

# Body Image and Health-related Behaviors Among Fitspirit Participants

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## Research Article

**Keywords:** Body size perception, Body size dissatisfaction, Healthy habits, Physical activity, Adolescent girls, Health behaviors, Self-perception, Obesity

**Posted Date:** May 26th, 2022

**DOI:** <https://doi.org/10.21203/rs.3.rs-1431145/v1>

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# Abstract

**Background:** Body image variables such as body size perception (BSP) and body size dissatisfaction (BSD) can influence health-related behaviors. However, few studies have investigated these body image variables in adolescent girls participating in a physical activity intervention. Therefore, the study objectives were to examine the 1) associations between health-related behaviors (physical activity, screen time, eating habits and sleep duration) and BSP and BSD among girls participating in FitSpirit, a physical activity intervention for girls; and 2) influence of weight control practices on the association between health-related behaviors and BSP and BSD.

**Methods:** This cross-sectional study used a sample of 545 adolescent girls (mean age:  $15.0 \pm 1.5$  years) from 240 schools. Body mass index, health-related behaviors, perceived actual body size and desired body size variables were self-reported and collected via an online questionnaire at the end of the FitSpirit intervention. A negative BSP score [perceived actual body size – calculated BMI z-score] indicates an underestimation of body size. A positive BSD score [perceived actual body size – desired body size] indicates a desire to reduce body size. A multiple linear regression analysis examined the effects of age, zBMI and health behaviors on BSP and BSD. A second multiple linear regression analysis examined the independent associations between BSP and BSD by weight control practice. The linear relationships between BSP and BSD were evaluated with Pearson's correlations.

**Results:** Underestimation and dissatisfaction of body size are more prevalent in participants living with overweight/obesity. Screen-time and sleep duration were independently associated with BSP score (Beta=0.02;  $P < 0.05$  and Beta=-0.07;  $P < 0.05$ , respectively), whereas only screen time was associated with BSD score (Beta=0.07;  $P < 0.001$ ). Physical activity was independently associated with BSP score only in participants trying to control their weight (Beta=-0.18;  $P < 0.05$ ).

**Conclusions:** Body size overestimation and dissatisfaction are associated with health-related behaviors, specifically with more screen-time and less optimal sleeping habits. Physical activity level does not appear to be associated with body image in girls engaged in a physical activity intervention and who want to lose or gain weight. Health promotion interventions could include screen-time and sleep components as they may influence body image.

## Background

Research has shown that regular physical activity (PA) and low sedentary time are positively associated with physical, social and mental health [1, 2]. Despite these known benefits, the latest evidence suggests that PA levels decline drastically during the transition from childhood to adolescence, especially in girls, while sedentary time increases considerably [3]. In Canada, only 14% of adolescent girls meet the daily 60 min of moderate-to-vigorous PA recommendations [4] which can be a critical determinant of obesity [5]. Compared to normal weight girls, adolescent girls living with overweight/obesity (OW/OB) are more likely to engage in unhealthy weight control practices [6]. Past research has shown that there is a bidirectional association between body image variables, such as body size perception (BSP) and body size dissatisfaction (BSD), and obesity-related behaviors, including an unhealthy lifestyle and weight control practices [6–8].

Several studies suggest that adolescent girls living with OW/OB are more likely to underestimate their body size, which can impact the adoption of certain health behaviors [7, 9]. For example, a previous study conducted in Quebec found that 90% of adolescent girls living with OW/OB failed to identify their size compared to 55% of

underweight and 13% of those normal weight [10]. Past research has shown that misperception can be an antecedent to healthy and unhealthy behaviors [7]. Body size overestimation is associated with a higher screen-time [11], greater vegetable consumption [12] and unhealthy weight control practices [7]. On the other hand, adolescents who underestimate their body size have a lower level of PA [13] and are less likely to adopt unhealthy weight control practices [14].

There is evidence that body size dissatisfaction is highly prevalent in girls, especially those living with OW/OB [15]. A study in Quebec demonstrated that, in adolescent girls, the desire to reduce body size was more present than the desire to increase body size (47% vs. 11%, respectively) [10]. Furthermore, 81% of adolescent girls living with OW/OB reported being dissatisfied with their body size compared to 45% of underweight and 52% of normal weight [10]. The aspiration to reduce body size has been associated with obesity-related behaviors such as poor sleep [16] and low consumption of fruits and vegetables [17]. BSD has also been shown to behave as both a motivation and barrier to PA [18, 19]. For example, it has been reported that individuals with a high BSD may avoid opportunities to exhibit their bodies in a public setting or be exposed to weight criticism during PA [18]. In contrast, it has been shown that some adolescent girls may engage in PA to improve or maintain a desired physical appearance [19]. Body size satisfaction may positively influence health behaviors in this population and protect against harmful weight control practices [20].

Adolescent girls were identified as a target population for several school-based interventions that aimed to increase the practice of PA and reduce screen-time [21–23]. Over the past 20 years, many health-promotion initiatives have been implemented to encourage young girls to adopt a healthy and active lifestyle [22, 24]. Through these various interventions, evidence suggests that "girls-only" school-based interventions, such as FitSpirit [25], may be successful approaches to increase PA [21, 26]. However, there are a lack of studies examining the association between body image variables, such as BSP and BSD, and health behaviors in adolescents participating in a "girls-only" school-based intervention.

