1.3 and 29.1±0.8, respectively. At the time of the study, 10 subjects (38.5 %) were classified as obese and 13 as overweight (50.0 %). The mean percentage of total weight loss post-bariatric surgery was 39.3±1.7 % after a mean of 2.0±0.2 years.

The vast majority of subjects presented grade 2 ES on the abdomen and upper arms, with no grade 1 or 4 for abdomen and no grade 3 or 4 for median thighs (Fig. 2a). The mean of ES was 103.1±6.0 % for the abdomen, 75.8±5.5 % for the upper arms, 47.5±2.9 % for medial thighs, and 75.5±18.8 % for the total ES percentage score. None of the characteristics studied (age: $r=0.2$, $p=0.40$; preoperative BMI: $r=0.3$, $p=0.19$; postoperative BMI: $r=0.14$, $p=0.49$; total weight loss: $r=0.05$, $p=0.815$; and time from surgery: $r=-0.09$, $p=0.68$) correlated with the total magnitude of ES.

Impact of ES on Daily Life Activities and Mobility

All subjects had ES on the abdomen, upper arms, and medial thighs, and all declared daily life inconveniences caused by ES at all these body parts, except for one subject who declared no inconvenience with her arms' ES. Daily life inconveniences were significantly higher for abdominal ES compared to medial thigh ES. No significant difference was observed between other body parts (Fig. 2b). The mean total daily life inconvenience score was 72.4±22.2 mm on a 100-mm scale. Moreover, some women indicated daily life inconveniences with ES on breasts (14, 53.8 %), buttocks (11, 42.3 %), face/neck (7, 26.9 %), back (5, 19.2 %), upper abdomen (4, 15.4 %), behind the thighs (1, 3.8 %), pubis (1, 3.8 %), forearms (1, 3.8 %), and ankles (1, 3.8 %). No significant correlation was observed between the total, abdominal, arm's, or thigh's percentages of ES and daily life inconveniences per body part or total scores. However, we found significant correlations between age and total or abdominal ES-related dailylife inconvenience scores ($r=0.47$, $p=0.02$; $r=0.41$, $p=0.04$) and between global self-esteem and abdominal-ES inconvenience score ($r=-0.55$, $p=0.004$). Pre-surgery BMI ($r=0.04$, $p=0.84$), actual BMI ($r=-0.03$, $p=0.89$), weight loss ($r=-0.04$, $p=0.86$), and time post-surgery ($r=0.33$, $p=0.99$) were not correlated with daily life inconvenience scores.

Twenty subjects (76.9 %) declared mobility limitations due to ES when they practiced PA or sports, for the several reasons presented in Fig. 3. Abdominal ES was cited as the most limiting during PA or sports for 18 (69.2 %) women, followed by upper arms (11, 42.3 %) and medial thighs (11, 42.3 %). The movements most reported as creating limitations due to ES were walking (abdomen and thighs), running (abdomen), bending (abdomen), and getting up (arms). Among the 26 women, only 8 (30.8 %) declared avoiding PA because of pain due to ES. Twelve women (46.2 %) declared avoiding certain PA or sports because of ES. The different reasons given by the subjects are presented in Fig. 3. Among women who reported avoiding PA, swimming was the most avoided activity (9, 75.0 %), followed by running (3, 25 %), dancing (2, 16.7 %), and cycling and tennis (1, 8.3 %). Solutions reported in order to practice PA with less inconvenience due to ES, by the 14 women who said they did not avoid PA or sports, were wearing a girdle to help maintain ES in place (5, 35.7 %), loose clothing with long sleeves (5, 35.7 %), and a swimsuit with a skirt (3, 21.4 %) to hide ES.

PA Practice and Fitness

Among the 26 subjects, 21 (80.8 %) achieved the IPAQ 1,000 METs/min per week general health recommendation and 18 (69.2 %) the weight maintenance recommendation of 1,680 METs/min per week. Total energy expenditure and time sitting declared were 4,206.0±4,989.1 METs/min per week and 428.1±163.8 min/day, respectively. Subjects walked a mean 538.6±16.0 m during the 6MWT, i.e., 81.8±2.2 % of the theoretical 6MWTD. The mean numbers of arm-curl and sit-to-stand repetitions were 19.1±1.0 and 14.2±0.8, respectively.

