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Biopsychosocial correlates of physical activity and sedentary time in adults with severe obesity

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Summary

Adults with severe obesity have poorer health, are less active and spend more time sedentary compared to people with a lower body mass index (BMI). There is a pressing need to understand the factors associated with low physical activity (PA) and excessive sedentary time to develop more effective behaviour change interventions for this population. The purpose of this study was to identify biopsychosocial correlates of PA and sedentary time in adults living with severe obesity. Forty-four adults living with severe obesity (age = 50.5 ± 13.3 years; BMI = 44.3 ± 7.8 kg/m^2) completed a survey including questions on sociodemographic characteristics, comorbidities, psychosocial factors (eg, social physique anxiety [SPA], social support for PA, PA level self-perception), quality of life, daily pain and self-reported moderate-to-vigorous intensity PA (MVPA). Participants also completed the 6-minute walk test (6MWT) to assess physical fitness and wore an accelerometer to assess objective PA and sedentary time. In stepwise linear multivariate analyses, higher objective MVPA was associated with higher 6MWT distance, being single and lower SPA (R^2 = 0.46, P < .001), whereas higher self-reported MVPA was associated with greater PA level self-perceptions (R^2 = 0.47, P < .001). Greater objective light intensity PA was associated with greater quality of life and self-efficacy for PA (R^2 = 0.26, P = .001). Greater sedentary time was associated with having more comorbidities (R^2 = 0.25, P < .001). This study shows that adults living with severe obesity who have more comorbidities, poorer quality of life and/or lower self-efficacy perception for PA are more likely to be sedentary and to practice less light intensity PA. Additionally, those who were in a relationship, had higher SPA and/or had lower physical fitness practiced less MVPA. Future research is needed to determine causal effects.

KEYWORDS

barrier, factor, morbid obesity, sedentary behaviour

1 | INTRODUCTION

In North America, the prevalence of physical inactivity is estimated to be 28%,[1] which is alarming considering its association with cardiovascular disease, type 2 diabetes, certain cancers and all-cause mortality.[2] In addition, adults spend more than half of their waking time sedentary,[3] which is an independent risk factor for cardiovascular disease and all-cause mortality.[3] Physical inactivity and sedentary time (ST) are distinct concepts which must both be examined due to their independent associations with health outcomes.[3] Physical inactivity is defined as physical activity (PA) levels which are insufficient to meet the recommended 150 minutes per week of moderate-to-vigorous

intensity PA (MVPA) per week, while ST is waking time spent in any activity that is performed in a sitting, reclining or lying position and characterized by low energy expenditure (≤1.5 metabolic equivalents [METs][4]). Understanding the underlying reasons for low PA and excessive ST among segments of the population who exhibit these risk factors can inform the development of intervention strategies to promote health and well-being. Considering that the prevalence of severe obesity (ie, body mass index (BMI) ≥35 kg/m^2; class II and III obesity) is rapidly increasing compared to class I obesity,[5] and that adults with severe obesity have poorer health, tend to be less active and engage in more ST than adults with overweight, or class I obesity[6,7] special attention is needed for this unique population in order to propose adapted PA interventions.

Researchers increasingly have been examining correlates of PA over the past two decades;[8] however, studies on biopsychosocial correlates of PA among persons with severe obesity are sparse. Knowledge on this population must be drawn from the broader literature examining correlates of PA among overweight (inclusive of those with severe obesity) and bariatric surgery populations. Briefly, studies of adults who are overweight have found that greater autonomous motivation,[9] self-efficacy[9] and intentions to be active[10] predict higher PA. Among patients awaiting bariatric surgery, Wouters et al[11] found that greater fear of injury and embarrassment were associated with lower levels of PA, and Hunt and Gross[12] found that greater perceived behavioural control, subjective norms and intention to be active were the strongest predictors of PA.

The current PA guidelines encourage people with obesity to engage in at least 150 minutes of MVPA per week, due to its well demonstrated health benefits.[13] However, increasing evidence suggests that increasing light intensity PA (LPA) and reducing ST may also improve health, independent of participation in MVPA.[3,14] LPA is particularly important to consider given that people with obesity perceive physical exercise as more difficult and less pleasant than people without obesity,[15] and that pleasure is related to long-term PA engagement.[16] However, to the best of our knowledge, no studies have examined biopsychosocial predictors of LPA and ST specifically among adults living with severe obesity.