Examining the association between body image variables and health behaviors is important to better understand this relation and intervene more specifically in "girls-only" school-based interventions. In this context, the first objective of this study was to determine whether health-related behaviors [PA, screen time, sleep duration and vegetable/fruit consumption], are independently associated with BSP and BSD among FitSpirit participants. The second objective was to investigate the association between BSP and BSD according to weight control practices. Finally, we hypothesized that misperception and dissatisfaction would vary with weight control practices and weight status.

## Methods

### Participants

The participants of this study took part in FitSpirit, a girls-only school-based intervention designed by a nonprofit organization (FitSpirit.ca). Since 2007, FitSpirit has helped schools organize activities and events for adolescents girls and engages approximately 12 000 participants yearly [27]. FitSpirit aims to raise adolescent girls' motivation and enjoyment of regular PA by offering them different opportunities to be physically active and thus, promote the adoption of an active lifestyle in the short and long-term [25]. School group activities are organized and led by a school staff member (FitSpirit leader). The intervention is generally carried out from February to May, but could

start earlier. Approximately 250 high schools partner with FitSpirit across two Canadian provinces (Quebec and Ontario) every year.

In the Spring of 2018 and 2019, FitSpirit participants from each school engage in the FitSpirit program were invited to participate in the evaluation study [25]. For each school, the FitSpirit leader invited girls interested by the evaluation, regardless of the school level of the participant, to provide consent. All participants who signed a consent form were included in the draw. At the end of the school year, which corresponds to the end of the intervention, FitSpirit sent an email inviting the girl's participants to complete an online questionnaire in French and English. The participants were classified according to an identification number and were selected once considering that the present study is cross-sectional. Of all the research participants, some were excluded from the analyses for different reasons as illustrated in the Flowchart

(Fig. 1).

## **Anthropometric measures**

Body mass index (BMI) was calculated from self-reported height and weight ( $\text{kg}/\text{m}^2$ ) and converted to a standardized z-score using age- and sex-specific 2007 WHO growth reference charts for 5–19 years [28]. Scores were used to classify the weight status of adolescents as underweight ( $\text{zBMI} < -2$  standard deviation), normal weight ( $1 > \text{zBMI} \geq -2$ ), overweight ( $2 > \text{zBMI} \geq 1$ ) or obese ( $\text{zBMI} \geq 2$ ) [28].

## **Health-related behaviors**

Self-reported PA was measured using the modified version of the short form of the International Physical Activity Questionnaire (IPAQ-SF) [29]. First, girls were asked about the total minutes spent on active travel and active leisure in the last seven-day period. Total PA time was calculated as the sum of these two results and then converted to mean minutes per day. Subsequently, screen time was used as a surrogate measure of sedentary time. The girls self-reported the average time they spent on a typical day, watching TV, playing computer and video games, using a computer (also for homework), cellphone, etc. Thereafter, screen time was converted to mean hours per day. Next, sleep duration was assessed with a single question asking girls to estimate, on average, how many hours they sleep in 24 hours. Consumption of vegetables and fruits was assessed using adapted questions from a validated self-reported survey [30]. Adolescent girls were asked to estimate how many days per week (0–7) and how many servings per day they consumed vegetables and fruits (not counting juice).

Current weight control practice was assessed using the questions taken from the Project EAT (Eating and Activity over Time), which was specifically designed to explore eating and weight-related issues among diverse young people across the life course [31]. Participants were asked the following question: Are you currently trying to. . . (1) lose weight, (2) stay the same weight, (3) gain weight/muscles, or (4) I am not trying to do anything about my weight.

## **Measurements of perceived actual body size and desired body size**

BSP and BSD were assessed using the Collins Figure Rating Scale [32], consisting of a series of seven-line drawing figures, ranging from extremely thin to obese with a middle figure representing a normal body size. Girls were asked to select the silhouette they believed was most similar to their own (perceived actual body size) as well

as the body figure they most desired to look like (desired body size). We standardized the Collins figure scale for the perceived and desired body size as described by Maximova et al. [33] so that each figure was assigned a corresponding z-score (-3, -2, -1, 0, 1, 2, 3). Because the silhouettes are correlated with BMI percentiles [34], z-scores of -1, 0 and 1 represent normal body weight, while z-scores of 2 and 3 standard deviations above and below the mean have been associated with the overweight/obese (OW/OB) and underweight categories, respectively.

Following this procedure, the BSP score was calculated as the discrepancy between the perceived actual body size and the actual body size (zBMI). According to the method described by Bordeleau et al. [35] using the BSP score, girls were classified into three groups: Underestimators (BSP score < -0.5); Accurate estimators (-0.5 ≤ BSP score ≤ 0.5); and Overestimators (BSP score > 0.5). Similarly, subtracting the desired body size from the perceived body size yielded the BSD score. According to the results obtained, the girls were also classified into three groups: desire to reduce body size (BSD score > 0.5); satisfied (-0.5 ≤ BSD score ≤ 0.5); and desire to increase body size (BSD score < -0.5).