Physical Self-Perception

The mean scores for physical condition (41.2±3.8 %) and sport competence (41.5±4.3 %) are the lowest scores obtained by our population, followed by body attractiveness (46.2±3.0 %), physical strength (49.6±4.3 %), global self-esteem (52.8±3.6 %), and physical self-worth (58.5±3.5 %).

Physical Exercise Beliefs

Subjects had mean scores of 86.9±2.0 % for general health benefits, 45.6±2.1 % for confidence, 67.3±5.1 % for embarrassment, and 44.4±3.9 % for fear of injury.

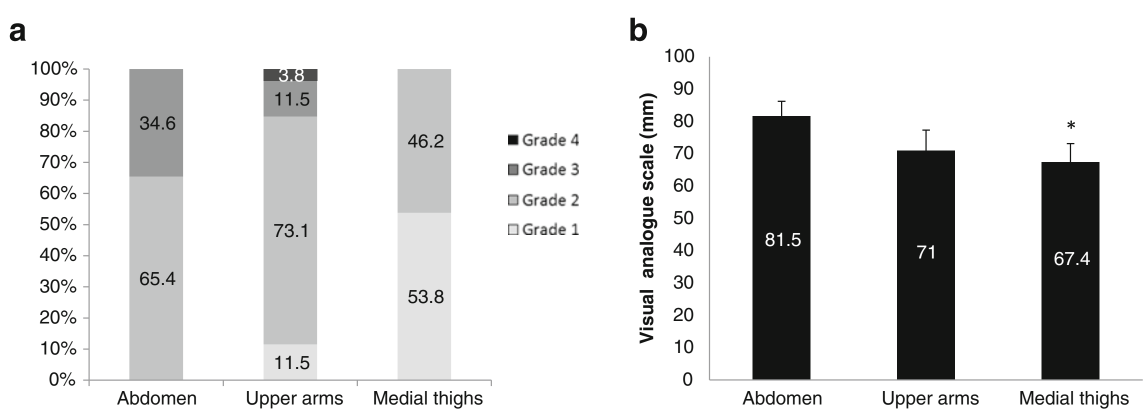


Fig. 2 **a** Percentage of women presenting excess skin on the abdomen, the upper arms, and the medial thighs by grade after massive weight loss. **b** Mean scores of daily life inconveniences by body parts caused by excess skin in women after massive weight loss. Data are presented as the mean (±SD). *Significantly different from abdomen

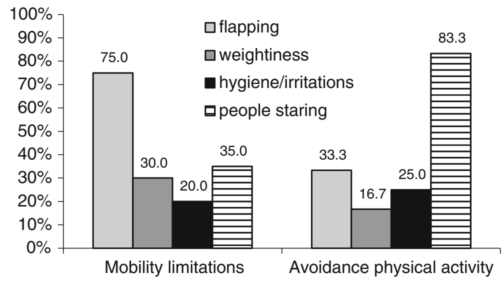


Fig. 3 Declared reasons of mobility limitations (n=20) and avoidance of physical activity (n=12) because of excess skin in percentage of women after massive weight loss

Comparison Between Subgroups

Subjects avoiding PA because of ES had significantly lower self-esteem, physical self-worth items (Fig. 4a), and experienced more embarrassment and fear of injury during PA (Fig. 4b). Although women who reported avoiding PA due to ES did not declare less energy expenditure, they declared more ES-related mobility limitations and displayed significantly lower 6MWTD and sit-to-stand repetitions compared to the other women (Table 1). Other comparative parameters between women who declared avoiding PA due to ES and those that did not are presented in Table 1. No significant difference was found between the two groups as to the magnitude of ES, but it tended to be greater in subjects avoiding PA (p=0.06).

