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Disability and Rehabilitation

ISSN: 0963-8288 (Print) 1464-5165 (Online) Journal homepage: www.tandfonline.com/journals/idre20

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To cite this article: Julia Hussien, Jennifer Brunet, Ahmed Jérôme Romain, Lucie Lemelin & Aurélie Baillot (2022) Living with severe obesity: adults' physical activity preferences, self-efficacy to overcome barriers and motives, Disability and Rehabilitation, 44:4, 590-599, DOI: 10.1080/09638288.2020.1773944

To link to this article: https://doi.org/10.1080/09638288.2020.1773944

Published online: 17 Jun 2020.

DISABILITY AND REHABILITATION
2022, VOL. 44, NO. 4, 590–599
https://doi.org/10.1080/09638288.2020.1773944

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RESEARCH PAPER

Living with severe obesity: adults' physical activity preferences, self-efficacy to overcome barriers and motives

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ABSTRACT

Background: This study aimed to explore the preferences, self-efficacy to overcome barriers and motives for physical activity of individuals with severe obesity (body mass index $\geq$35 kg/m^2).

Methods: 44 adults with severe obesity (50.5 ± 13.3 years, 80% female) consented to participate in this study. Accelerometers, the 6-minute walking test, and questionnaires were used to collect data on participants' sociodemographic and medical characteristics, physical fitness, physical activity behaviour, preferences for physical activity, self-efficacy to overcome physical activity barriers and motives for physical activity.

Results: A preference for walking (89%) and engaging in supervised physical activity (61%) at moderate intensity (46%) was reported. Most participants (71%) preferred engaging in physical activity outdoors for a duration of 30 to 60 min (84%), either in the morning (64%) or in the evening (48%). Participants had the lowest self-efficacy to overcome physical activity barriers when they had poor health and pain. The two most frequently reported physical activity motives were: preventing health problems and having better health.

Conclusions: A preference-based program focusing on health motives and addressing health and pain issues may help to promote physical activity behaviour among adults with severe obesity. Nevertheless, experimental studies are needed to determine if such strategies effectively increase physical activity behaviour in this population.

➤ IMPLICATIONS FOR REHABILITATION

- Physical activity preferences (i.e., walking, biking and swimming performed at a moderate intensity and outdoors for a duration of 30 minutes to 1 hour with supervision) can be used to enhance motivation in people with severe obesity.
- Addressing the main barriers of regular physical activity (e.g., poor health, pain, depression) could ensure better adherence to physical activity in people with severe obesity.
- Using motives of health improvement and health problems prevention could lead to increased physical activity in people with severe obesity.

ARTICLE HISTORY
Received 28 August 2019
Revised 20 May 2020
Accepted 21 May 2020

KEYWORDS
Morbid obesity; exercise; obstacles; facilitators; motivations; accelerometer

Introduction

Obesity is a global epidemic directly affecting the lives of millions of people and resulting in high costs to health care systems worldwide [1]. Individuals living with obesity report reduced quality of life due to physical and psychological health consequences [2]; even more so, individuals living with severe obesity (i.e., those with a body mass index (BMI) $\geq$ 35 kg/m^2) are at a heightened risk of developing physical and psychological comorbidities such as type 2 diabetes, hypertension, and anxiety compared to individuals with a lower BMI [3,4]. This is concerning because roughly 5% of Canadian [5] and 8% of American [6] adults live with severe obesity and this number is expected to rise [5,7].

In addition, although the physical and psychosocial benefits of engaging in physical activity regularly are well documented [8], more than 65% of Canadians living with severe obesity report being physically inactive [9]. Nonetheless, most feel they should do something in the next year to improve their health and/or intend to do something, with 'increasing physical activity behaviour' being the choice most reported [9]. The notably low physical activity levels can be partly explained in light of the self-determination theory (SDT) which is a widely used framework with different sub-theories to explain human behaviour [10]. Within SDT, motivation runs on a continuum ranging from non-self-determined regulations to self-determined regulations. These regulations are amotivation (absence of regulation and motivation), external regulation (motivation regulated by external pressure or reward), introjection regulation (behaviour regulated to avoid feelings of guilt), identified regulation (behaviour regulated for its possible outcome), integrated regulation (behaviour regulated for personal values), and intrinsic motivation (behaviour regulated for the pleasure of doing it) [11–13]. These regulations are particularly important as different motivations can explain why people

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engage in PA and can affect PA practice or weight loss over time [14–16].

The intention behaviour-gap may also help to explain why people do not engage in physical activity [17]. Indeed, adults with severe obesity may intend to engage in physical activity but do not because it is difficult due to weight-related (e.g., restricted mobility, body dissatisfaction) and non-weight related physical activity barriers (e.g., lack of motivation, competing responsibilities) [18]. Nevertheless, even if some adults manage to initiate physical activity, many experience difficulties maintaining the recommended physical activity levels as illustrated by studies showing that adults with obesity have poor adherence to physical activity programs and dropout rates between 20 and 80% [19]. Taking into consideration adults' physical activity preferences and addressing physical activity barriers predicts better adherence to physical activity programs [20] as it is assumed to foster perceptions of autonomy and competence [21,22], which according to SDT, promotes more self-determined regulations and in turn adherence. Thus, gaining a better understanding of what adults living with obesity prefer and their physical activity barriers will help to inform the development of programs to promote sustained physical activity participation in this population.