## Statistical analyses

Student's t-test was used to explore the mean of continuous variables, e.g., PA, screen time, sleep duration and fruit and vegetable consumption, and difference between weight status subgroups. Chi-squared ( $\chi^2$ ) tests were used to examine differences in the prevalence of each categorical variable for BSP (accuracy, underestimation and overestimation) and BSD (satisfaction, desire to reduce body size and desire to increase body size). Multiple linear regression models were analyzed to examine the effects of age, zBMI and health behaviors on BSP and BSD scores. Models with the lowest Akaike information criterion (AIC) were chosen. Girls were then divided into four groups according to their current weight control practice: Trying to lose weight, trying to maintain weight, trying to gain weight/muscles, and not trying to do anything. A second multiple linear regression analysis examined the association between BSP and BSD by weight control practice. The linear relationship between BSP and BSD according to weight control practices was evaluated with Pearson's correlations. Finally, Pearson's correlation analyses investigated the associations between BSP and BSD adjusted for age. Statistical significance was considered at  $P$ -value ≤ 0.05. All analyses were performed with SAS OnDemand for Academics (Cary, NC, USA).

## Results

### Participant characteristics

The mean age for the 545 adolescent girls was 15.0 ± 1.5 years. For the total sample, about three quarters (77%) were considered normal weight, while 23% were classified as OW/OB. The descriptive statistics of adolescents' characteristics are presented by weight status in Table 1. In both the normal weight and OW/OB subgroups, mean perceived actual body size was significantly smaller ( $p < 0.05$ ) than self-reported zBMI (-0.5 ± 1.0 vs. -0.2 ± 0.7 and 0.9 ± 0.8 vs. 1.7 ± 0.7, respectively). Furthermore, mean desired body size was smaller than BSP score in the normal weight subgroup, but higher in the OW/OB subgroup (Table 1). Regarding health behaviors, sleep duration was the only health behavior for which there was a significant difference between the weight status subgroups.

Table 1  
 Characteristics of participants classified by body weight status

	Normal weight (n = 422)	Overweight/obese (n = 123)	p-value
Body image variables			
Age (y)	15.0 ± 1.5 (12.0, 17.8)	15.2 ± 1.4 (12.0, 17.8)	0.10
zBMI	-0.2 ± 0.7 (-1.88, 0.98)	1.7 ± 0.7 (1.00, 3.98)	< 0.001
Perceived actual body size	-0.5 ± 1.0 (-3.0, 3.0)	0.9 ± 0.8 (-1.0, 3.0)	< 0.001
Desired body size	-0.9 ± 0.9 (-3.0, 3.0)	-0.7 ± 0.9 (-3.0, 1.0)	< 0.05
Body size perception score	-0.3 ± 0.9 (-2.9, 3.4)	-0.9 ± 0.9 (-4.0, 1.0)	< 0.001
Body size dissatisfaction score	0.4 ± 1.1 (-5.0, 6.0)	1.5 ± 1.0 (-1.0, 6.0)	< 0.001
Health-related behaviors			
Physical activity (h/day)	1.2 ± 1.0 (0.0, 7.1)	1.2 ± 1.1 (0.0, 6.2)	0.83
Screen time (h/day)	3.4 ± 2.0 (0.4, 10.1)	3.4 ± 1.9 (0.6, 10.0)	0.92
Sleep duration (h/day)	8.1 ± 1.4 (3.0, 13.0)	7.8 ± 1.5 (3.2, 12.0)	< 0.05
Fruits/Vegetables (servings/day)	3.6 ± 2.1 (0.1, 8.0)	3.2 ± 2.0 (0.3, 8.0)	0.10
Data are presented as non-adjusted means ± SD (min-max).			

## Body size perception and body size dissatisfaction

Mean BSP score was lower in the OW/OB subgroup, and BSD score was smaller in the normal weight subgroup (Table 1). Moreover, 41% of the girls accurately self-evaluated their body size (“Accurate estimators”), 45% thought they were thinner (“Underestimators”) and 14% thought they were bigger (“Overestimators”) than they were (zBMI). Figure 2A shows that the prevalence of categorization of BSP was different according to weight status. Underestimation was more prevalent among girls living with OW/OB compared to the normal weight group (56%

vs. 41% respectively). Regarding BSD, 34% of the total sample reported being satisfied with their body size, while 55% expressed the desire to reduce their body size and 11% to increase their body size. Figure 2B shows that 45% of normal-weight girls wanted to reduce their body size while this proportion rose to 92% among the OW/OB subgroup.

## Associations between Body size perception, body size dissatisfaction and health-related behaviors

Table 2 presents the effect of age, zBMI and health behaviors [PA, screen-time, sleep duration and vegetable/fruit intake] in BSP and BSD scores. Results revealed that screen time and sleep duration were independently associated with BSP score (Beta = 0.05,  $p < 0.05$ ; Beta = -0.07,  $p < 0.05$ , respectively). Screen-time was the only health behavior associated with the BSD score (Beta = 0.07,  $p < 0.001$ ).