No significant difference was observed between subjects achieving PA recommendations, for general health benefits and weight maintenance, or those that did not with respect to anthropometric data, age, percentage of ES, daily life inconvenience scores, physical exercise beliefs, and physical fitness. For physical self-perception, only physical self-worth was significantly lower in subjects not achieving recommendations for general health benefits (42.6±20.9 vs. 62.2±15.0 %, p=0.02) and weight maintenance (46.3±16.8 vs. 63.9±15.5 %, p=0.02).

Fig. 4 **a** Physical self-perception profile of women who reported avoiding physical activity and those that did not after massive weight loss. **b** Exercise beliefs of women who reported avoiding physical activity and those that did not after massive weight loss. Data are presented as the mean (±SD). *p<0.05 between groups. *PA* physical activity

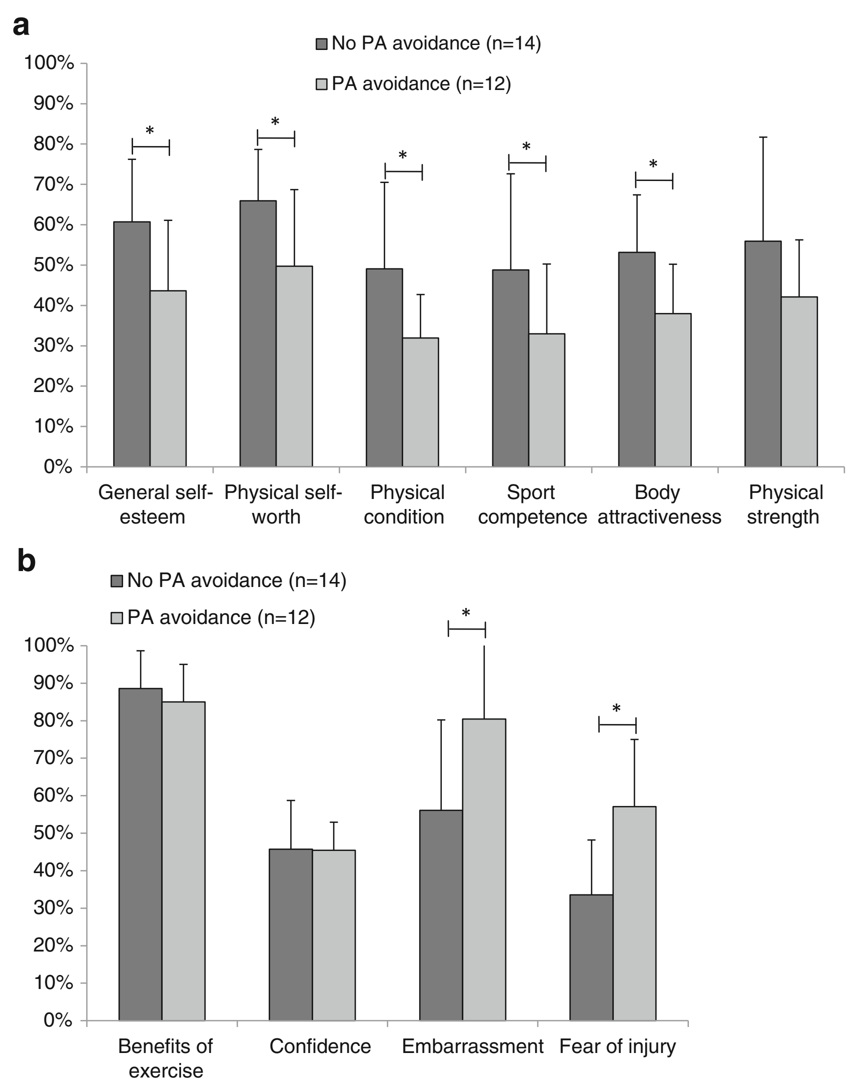


Table 1 Comparison between women declaring avoiding or not physical activity or sport because of excess skin