Currently, knowledge regarding physical activity preferences and barriers among adults with severe obesity is limited, and to our knowledge, no studies provide information about the different physical activity characteristics (i.e., preferred type, location of physical activity, context etc.) that adults with severe obesity prefer. In addition, most published studies on physical activity barriers have sampled adults with obesity without distinction of its severity or have included bariatric surgery patients [18,23–27]. Based on these studies [18,23–27], lack of access to equipment or accommodating facilities, extensive working hours, lack of time, body dissatisfaction, functional limitations and fatigue are barriers to physical activity. One study comparing women based on severity of obesity [28] found greater physical activity barrier scores for lack of self-discipline, lack of good health, and fear of injury in women with more severe obesity when compared to women with less severe obesity, and underlined that more psychological barriers were reported in women with more severe obesity. Collectively, findings from several studies support the idea that results derived from data on people with obesity may not be transferable to adults with severe obesity because they present poorer mental and physical health compared to adults within lower obesity classes, but better health and quality of life than patients awaiting bariatric surgery; this highlights the necessity to consider them separately [9,29,30].

Similar to physical activity preferences and barriers, knowledge regarding motives to engage in physical activity among adults with severe obesity is limited. Preliminary data show that weight management, health, enjoyment, body image, and social support are motives for physical activity reported by adults who have received bariatric surgery [25]. Previous studies underlined that people engaged in physical activity for several motives (e.g., improving health, aesthetic reasons) and that these motives are differentially related to physical activity or weigh loss [31,32]. A study in which researchers used semi-structured interviews with obese and formerly obese adults was conducted and uncovered several themes related to motives for physical activity, including protection (maintaining functional capacity and promoting weight loss) and pleasure (enjoyment, socializing, and feelings of accomplishment and mastery) [33]. These motives for physical activity can be tied to general behavioural motives described within the SDT [10]. Moreover, SDT along with other theories such as self-efficacy theory [34], stipulate that people will engage in a behaviour (e.g., physical activity) if they feel confident in their ability to overcome impeding barriers. Indeed, reviews show that self-efficacy beliefs are related to physical activity engagement not only in the general population but also in adults with obesity [35,36].

Overall, research specific to the experiences of adults with severe obesity still needs to be conducted so that physical activity programs can be aligned with their unique needs. To address the aforementioned knowledge gaps, the primary aim of this study was to report on the physical activity preferences, self-efficacy to overcome physical activity barriers and physical activity motives of adults with severe obesity. The secondary aim was to describe the magnitude of associations of physical activity with: (a) self-efficacy to overcome physical activity barriers, and (b) physical activity motives in this population.

Methodology

Study design and setting

This study was a cross-sectional study. After providing informed consent, participants performed a 2-h evaluation at the Institut du Savoir de Montfort? or the Université du Québec en Outaouais (UQO), during which weight, height and submaximal physical fitness were assessed by a research assistant or the last author (AB). During this session, participants also completed a questionnaire package in which they self-reported sociodemographic and medical characteristics, physical activity preferences, self-efficacy to overcome physical activity barriers and physical activity motives. At the end of the session, participants were given an accelerometer with instructions to wear it for 7 consecutive days. Participants received 20$CAD as compensation for their time. The study protocol was approved by the Ethics Review Board of research on humans of the Montfort Hospital, UQO, Ottawa University and the Centre integré de santé et des services sociaux de l'Outaouais.

Recruitment procedures

A convenience sample of adults with severe obesity were recruited between September 2016 and February 2018 in the Ottawa/Gatineau region using media (e.g., advertisements in free local newspapers, on the radio, on television, and on relevant websites; postings on social media), as well as by placing posters and display screens in local hospitals, private clinics, bookstores, supermarkets, and sports centers.

Inclusion and exclusion criteria

Adults were eligible to participate in this study if they: (1) were $\geq$ 18 years of age, (2) had a BMI $\geq$ 35 kg/m^2, (3) were French-speaking, and (4) were able and willing to provide informed consent. Adults were excluded if they: (1) had undergone bariatric surgery within the last 12 months, and/or (2) were in a temporary state of impaired practice of physical activity due to an accident (e.g., sprain) or an acute illness (e.g., mononucleosis).

Measures

Sociodemographic and medical characteristics

Sociodemographic characteristics (i.e., age, sex, ethnicity, civil status, work status, income, highest level of education attained, and perceived socio-economic status [37]), comorbidities (i.e., dyslipidemia, hypertension, type 2 diabetes, sleep apnea, heart and

vascular diseases, asthma, arthritis and/or arthrosis, depression and/or anxiety), presence of daily pain during the last 3 months, and use of ambulatory assistive devices (e.g., orthotics, walker, cane) were self-reported by participants. The number of comorbidities was calculated as the sum of the presence of the comorbidities mentioned above. Smoking status (i.e., non-smoker, former smoker, smoker) was self-reported. History of alcohol use was assessed using the Alcohol Use Disorder Identification Test (AUDIT-C) [38]. The AUDIT-C consists of three questions regarding (1) the frequency of alcohol consumption, (2) the typical quantity of drinks consumed in a day, and (3) the frequency in which six drinks or more are consumed in a single occasion. Scores range from 0 to 12, whereby scores of 3 (for women) or 4 (for men) signify the presence of an alcohol disorder or hazardous drinking behaviour. The presence of depressive symptoms was evaluated using the Center for Epidemiologic Studies Depression Scale [39] wherein participants were asked to indicate how often in the last week they felt or behaved in the matter portrayed in the question using a 4-point Likert scale ranging from 0 (*rarely or none of the time*) to 3 (*most or almost all the time*). Scores $\geq$ 16 indicated the presence of depressive symptoms.