Table 2  
Contribution of health behaviors on body size perception and dissatisfaction scores

Variables	Body size perception score					Body size dissatisfaction				
	R <sup>2</sup>	Partial R <sup>2</sup>	Beta	p-value	95% CI	R <sup>2</sup>	Partial R <sup>2</sup>	Beta	p-value	95% CI
	0.19					0.32				
Age (y)		0.03	0.07	0.004	[0.02, 0.13]	0.00	0.05	0.09		[-0.01, 0.10]
zBMI		0.13	-0.33	< 0.001	[-0.39, -0.26]	0.30	0.58	< 0.001		[0.51, 0.66]
Physical activity (h/day)		—	—	—	—	—	—	—	—	—
Screen time (h/day)		0.02	0.05	< 0.05	[0.02, 0.09]	0.02	0.07	< 0.001		[0.03, 0.11]
Sleep duration (h/day)		0.01	-0.07	< 0.05	[-0.12, -0.01]	—	—	—	—	—
Fruits/vegetables (servings/day)		—	—	—	—	—	—	—	—	—
CI: confidence intervals;										
—: Variable not retained in the model with the lowest Akaike's Information Criterion-corrected (AIC).										

## Body image and health behaviors by weight control practices

In the present study, 56% of the OW/OB subgroup reported trying to lose weight while this prevalence was 19% in the normal-weight subgroup. Furthermore, a higher percentage of girls with a normal weight were trying to control their weight or gain weight/muscles than girls living with OW/OB (31% vs. 22% and 20% vs. 10%; respectively). As presented in Table 3, PA was only independently associated with BSP score among girls trying to control their weight (Beta = -0.18,  $p < 0.05$ ). In contrast, each serving of fruit/vegetable was associated with a variation of -0.1 of BSP score in the subgroup of girls who were not trying to control their body weight (Beta = -0.10,  $p < 0.05$ ). Thus,

each hour of PA among girls trying to control their weight was associated with a variation of -0.18 of the BSP score (Beta = -0.18,  $p < 0.05$ ).

Table 3

## Contribution of health behaviors in body size perception and dissatisfaction scores by weight control behaviors

Variables	Body size perception score					Body size dissatisfaction score				
	R <sup>2</sup>	Partial R <sup>2</sup>	Beta	p-value	95% CI	R <sup>2</sup>	Partial R <sup>2</sup>	Beta	p-value	95% CI
<b>Trying to lose weight (n = 147)</b>										
	0.29					0.11				
Age (y)		0.01	0.07	0.13	[-0.02, 0.17]		—	—	—	—
zBMI		0.23	-0.53	< 0.001	[-0.67, -0.38]		0.09	0.32	< 0.001	[0.15, 0.49]
Physical activity (h/day)		—	—	—	—		—	—	—	—
Screen time (h/day)		—	—	—	—		—	—	—	—
Sleep duration (h/day)		0.05	-0.12	0.007	[-0.21, -0.03]		0.02	-0.09	0.08	[-0.19, 0.01]
Fruits/vegetables (servings/day)		—	—	—	—		—	—	—	—
<b>Trying to control weight (n = 157)</b>										
	0.38					0.13				
Age		—	—	—	—		—	—	—	—
zBMI		0.29	-0.51	< 0.001	[-0.64, -0.38]		0.10	0.24	< 0.001	[0.14, 0.35]
Physical activity (h/day)		0.03	-0.18	< 0.05	[-0.30, -0.05]		—	—	—	—
Screen time (h/day)		0.06	0.12	< 0.001	[0.07, 0.18]		0.03	0.06	< 0.05	[0.01, 0.11]
Sleep duration (h/day)		—	—	—	—		—	—	—	—
Fruits/vegetables (servings/day)		—	—	—	—		—	—	—	—
<b>Trying gain weight/muscle (n = 98)</b>										
	0.04					0.46				
Age		—	—	—	—		—	—	—	—

CI: confidence intervals;

—: Variable not retained in the model with the lowest Akaike's Information Criterion-corrected (AIC).

	Body size perception score				Body size dissatisfaction score			
zBMI	0.04	-0.18	< 0.05	[-0.35, -0.01]	0.42	0.87	< 0.001	[0.67, 1.07]
Physical activity (h/day)	—	—	—	—	—	—	—	—
Screen time (h/day)	—	—	—	—	0.01	0.07	0.13	[-0.02, 0.17]
Sleep duration (h/day)	—	—	—	—	0.02	0.17	< 0.05	[0.02, 0.33]
Fruits/vegetables (servings/day)	—	—	—	—	—	—	—	—
<b>Not trying to do anything (n = 137)</b>								
	0.27				0.18			
Age	0.02	0.10	< 0.05	[0.00, 0.19]	—	—	—	—
zBMI	0.20	-0.45	< 0.001	[-0.60, -0.31]	0.16	0.37	< 0.001	[0.22, 0.51]
Physical activity (h/day)	—	—	—	—	—	—	—	—
Screen time (h/day)	—	—	—	—	0.03	0.08	< 0.05	[0.00, 0.15]
Sleep duration (h/day)	—	—	—	—	—	—	—	—
Fruits/vegetables (servings/day)	0.05	-0.10	< 0.05	[-0.17, -0.03]	—	—	—	—
CI: confidence intervals;								
—: Variable not retained in the model with the lowest Akaike's Information Criterion-corrected (AIC).								