	Women not avoiding PA (n=14)	Women avoiding PA (n=12)	p values
General characteristics			
Age (years)	44.50 (±8.3)	47.25 (±11.6)	0.49
Preoperative BMI (kg/m^2)	49.37 (±6.3)	47.16 (±6.6)	0.39
Current BMI (kg/m^2)	29.06 (±4.6)	29.09 (±3.6)	0.98
Total weight loss (%)	40.77 (±8.4)	37.54 (±9.5)	0.37
No. of comorbidities	1.4 (±1.2)	1.4 (±1.4)	
Abdomen ES (%)	94.01 (±22.1)	113.78 (±36.3)	0.12
Upper arms ES (%)	69.34(±23.2)	83.23 (±31.8)	0.21
Medial thighs ES (%)	43.98 (±15.5)	51.61 (±13.9)	0.20
Total ES (abdomen, arms, thighs, %)	69.11 (±15.3)	82.87 (±20.4)	0.06
Perceptions			
Total daily life inconveniences (mm)	70.87 (±18.3)	74.17 (±20.4)	0.71
Subjects with mobility limitations because of ES (%)	57.1	100	0.02
Subjects avoiding PA because of pain (%)	28.6	33.3	1.0
PA practice and sedentary indicator			
Subjects reaching PA recommendations for good health (%)	78.6	83.3	1.0
Subjects reaching PA recommendations for WL maintenance (%)	64.3	75.0	0.68
Total IPAQ score (MET/min/sem)	4,094.25 (±4496.5)	4,336.42 (±5713.4)	0.91
Sitting time (min)	430.71 (±169.1)	435.00 (±179.3)	0.95
Physical fitness			
6MWTD (m)	569.93 (±82.2)	502.00 (±66.9)	0.03
Theoretical 6MWTD reached (%)	86.13 (±11.5)	76.82 (±8.4)	0.03
Arm-curl number	20.43 (±4.1)	17.50 (±6.2)	0.16
Sit-to-stand number	15.71 (±4.0)	12.50 (±4.1)	0.05

Data are presented as the mean (±standard deviation)

PA physical activity, *L* limitations, *ES* excess skin, *WL* weight loss, *IPAQ* International Physical Activity Questionnaire, *MET* metabolic equivalent, *6MWTD* 6-min walking distance

Discussion

This transversal study shows that after massive weight loss following bariatric surgery, all subjects presented ES and that, except for one, all experienced daily life inconveniences due to ES. For some, ES led to the avoidance of certain physical activities. However, it was impossible to identify a strong association between the magnitude of ES, either total or body part-specific, and reported daily life inconveniences.

All subjects had ES on the abdomen, upper arms, and thighs due to massive post-bariatric surgery weight loss, confirming that this issue is frequent in this population [8–10]. Unfortunately, other studies did not evaluate the magnitude of ES objectively, preventing comparison with our data. The mean total inconvenience score was 72.4 (±22.2)mm on a 100-mm scale in our population, which is similar to what has been reported previously [8]. According to our results, mean daily life inconvenience caused by ES was mainly due to abdominal ES, followed by upper arm and medial thigh ES. While it is reasonable to assume that a higher degree of ES causes more daily life inconveniences, paradoxically, our results showed no correlation between the degree of ES and the degree of inconvenience. However, age and self-esteem did significantly correlate with daily life inconveniences. Despite the absence of any significant difference, subjects who reported that they avoided PA due to ES tended to have more ES than subjects who reported that they did not avoid PA due to ES. Another study found no correlation between the unpleasantness experienced caused by ES and age; however, the population was a mix of men and women as opposed to our women-only population [8].

Over three quarters of our subjects declared mobility limitations due to ES when they practiced PA or sports and that abdominal ES was the most limiting. These results are consistent with those of Kitzinger et al. [9] who reported that 96 % of the 425 subjects who had undergone gastric bypass surgery declared having at least some problems in practicing sports as opposed to only 4 % who said they did not experience discomfort during PA due to ES. Interestingly, our results show, for the first time, that walking, running, bending, and getting up are reported as the most limited movements due to the flapping, irritation, and sheer weight of the ES as well as the staring gazes of other people. These reasons were concordant with those reported by Biorserud et al. [8].