Anthropometrics

A calibrated board was used to measure participants' height to the nearest 0.5 cm and an electronic scale was used to measure their weight to the nearest 0.1 kg.

Physical activity and sedentary time

Physical activity was self-reported by participants using The Global Physical Activity Questionnaire-Version 2 (GP) [40]. The GP consists of 16 questions related to physical activity practice during work, leisure and travel. The data were analyzed according to the guide (obtained from https://www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf) provided by the World Health Organization, and was used to determine the amount of time spent in moderate and vigorous intensity physical activity (minutes/week). In addition, physical activity and sedentary time were assessed using triaxial accelerometers (Actigraph® wGT3X-BT). Participants were instructed to wear the device on their right hip during waking hours for 7 consecutive days and keep a log of the activities they performed and any times they removed the accelerometer to engage in water activities (e.g., swimming). The accelerometer data were extracted and downloaded in 10-s epochs using the Actilife software v.6.13.3 and were cleaned according to the diaries submitted by the participants; only data from participants with $\geq$ 4 consecutive days of $\geq$ 9 h of wear time were analyzed. Of note, non-wear time was identified as a period of 180 min of consecutive zeros [41]. Accelerometer data were used to determine the: (1) total energy expenditure (kcal/day), (2) amount of time spent in light intensity physical activity (hours/day), (3), amount of time spent in moderate and vigorous intensity physical activity (minutes/week), and (4) sedentary time (hours/day). Total energy expenditure was calculated according to the Freedson Combination formula [42] and because physical activity intensity classifications have not yet been established for adults with obesity, existing cut-off values were used (sedentary time = <100 counts-per-minute (cpm), light physical activity = 100–1,951 cpm, moderate intensity physical activity = 1,952–5,724 cpm, and vigorous intensity physical activity > 5,724 cpm). Using the time spent in moderate and vigorous intensity physical activity, participants were categorized as either active ($\geq$ 150 min/week) or inactive/insufficiently active (<150 min/week) according to the CSEP guidelines (obtained from https://csepguidelines.ca/wp-content/uploads/2018/04/CSEP_PAGuidelines_adults_fr.pdf).

Submaximal physical fitness

The 6-min walking test (6MWT), which has been validated for adults with obesity [43,44], was used in accordance with the American Thoracic Society (ATS)'s protocol [45]. Participants were instructed to walk as far as possible during a period of 6 min by walking back and forth on a 20-meter corridor that had been calibrated every 3 meters. Participants performed the 6MWT twice, with a 20-min break in-between, and the average for both tests were computed.

Physical activity preferences

Participants responded to seven multiple-choice questions that inquired about their preferred type(s), place(s), time(s), and physical activity intensities, as well as the type of supervision and companionship they would like for physical activity, even if they were not currently engaging in any physical activity. For each question, participants could select multiple answers, except if they selected "no preference." For example, when asked "When do you enjoy physical activity?" participants could choose any/all of these options: "in the morning," "at noon," "in the afternoon," "in the evening," or could choose "no preference."

Self-efficacy to overcome physical activity barriers

Participants' self-efficacy to overcome common physical activity barriers were assessed using a questionnaire developed according to Bandura's recommendations [46] wherein they were asked to indicate to what extent they feel able to participate in physical activity regularly (at least three times per week) in spite of different events/situations using a 0 to 100% confidence scale. The events/situations in question were when: (1) the weather is bad, (2) I have more interesting things to do, (3) I do not take pleasure in practicing physical activity, (4) I lack motivation, (5) I am in a bad mood, (6) I'm running out of time, (7) I made other commitments, (8) I do not have access to equipment or sports facilities, (9) I do not have the support of my family or my friends, (10) I am tired, (11) I have pain, (12) physical activity costs too much, (13) I feel embarrassed by my appearance, (14) I am on holidays, (15) I am in poor health, (16) I am depressed, (17) I am embarrassed to be looked at by others, (18) I fear injuring myself, (19) I am stressed, and (20) It is difficult to get to the location. Lower scores indicate lower self-efficacy to participate in physical activity regularly when faced with common barriers.

Physical activity motives

Participants completed the Exercise Motivations Inventory (EMI), a validated questionnaire containing 51 items measured on a 5-point Likert scale, ranging from 0 (*not true for me*) to 5 (*very true for me*) that assesses physical activity motives. The items are organized into 14 subdimensions: stress management, revitalisation, enjoyment, challenge, social recognition, affiliation, competition, health pressures, ill-health avoidance, positive health, weight management, appearance, strength and endurance, and nimbleness [47,48]. These 14 subdimensions were analyzed separately to address aim 1 using descriptive statistics; however, to reduce the number of tests when exploring relationships between physical activity and other variables (and thus reduce the probability of observing at least one significant result due to chance) (aim 2), the 14 motives subdimensions were merged into five main motives (i.e., body-related, health, interpersonal, fitness, psychological) according to Markland and Ingledew [48].