Pearson's correlations were conducted to examine the associations between BSP and BSD scores among participants reporting different weight control practices. Significant positive correlations between BSP and BSD among participants using different weight control practices were observed. However, the correlations by weight status subgroups were not all significant (Fig. 3). Figure 3A shows significant positive correlations between BSP and BSD scores among girls trying to lose weight in the normal and obese subgroups. Moreover, the relationships between BSP and BSD were significantly different between the two subgroups (slope and intercept:  $p < 0.001$ ). In girls trying to control their weight (Fig. 3B) and those who are trying to gain weight (Fig. 3C), significant relationships were observed only in normal-weight girls. Finally, Fig. 3D shows significant positive correlations between BSP and BSD scores among girls who are not trying to do anything in the normal and obese subgroups. The relationships between BSP and BSD were significantly different between the two subgroups (slope and intercept:  $p < 0.05$ ).

## Discussion

Misperception and dissatisfaction of body size are common phenomena among adolescents [10]. Since BSP and BSD can be determinants of health behaviors and unhealthy weight control practices, it is important to question whether or not adolescent girls who engage in PA interventions have a positive body image. In response to these concerns, this study aimed to examine the associations between health-related behaviors, BSP and BSD in girls who participated in a PA promotion intervention and to document the degree to which behaviors are associated with the expression of BSP or BSD. These findings suggest that some health-related behaviors, i.e. screen time, sleep patterns, are associated with overestimation and dissatisfaction, which may vary depending on weight control practices and weight status.

First, when compared by weight status subgroups the prevalence observed in a population of adolescents from the province of Quebec, FitSpirit participants living with OW/OB appeared to assess their weight status more accurately (10% vs. 42%, respectively) while the normal-weight subgroup underestimated their body size (13% vs. 41%, respectively) [10]. These results are in line with Gesell *et al.* (2010), who found that a PA intervention among overweight children had an impact on the accuracy in body size perception, which could explain why girls living with OW/OB have a more accurate perception of their weight status [36]. A review also demonstrated that the increase in the tendency to underestimate body size may be explained by the “visual normalization theory” [37]. This theory suggests that one’s perception of his/her own body size depends on the size of the bodies this person is frequently exposed to in his/her environment [37]. In the present study, the proportion of adolescents living with OW/OB was higher than in the one carried out in Quebec (23% vs. 19%, respectively) [10]. Hence, in FitSpirit, the higher exposure to heavier bodies may explain the greater underestimation of body size among normal weight participants and the more accurate perception among those living with OW/OB. In addition, this difference in prevalence between the two studies could also be explained by a potential selection bias. Adolescents involved in FitSpirit desired to improve their level of PA for different reasons, including reasons related to BSD.

Moreover, our results are in line with previous studies showing that adolescents living with OW/OB report body size dissatisfaction more frequently [10]. However, the present results revealed that girls living with OW/OB reported a higher proportion of the desire to reduce body size than another adolescent girl’s population from Quebec (92% vs. 78%, respectively) [10]. This higher proportion could be explained by the context of the studies, including a possible selection bias induced by a higher interest toward PA in our study as well as a potential impact of the intervention itself. In addition, it has been shown that this type of intervention, exclusive to girls, could enhance the comparison of the body between the participants and may lead to a more frequent desire to reduce body size [38].

Regarding health behaviors, screen-time was positively associated with BSP and BSP. Thus, each hour of screen-time was associated with a significant increase of body size overestimation and a desire to reduce body size. Social media such as Instagram occupy an important proportion of screen-time in adolescents girls [39]. The users of these social media platforms are frequently exposed to appearance-highlighting content, including retouched images, leading to unrealistic body ideals [40, 41]. Adolescent girls who fail to meet these standards may view their body concerns increase, which can be related to body size overestimation and dissatisfaction [7, 42, 43]. In line with the meta-analysis results, higher screen time may be associated with the desire to reduce body size [44].

Furthermore, research revealed that exposure to social media is linked to body dissatisfaction [44]. Higher social media usage increases opportunities for adolescent users to engage in social comparisons as they can compare themselves to their friends, family, influencers and celebrities [45, 46]. A recent study by Scully *et al.* (2020)

suggests that body dissatisfaction increases significantly with time spent on social comparisons [47]. Furthermore, previous studies have shown that screen-time use can delay bedtime, reducing sleep duration in adolescents [48]. Correspondingly, the present study results showed that one hour less of sleep was associated with a body size overestimation. Thus, a possible relationship could exist between screen-time, sleep duration, and overestimation of body size.

Even though PA did not emerge as an independent variable associated with body image, past studies showed that PA could be indirectly related via its association with screen-time and sleep duration. Greater screen-time has been associated with a lower PA [49] while a higher PA has improved sleep duration [50, 51]. In addition, because the current study is cross-section, it is impossible to establish a causal relationship. Considering that the data were collected towards the end of the FitSpirit intervention, the study participants are those who have remained engaged until this moment and therefore, are more inclined to achieve a minimum of PA, which could have impacted the results. Nevertheless, the results of the study suggest that 53% of the participants meet the daily 60 min of moderate-to-vigorous PA recommendation which is higher than what has been found in similar populations [4]. Moreover, we do not have comparative data that would allow us to better analyze the impact of changes in PA on BSP and BSD during the FitSpirit intervention.