It is important to emphasize that in our study, nearly half of the women declared avoiding some PA or sports due to ES. Swimming was the most avoided of all sports, probably due to feelings of embarrassment because of the stares of other people, which was the most frequent explanation of avoidance of PA. Biorserud et al. [8] also highlighted that a remarkably high proportion of subjects actually avoided the very same activities they used to perform before bariatric surgery because of other people staring. According to our results, this group experienced more barriers to the practice of PA: more embarrassment and fear of injury during PA or sports, lower self-esteem and physical self-worth, and tendency to display a greater degree of ES. Thus, the psychological parameters related to ES, such as feelings of embarrassment, lower self-esteem, other people staring, seem to be more important in the avoidance of PA practice than the physical inconvenience or limitation caused by ES. Supervised PA practice or psychological follow-up before and after bariatric surgery could help subjects experience less embarrassment and improve their body image [41–43] as ES itself can only be reduced by expensive plastic surgery.

Although the group of women who reported avoiding PA because of ES did not report less energy expenditure than those who did not report avoiding PA, they did have significantly lower 6MWTD and arm-curl numbers, suggesting that they chose less intense activities. This may contribute to their lower physical fitness. Nevertheless, the theoretical 6MWTD reached by each group (76.8±8.4 vs. 86.1±11.5 %) revealed a relatively good fitness level compared to the data reported prior to bariatric surgery by others (<60 % of the normative values) [44, 45]. Our results also showed no significant difference for percentage of ES and daily life inconveniences between subjects that reached PA recommendations for health and weight maintenance and those that did not. Although Biorserud et al. [8] found that subjects who exercised more than three times per week reported a significantly lower degree of inconvenience than those who exercised less often, they failed to show any correlation between the unpleasantness experienced because of ES and the level of PA, and between subjects performing PA at least 30 min/day compared to those who were less active. This previous finding supports our results. Therefore, while ES may be a barrier to the practice of PA for some women, it does not in itself preclude the regular practice of PA.

Our study is the first study of its kind to focus on the effects of ES on the practice of PA, providing new and important information with respect to the physical and psychological consequences of bariatric surgery and postoperative results. Clinicians should be aware of the impact of post-bariatric surgery ES in order to fully inform and adequately counsel their patients. Clinicians should expressly address this important issue in discussions with their patients. Counseling that takes all of the possible consequences of ES into consideration will lead to better-informed choices regarding bariatric surgery as well as more realistic expectations with respect to the aftermath and challenges which await patients who opt for it. The effect of ES was evaluated with a combination of objective and subjective measures in order to quantify the magnitude of ES and its inconveniences. Our results on the practice of PA should be interpreted with caution since we used self-reported data which are susceptible to recall and desirability bias [25]. Nevertheless, we added an objective evaluation of physical fitness to reduce this bias and assume that all women over-reported their practice of PA. Longitudinal data will be needed in the future to confirm our results. It will also be important to explore the effects of reconstructive plastic surgery on daily life inconveniences and barriers to the practice of PA. Finally, our results cannot be generalized to all post-bariatric patients, given our relatively small sample size focusing only in women and the absence of extreme values of ES.

Conclusion

ES is a major problem after massive weight loss, causing physical, social, and psychological inconveniences. Although patients with ES declared inconveniences during PA, some found ways to remedy or avoid embarrassment during PA. Thus, although ES can be a real barrier to the practice PA, it does not in itself prevent the regular practice of PA. The magnitude of ES does not seem to be as highly related to the avoidance of PA as are physical self-perception, feelings of embarrassment, and social stigma. Knowing that ES is a barrier for some patients, especially toward the practice of specific types of PA, clinicians should engage open discussions with their patients, as much preoperatively as postoperatively, in order to fully inform and adequately counsel about ES, its possible consequences, and the different means to deal with it.

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