Data analysis

Data were analyzed with SPSS version 25 (IBM Corp, Armonk, NY, USA). The normality of the data was tested by dividing skewness and kurtosis values by their respective standard error, with values ≥ 1.96 indicating significant deviations from normality. The results are presented as medians (interquartile ranges (IQR)) or means ± standard deviations depending on the data normality. Bivariate correlations were estimated to describe the magnitude of the associations of physical activity (light and moderate-to-vigorous intensities) with physical activity motives, and self-efficacy to overcome physical activity barriers. Non-parametric tests (i.e., Spearman's rank order correlations) were used due to the small sample size and the absence of normal distributions. Effect sizes (r) were computed and can be interpreted as: $r = \pm.1$ small size, $r = \pm.3$ medium size, and $r = \pm.5$ large size [49].

Results

Sample characteristics

Initially, 89 people expressed interest in this study. Sources of potential participants were: advertisements in medical centers ($n = 29$; 33%), media ($n = 17$; 19%), university ($n = 16$; 18%), library ($n = 4$; 5%), gym center ($n = 3$; 3%), and grocery stores ($n = 2$; 2%), referral from relatives ($n = 4$; 5%), and 14 uncertain (16%). Of the potential participants, 22 did not meet the inclusion/exclusion criteria (25%), 12 declined to participate (13%), and 11 were no longer reachable (12%), leaving 44 to be enrolled in this study (49%). Reasons for ineligibility were: BMI < 35 ($n = 16$; 73%), unable or unwilling to attend assessment at designated location ($n = 3$; 14%), temporarily unable to engage in physical activity ($n = 2$; 9%), and not French-speaking ($n = 1$; 4%).

Table 1 illustrates the sample characteristics of the analytical sample of 44 participants ($n = 35$ female; 79.5%). The sample was predominantly Caucasian ($n = 36$; 82%) and had a mean age of 50.5 ± 13.3 years, mean BMI of 44.3 ± 7.8 kg/m^2, and a median of 2 (IQR 2) comorbidities. Results from the GP revealed that 30 participants (68.2%) met the Canadian physical activity guidelines of 150 min/week of moderate and vigorous physical activity; however, results from the accelerometers revealed fewer participants ($n = 22$; 53.7%) actually met the physical activity guidelines. Participants spent a majority of their awake time (13.5 ± 1.5 h/day) being sedentary (77.3 ± 7.1%; 10.5 ± 1.4 h/day) or participating in light physical activity (19.1 ± 6.2%; 2.6 ± 0.9 h/day).

Table 1. Sociodemographic, medical and behavioral characteristics of adults with severe obesity ($N = 44$).

Sociodemographic data	Mean	Standard deviation
Age (years)	50.5	13.3
Social status perception	5.7	2.2
	Frequency	Percentage
Sex: Female	35	79.5
Ethnicity: Caucasian	36	81.8
Civil status: Common law or Married	27	61.4
Education: ≥ High School	42	95.5
Income: ≥ $75,000 CAD[a]	13	34.2
Professional status: Employed[b]	24	54.5
Biological/medical data	Mean	Standard deviation
Body mass index (kg/m^2)	44.3	7.8
	Frequency	Percentage
Sleep apnea	17	38.6
Anxiety and/or depression	17	38.6
Arthritis and/or arthrosis	14	31.8
Asthma	14	31.8
Hypertension	11	25.0
Type 2 diabetes	8	18.2
Dyslipidemia	6	13.6
Cardiovascular diseases	3	6.8
Depression[c]	12	27.3
Daily pain for the last 3 months	19	43.2
Behavioral data	Mean	Standard deviation
LPA[d] (h/d)	2.6	0.9
MVPA[d] (min/wk.)	209.2	145.2
Self-reported MVPA (min/wk)	702.5	832.3
Sedentary time[d] (h/d)	10.5	1.4
Max 6-minute walk test distance (m)	475.9	105.7
	Frequency	Percentage
Hazardous alcohol drinkers (total)	27	61.4
Former smokers[e]	16	36.4

LPA: light physical activity; MVPA: moderate to vigorous physical activity.
[a]Total annual household income before taxes. $N = 38$ because 6 participants did not know their income and/or want to respond.
[b]Part-time or full-time employment.
[c]Depression classified using the Center for Epidemiologic Studies Depression Scale.
[d]Data collected through accelerometers for $N = 41$ (lost device ($n = 1$). participant unwilling to wear the device ($n = 1$). unstopped activity on the device ($n = 1$).
[e]None of the participants are current smokers.

Physical activity preferences

The four most preferred types of physical activity reported by participants were walking ($n = 39$; 88.6%), biking ($n = 28$; 63.6%), swimming ($n = 24$; 54.5%), and aquafitness ($n = 19$; 43.2%). Other activities mentioned are presented in Figure 1. Table 2 summarizes participants' preferred characteristics of physical activity. Overall, roughly half of the sample liked moderate intensity physical activity ($n = 20$; 45.5%) and more than three quarters liked engaging in physical activity for 30 min to 1 h ($n = 37$; 84.1%). In comparison to practicing physical activity outside ($n = 31$; 70.5%), very few participants reported a preference toward physical activity practiced in a structured environment with medical surveillance ($n = 7$; 15.9%). Additionally, participants reported a preference for engaging in physical activity either in the morning or in evening ($n = 28$; 63.6%, $n = 21$; 47.7%) and with supervision from a professional ($n = 27$; 61.4%). Participants did not have preferences when it came to scheduling physical activity (i.e., when desired or at set schedule) or for which companion(s) they preferred to engage in physical activity with (e.g., alone, in a group).