Another aim of the present study was to determine if the association between health behaviors with BSP and BSD differed by weight control practices. Results showed that fruit/vegetable consumption was associated with the underestimation of body size in those not trying to control their weight. We also found that PA was only associated with underestimation in the subgroup currently trying to control weight. This result is consistent with another study among primary school children that observed that girls who perceived themselves as overweight were favorable towards PA to control weight [52]. Therefore, it is positive to note that PA level is not associated with BSP and BSD in the other weight control practices. Therefore, PA level is not related to body image variables in girls who are trying to lose weight or gain weight/muscles engaged in a PA promotion intervention.

Given that BSP and BSD are influenced by body weight status and weight control practices, understanding the association between these BSP and BSD by body weight status and weight control practice may provide a further understanding of these associations. Accordingly, as observed in Fig. 3, we found significant correlations between BSP and BSD scores according to weight control practices and weight status. A relationship was present in all normal-weight subgroups regardless of the weight control practices. As observed in Fig. 3A, the correlation is similar between the two weight subgroups. However, in Fig. 3D, the correlation is much stronger in adolescent girls living with OW/OB. The positioning suggests that the greater underestimation is associated with body size satisfaction with this group. This result is in line with the study by Bordeleau et al. (2021) conducted among primary school children, where an underestimation in children living with obesity was associated with a lower desire to be thinner [35]. Thus, youth living with OW/OB who underestimate themselves protect themselves from a BSD and unhealthy weight control practices. Moreover, those who reported trying to control their weight seemed to be satisfied with their body size and almost all girls living with OW/OB were underestimators. As mentioned, PA was associated with BSP only in girls trying to control their weight. Considering that girls were assessed when they were already engaged in the intervention, they may have changed their habit towards PA which could have influenced their body size perception and satisfaction. Thus, although it is possible to note differences between perception and dissatisfaction by body weight status and weight control behaviors, studies are needed to further investigate their relationships and the association with health behaviors in longitudinal studies.

# Strengths and limitations

The strengths of this study include the large number of participants and random selection process from the 240 participating schools. In addition, to our knowledge, no study evaluated the associations between BSP and BSD by weight control behaviors. Study limitations should also be considered when interpreting these findings. First, the cross-sectional design limits the analysis of temporal relationships between body image, health behaviors and weight control practices. Second, the intervention may have attracted girls interested in enhancing their PA level, which may not represent all adolescent girls. Fourth, FitSpirit is an intervention carried out by a school staff member with different levels of motivation [53], body image self-perceptions, and beliefs around weight control practices. Finally, self-reported measurements were used in our study. Previous studies suggest that self-reported height is often overestimated and weight underestimated among adolescent girls [54]. This suggests that the BMI variable used this study might be lower than measured BMI. Adolescents also tend to self-report a higher level of PA [55] which could have impacted the results obtained in the association between PA and body image variables. Future research should consider the use of accelerometers to provide measures of PA.

## Conclusions

Findings from this study provide evidence that body size underestimation and dissatisfaction are common among girls participating in a PA promotion intervention, more specifically among adolescent girls living with OW/OB. The relationship between BSP and BSD scores depends on weight status and weight control practice. Screen time and sleep duration were independently associated with body size perception whereas only screen-time was associated with body size dissatisfaction. PA was only associated with body size perception in girls trying to control their weight, not in those trying to lose or gain body weight. This research is an important step in exploring the association between body image variables and health behaviors. Further work is needed to evaluate the impact of a PA intervention that includes other lifestyle habits such as screen-time and sleep duration. Interventions should also include an educational component to increase girls' awareness of the negative impact of social media use on body image.

## Abbreviations

Physical activity (PA)

Body mass index (BMI)

Body size perception (BSP)

Body size dissatisfaction (BSD)

BMI z-score (zBMI)

Overweight/obese (OW/OB)

## Declarations

### acknowledgements

We thank all the co-researchers who participated in the development of the project and the questionnaire - Jonathan Tremblay: Associate Professor and researcher, École de kinésiologie et des sciences de l'activité physique de la Faculté de médecine, Université de Montréal. Martin Juneau: Cardiologist, Researcher and Director of prevention at the Montreal Heart Institute (MHI). Associate Professor at the Faculté de médecine, Université de Montréal. Director of the Center for Preventive Medicine and Physical Activity (Center ÉPIC). Jean Lemoyne: Associate Professor and researcher, Département des sciences de l'activité physique, Université de Trois-Rivières. Nicolas Moreau: Associate Professor and researcher, Faculté des sciences sociales, École de service social, Université d'Ottawa.

We thank the FitSpirit organization for its collaboration. We thank all girls, school leaders, FitSpirit ambassadors, coordinators and school boards involved in the intervention. We acknowledge Serge Simard and Christian Couture for providing statistical support.

### **Contributions**

VD, MEM, JMB conceptualized and designed the study. VD, MEM, JMB contributed to data collection. MB, VD, NA analyzed and interpreted the data. MB prepared figures and drafted manuscript. JG, VD, NA edited and revised manuscript and all authors contributed to reviewing and developing the final manuscript. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work.

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### **ETHICS DECLARATIONS**

#### **Ethics approval and consent to participate**

This research project has been performed in accordance with the [Declaration of Helsinki](#). Ethics approval was obtained from the *Comité d'éthique de la recherche en santé* of the Université de Montréal (CERES, #16160, 21/12/2016) and Université Laval (#2018-331). In the Province of Québec, parental consent is required only for children under 14 with their assent. In the case of project with very low risk, it is thus authorized to ask only for the consent of youth aged 14 years and older. Thus, all participants and their parents (for participants 13 years and younger) provided parental written informed consent and youth's assent. All methods were carried out in accordance with relevant guidelines and regulations.

#### **Consent for publication**

Not applicable.

#### **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the first author upon reasonable request.

#### **Competing interest**

The authors declare that they have no competing interests.

## Funding Source

The study is co-funded by the Public Health Agency of Canada and by the FitSpirit organization. We would also like to express our gratitude to the Fonds de Recherche en Santé du Québec for their financial support.

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## Figures

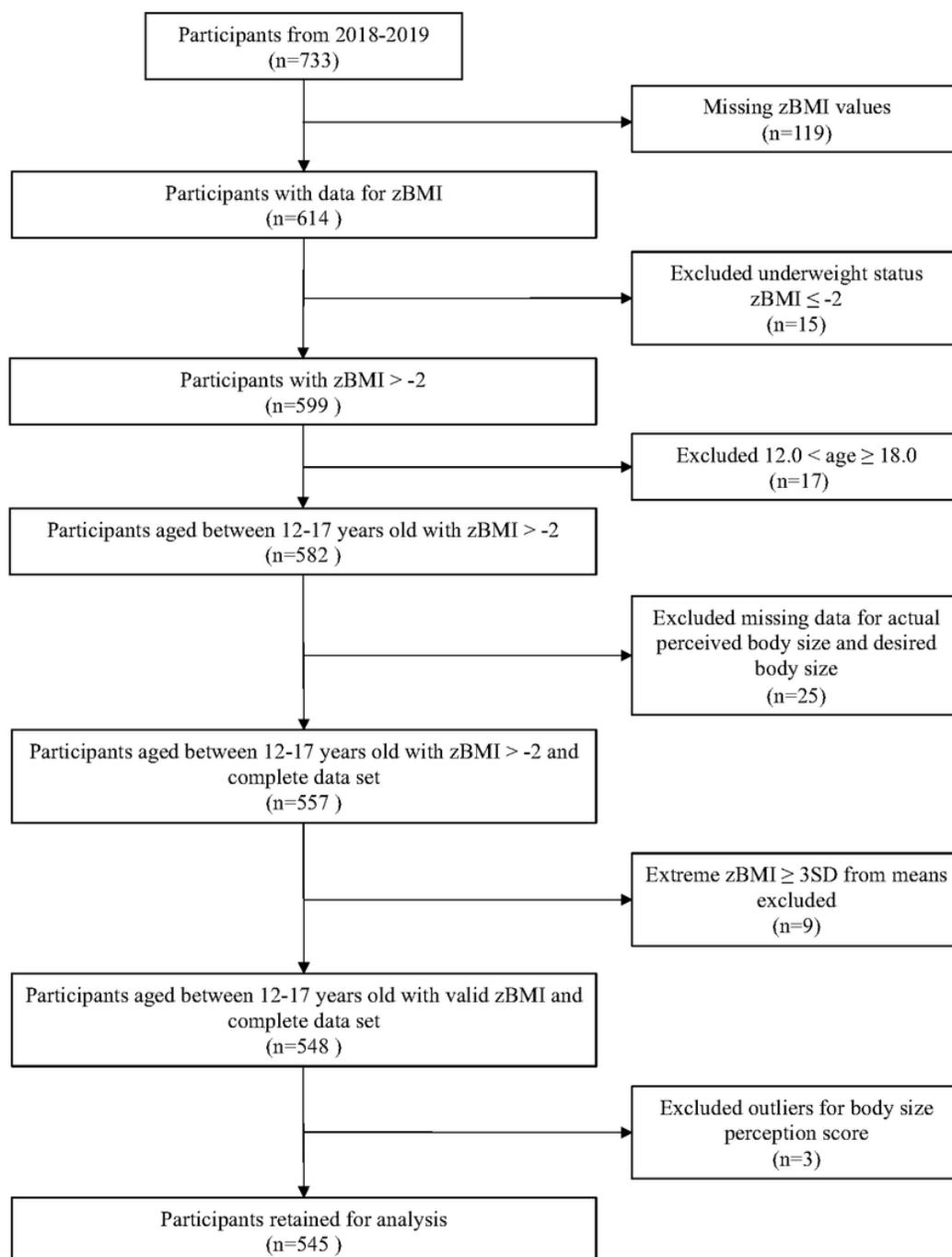
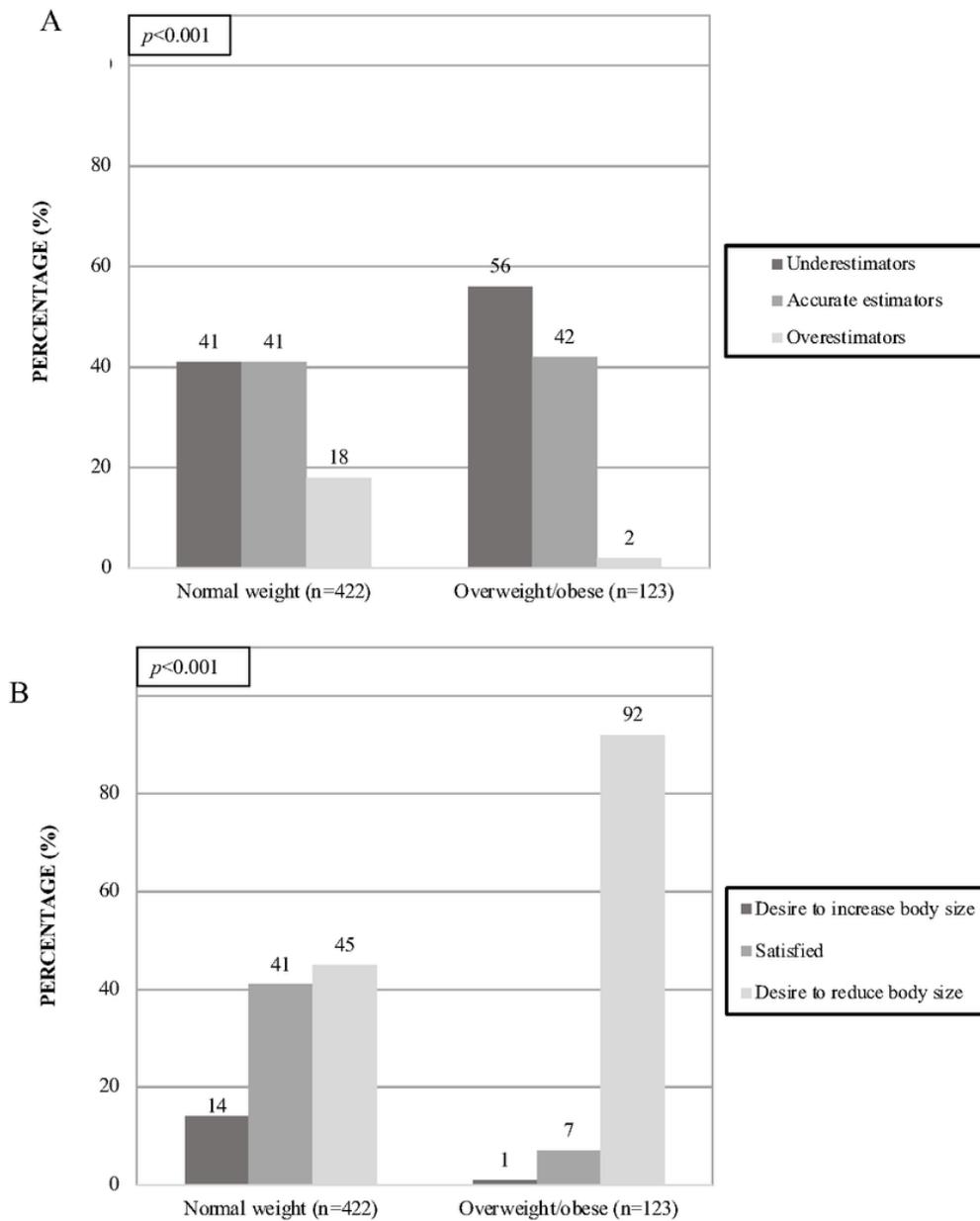