Self-efficacy to overcome physical activity barriers

The mean score for self-efficacy to overcome physical activity barriers was 41.2 ± 22.6% out of a possible 100%. Figure 2 summarizes the self-efficacy scores to overcome 20 physical activity barriers. Participants had the least self-efficacy to overcome physical activity barriers related to poor health (28.4 ± 33.3%), pain (34.1 ± 34.0%), stress (35.9 ± 37.2%), other commitments (36.4 ± 31.1%) and depressive feelings (36.6 ± 36.3%).

Motives for physical activity

Figure 3 summarizes the scores for the 14 physical activity motives. The top five motives were ill-health avoidance (6 (IQR 1)), positive health (6 (IQR 1)), weight management (5.8 (IQR 1)), nimbleness (5 (IQR 2)) and strength and endurance (4.9 (IQR 2.4)).

Associations of physical activity with motives for physical activity, and self-efficacy to overcome physical activity barriers

As shown in Table 3, physical activity was moderately associated with self-efficacy to overcome several barriers to physical activity, with the magnitude and direction of associations varying across method of physical activity assessment and type of barrier, respectively. Amount of time spent in moderate and vigorous intensity physical activity

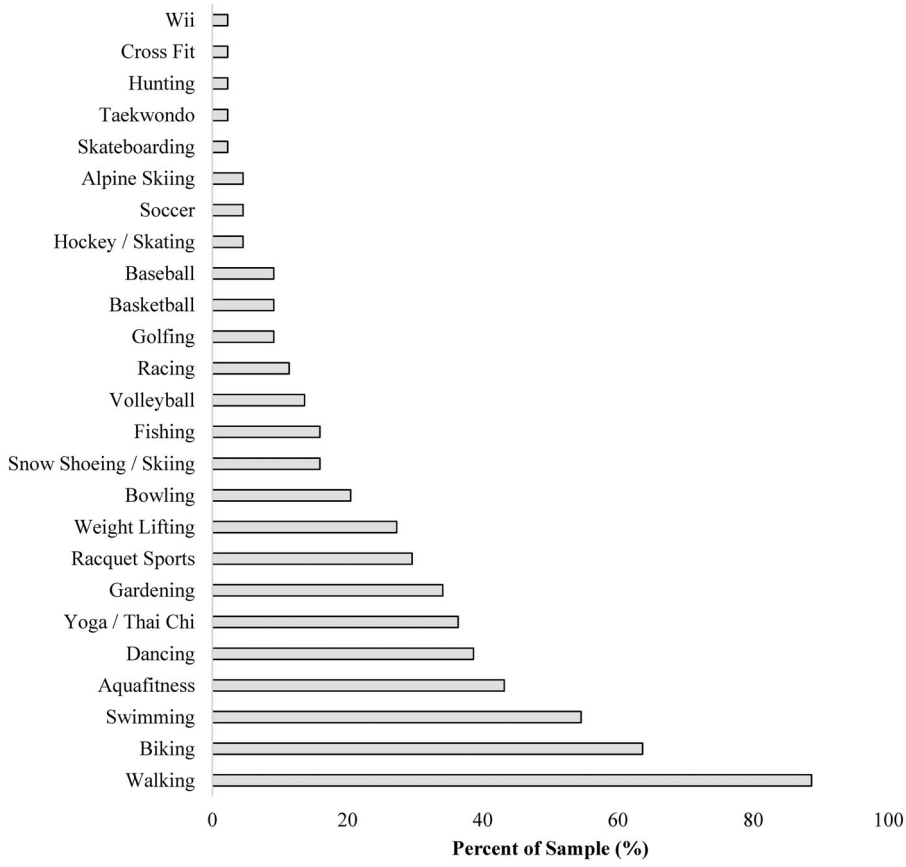

Figure 1. Preferences for physical activity types reported by adults with severe obesity ($N = 44$).

based on accelerometer data were weakly and negatively associated with body-related physical activity motives. Also, self-reported moderate and vigorous intensity physical activity was moderately and positively associated with psychological physical activity motives, and weakly and positively associated with fitness motives. The magnitude for the other associations was very small or close to zero.

Discussion

The current study set out to explore the physical activity preferences, self-efficacy to overcome physical activity barriers, and physical activity motives experienced by adults with severe obesity to help guide the development of tailored physical activity programs.