Figure 1

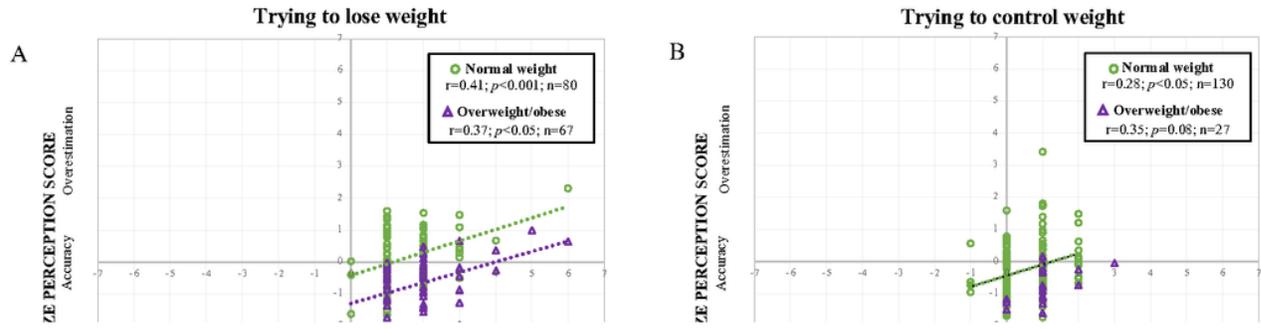
Flowchart of the study selection process.



**Figure 2**

**Figure 2**

Prevalence of categorization of body size perception (accuracy, underestimation and overestimation) and body size dissatisfaction (satisfaction, desire to reduce body size and desire to increase body size) by weight status (normal weight and overweight/obese) in girls (N=545).



**Figure 3**

Trying to lose weight (A), trying to control weight (B), trying to gain weight/muscle (C) and not trying to do anything (D).