Regarding physical activity preferences, walking was the preferred type of physical activity reported, followed by biking and swimming. These results are in accordance with results found in the general Canadian and American population [50,51]. The popularity of walking can be explained by the fact that it can be easily integrated into everyday life, performed at self-selected intensities, and does not require specific skills and materials (low-cost activity) [52]. From a practical perspective, these results are meaningful because walking interventions have been shown to be feasible and an effective means to improve cardiometabolic factors, body composition, quality of life, and mental health in individuals with or without obesity, as well as those with severe obesity [52–56]. The results of this study also suggest that moderate intensity physical activity was the most preferred intensity and that the preferred physical activity duration range was between 30 min and 1 h. Taken together, offering multiple moderate intensity walking sessions lasting between 30 min to 1 h may help to increase the number of adults with obesity who meet physical activity recommendations of 150 min per week. Additionally, sessions could be offered individually or in a group and either in the morning or in the evening considering that participants' preferred engaging in physical activity in the morning or the evening ($n = 28$; 63.6%, $n = 21$; 47.7%), but did not have preferences when it came to companionship (e.g., group, alone). Hence, given the importance of autonomy in facilitating physical activity, improving engagement and adherence to physical activity in this population can be done by offering sessions at times that work around adults' other commitments such as work schedules [57]. In comparison to practicing physical activity outdoors ($n = 31$; 70.5%), very few participants liked practicing physical activity in a structured environment with medical surveillance ($n = 7$; 15.9%). This result fits with the notion that participants prefer walking (which is most commonly done outdoors) and is in line with Krinski et al.'s [58] findings, whereby adults with obesity who walked outdoors reported more pleasure, less perceived exertion, and greater intentions to participate in additional outdoor walking. In contrast, the lack of desire for practicing physical activity in a structured environment with medical surveillance can likely be explained by the fact that this sample had few physical comorbidities and relatively high levels of physical activity compared to other Canadian samples of adults with severe obesity [9]. It may also be explained by prior experiences, such that if participants had negative experiences, they may not want to resubmit themselves to this type of program. However, it is important to note that most participants wanted some form of supervision from a professional. Given that supervision is known to increase physical activity adherence and motivation, and may lead to greater benefits over time in adults with obesity [59,60], it should be considered as an important component when designing physical

Table 2. Preferences for characteristics of physical activity reported by adults with severe obesity ($N = 44$).

	Frequency	Percentage
Intensity[a]		
Light intensity	10	22.7
Moderate intensity	20	45.5
High intensity	1	2.3
Varying intensities	15	34.1
No preference	4	9.1
Duration[a]		
< 15 minutes	5	11.4
30 minutes	15	34.1
45 minutes	9	20.5
1 hour	13	29.5
2 hours	2	4.5
> 2 hours	0	0.0
Location[a]		
At home	21	47.7
Sporting facilities	25	56.8
Community centers	11	25.0
Structure with Medical Surveillance	7	15.9
Outside (park, forest, street, etc.)	31	70.5
No preference	1	2.3
PA companion[a]		
In a Group[b]	22	50.0
Alone	29	65.9
With family	26	59.1
With friends	28	63.6
With a Pet	6	13.6
No preference	1	2.3
Time of day[a]		
Morning	28	63.6
Midday	5	11.4
Afternoon	13	29.5
Evening	21	47.7
No preference	6	13.6
Supervision		
Only no supervision	7	15.9
Only supervised by a professional	18	40.9
Both	9	20.5
No preference	10	22.7
Scheduling		
Only a set schedule	12	27.3
Only when desired	15	34.1
Both	3	6.8
No preference	14	31.8

[a]Participants had the option to select multiple answers, except if they selected "no preference."
[b]Group with whom the participant shares no particular connection.

activity programmes. Also, in terms of supervision, it is important to ensure that professionals supervising physical activity do not display weight bias or obesity stigma (i.e., negative attitudes towards, and beliefs about, others because of their weight) and have an autonomy-supportive style of training (e.g., provide choices, consider participants' feelings) in order to enhance motivation in this population [61,62].

In terms of self-efficacy to overcome physical activity barriers, the results suggest that poor health, pain, stress, other commitments, and feelings of depression undermined participants' confidence to engage in regular physical activity. This result is not surprising considering that poor health and pain are associated with several comorbidities that can impact individuals' ability to engage in physical activity [63–66]. For example, individuals with asthma often limit physical activity involvement to avoid negative respiratory symptoms [63], anxiety and depression can lead to social fear and low self-concept, respectively [64], arthritis- and arthrosis-related joint pain can act as a functional limitation to engaging in physical activity [65], and the interrupted sleep schedules associated with sleep apnea can lead to daytime fatigue and decreased physical endurance [66]. In contrast to previous studies with bariatric surgery patients and people with obesity [18,23–27,67,68], our results don't suggest that embarrassment, perceived lack of time and motivation were listed among the events/situations that most undermined self-efficacy to engage in physical activity. The discrepancy may be explained by the focus on barriers to engage in *regular* physical activity (defined at three or more times per week) and the sample being relatively active in our study. These findings suggest that, among relatively active adults with severe obesity, programs should include counselling or resources to address barriers such as poor health (e.g., by reducing physical activity intensity initially and slowly progressing to moderate intensity), pain (e.g., by encouraging physical activity involvement that does not stress body components that are already in pain), stress and depressive feelings (e.g., through education on overcoming emotions to initiate physical activity and the positive effects of physical activity on mood), and other commitments (e.g., teaching participants to schedule their physical activity in advance). Moreover, they suggest too that it is important to promote self-efficacy to overcome physical activity barriers because, in general, greater self-efficacy to engage in physical activity whilst experiencing barriers was positively associated with physical activity, as in previous research [35]. However, additional studies are required to understand the mechanisms that explain the inconsistencies observed in the associations based on whether physical activity was self-reported or measured using accelerometers.

Concerning physical activity motives, the three most reported motives were ill-health avoidance, positive health, and weight management. Report of weight management motives by adults with obesity is unsurprising; however, in practice, weight loss motives should not to be used to encourage regular practice of physical activity because physical activity interventions lead only to modest weight loss [69]. Thus, if adults do not observe desired weight loss, they can become discouraged and cease participating in physical activity over time. In addition, weight loss motives are external according to SDT [10] and these are generally inversely related to physical activity over time [12]. The results of this study support these previous findings and suggest that adults with severe obesity who focus on the extrinsic outcomes (e.g., appearance improvements) engage in less physical activity. The fear that others will negatively evaluate their appearance could explain why these adults avoid engaging in physical activity [70,71]. Conversely, physical activity was positively associated with fitness and psychological physical activity motives. This finding is in line with previous research grounded in SDT documenting that intrinsic motives are positive correlates of physical activity [12]. Considering that prolonged involvement in physical activity requires self-determined forms of motivation [12,13], interventions may benefit from promoting intrinsic motives (e.g., fitness and psychological motives) among adults with severe obesity. Despite this, it is important to understand that adults may initiate physical activity for external motives [72], notably because physical activity is not necessarily pleasant when initiated, but it is critical to help people internalize the behaviour in order to help them maintain physical activity over time [16]. Achieving self-determined motivation can be done by fostering the innate psychological need for feelings of competence, autonomy, and relatedness [10].

This study is novel due to its focus on adults with severe obesity and provides information that can help to inform the development of physical activity interventions for this population. However, limitations should be considered when interpreting the findings. Convenience sampling prevents generalizations of results to all adults with severe obesity. Relatedly, compared to other samples of Canadian adults living with severe obesity, the prevalence of women and adults with a high school diploma was

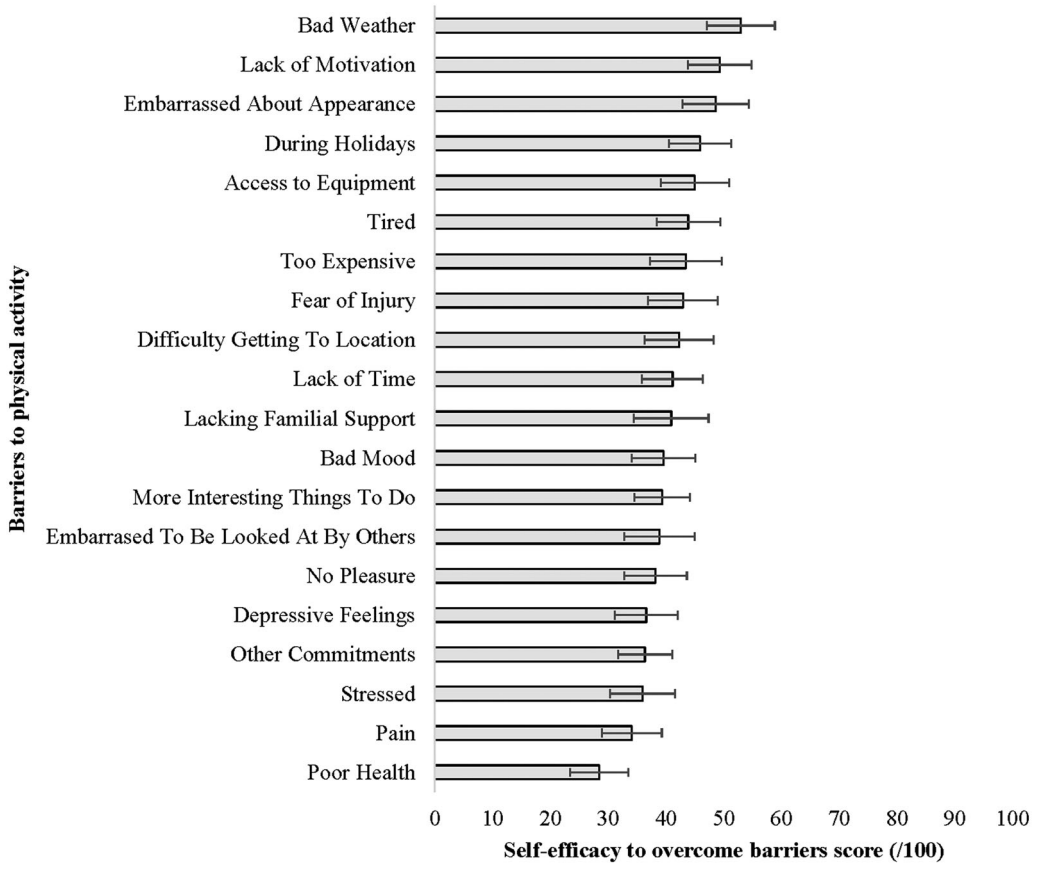

Figure 2. Mean scores for self-efficacy to overcome physical activity barriers reported by adults with severe obesity ($N = 44$). Error bars represent ± 1 standard error.

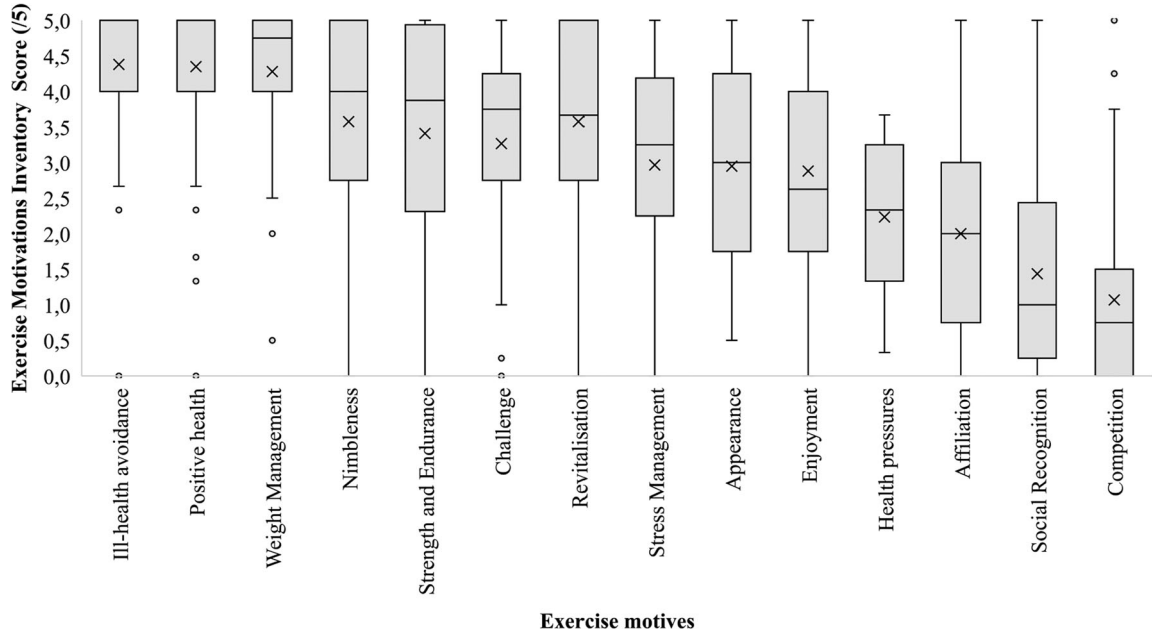

Figure 3. Motives for physical activity reported by adults with severe obesity ($N = 44$).

higher in this sample, and the prevalence of physical comorbidities was lower (especially for hypertension, type 2 diabetes, and heart diseases) [9]. In addition, although 35% of Canadian adults living with severe obesity reported that they participated in 150 min/week of moderate and vigorous intensity physical activity in other studies [9], over 65% of the current sample reported doing so. It is possible that this sample was more active as a result of: (1) a bias toward recruiting adults who were more active/willing to be monitored as a consequence of having interested participants contact us, and/or (2) the Hawthorne effect (i.e., an increased physical activity involvement while wearing the accelerometer due to knowledge that they were being recorded) [73]. Thus, it is unknown whether the current findings may be generalized to less healthy and insufficiently/inactive group of

Table 3. Associations of physical activity with motives for physical activity, and self-efficacy to overcome physical activity barriers in adults with severe obesity.

	LPA (accelerometer) r ($N = 41$)	MVPA (accelerometer) r ($N = 41$)	Self-reported MVPA r ($N = 44$)
Physical activity motives			
Body related	0.04	−0.27	−0.11
Health	0.04	−0.03	0.08
Interpersonal	0.04	0.15	0.07
Fitness	0.17	−0.09	0.27
Psychological	0.12	0.08	0.39*
Self-efficacy to overcome barriers			
Poor health	0.04	0.07	0.16
Pain	−0.01	−0.02	0.05
Stressed	0.18	0.06	0.22
Other commitments	0.48**	0.28	0.25
Depressive feelings	0.02	−0.07	0.13
No pleasure	0.08	0.06	0.20
Embarrassed to be looked at by others	0.12	0.07	0.16
More interesting things to do	0.06	0.09	0.34*
Bad mood	0.33*	0.15	0.19
Lacking familial support	0.21	0.42*	0.28
Lack of time	0.45**	0.18	0.33*
Difficulty getting to location	0.26	0.15	0.40*
Fear of injury	0.23	0.11	0.22
Too expensive	0.30	0.18	0.31*
Tired	0.09	−0.17	0.03
Access to equipment	0.40**	0.37*	0.26
During holidays	0.06	−0.00	0.31*
Embarrassed about appearance	0.11	0.13	0.23
Lack of motivation	−0.08	−0.20	0.21
Bad weather	0.45**	0.23	0.34*

LPA: light physical activity; MVPA: moderate-to-vigorous physical activity.
*$p < 0.05$.; **$p \leq 0.005$.
Dark gray: medium effect size, light grey: small effect size.

adults with severe obesity, or those with lower socioeconomic statuses, ethnic minorities, and men. Last, the sample size was small. Whilst the 14 motives subdimensions were merged into five main motives to reduce the number of tests when exploring relationships between motives and other study variables, replication with a larger sample size is needed.

Conclusion and perspectives

The results of this study could serve as a first step in improving physical activity programs tailored to the specific needs of adults with severe obesity. Based on the results, physical activity programs for these adults could rather propose: (1) supervised outdoor moderate intensity physical activity that involves walking (or swimming and biking), (2) physical activity sessions lasting between 30 min to 1 h, and (3) provide options for morning and evening sessions to accommodate for adults' other commitments such as work. Also, an emphasis on interventions to improve self-efficacy to overcome physical activity barriers could be considered. This study also suggests that focusing on health-related motives in particular may help for long-term physical activity adherence among adults with severe obesity. Notwithstanding the contributions of this study, additional studies are needed to: (1) further explore the present study aims with different adult populations with severe obesity, (2) use these results to design programs to increase physical activity involvement, and (3) determine whether the proposed strategies above effectively increase physical activity adherence and reduces drop-out rates among this population.

Acknowledgments

We would like to thank Florence Hulneault-Leblanc, Anne Bastin and Shrin Ataei Talebi for their implication in the assessments of participants.

Disclosure statement

The authors declare that they have no conflict of interest.

Funding

The Institut du savoir Montfort-Recherche funded this research.

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