In light of the limited knowledge regarding potential correlates of ST among adults with severe obesity, coupled with the narrow range of potential correlates of PA (particularly LPA), studies are required to illuminate potential factors to target in change behaviour interventions. Potential correlates from a range of theories and models (eg, self-determination theory, transtheoretical model of health behaviour change) were examined to broadly consider which correlates might be most relevant for this population. Therefore, the aim of the present study was to identify biopsychosocial factors associated with MVPA, LPA and ST among adults living with severe obesity.

WHAT IS ALREADY KNOWN ABOUT THIS SUBJECT

- People with severe obesity are less active and engage in more sedentary time than adults with normal weight, overweight or class I obesity.
- Previous studies on psychosocial correlates of physical activity among persons with severe obesity come from the broader literature on overweight (inclusive of those with severe obesity) and bariatric surgery populations.

WHAT THIS STUDY ADDS

- Adults with severe obesity who were single, had better physical fitness and experienced lower levels of social physique anxiety had higher levels of moderate-to-vigorous intensity physical activity.
- Adults with severe obesity who had a higher quality of life and greater self-efficacy for physical activity engaged in more light intensity physical activity.
- Adults with severe obesity and more comorbidities spent more time being sedentary.

2 | METHODS

2.1 | Participants and procedures

This cross-sectional study was conducted at the Institut du Savoir de Monfort and the Université du Québec en Outaouais. The Monfort Hospital, University of Ottawa and Centre Integré de Santé et des Services Sociaux de l'Outaouais Research Ethics Boards approved the study protocol (AB-20-05-16). All participants provided written informed consent prior to completing study assessments.

A convenience sample of 44 participants residing in the Ottawa/Gatineau area were recruited between September 2016 and February 2018 through social media, free advertisements in local newspapers, radio and television stations, research group webpages and posters placed in local hospitals, health clinics, bookstores, supermarkets and sports centres. Inclusion criteria were: (a) be 18 years of age or older, (b) have a BMI ≥35 kg/m^2 and (c) be French-speaking. Exclusion criteria were: (a) have undergone bariatric surgery within the last 12 months and (b) be temporarily unable to engage in PA due to an accident (eg, ankle sprain) or acute illness (eg, mononucleosis, flu).

Participants attended a 2-hour assessment at either the Institut du Savoir de Monfort or the Université du Québec en Outaouais, where they completed questionnaires that assessed PA and potentials correlates of PA (Table 1). Weight, height and physical fitness were assessed by a research assistant or by the first author (AB). After completing the assessment, participants were provided with an accelerometer to wear for seven consecutive days. Participants received CA$20.00 as compensation for their participation upon returning the accelerometer.

TABLE 1 Variables measured

Variables	Tools name
Weight and height	Scale and height rod
Sociodemographic information	Self-declared in a questionnaire
Medical information	Self-declared in a questionnaire
Depression and anxiety	Center for Epidemiologic Studies Depression scale
Light, moderate and vigorous intensities PA	Global PA Questionnaire + accelerometer
Sedentary time	Accelerometer
Social physique anxiety	Social Physique Anxiety scale
PA self-perception	Kendzierski questionnaire
Behavioural regulations related to PA (motivation)	Behavioural Regulation in Exercise Questionnaire
PA motives	Exercise Motivations Inventory
Self-efficacy for PA	Self-Efficacy to Regulate Exercise scale
PA stage of change	PA Stages of Change Instrument
Social support for PA	Social Support Questionnaire
Quality of life	Laval questionnaire
Physical fitness	Six-minute walk test

Abbreviations: PA, physical activity.

2.2 | Measures

2.2.1 | Anthropometric measurements

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

2.2.2 | Sociodemographic and medical information

Participants were asked to report their age, sex, ethnicity, civil status, employment status, income level, highest level of education attained, perceived socioeconomic status,[17] smoking history, comorbidities (ie, dyslipidaemia, hypertension, type 2 diabetes, sleep apnoea, heart and vascular diseases, asthma, arthritis and/or arthrosis, depression and/or anxiety) and chronic pain (ie, presence of daily pain during the past 3 months). The number of comorbidities was calculated by adding the number of self-declared comorbidities. The presence of depressive symptoms was assessed using the Center for Epidemiologic Studies Depression (CES-D) scale.[18] Scores ≥16 indicate the presence of depressive symptoms. Scores on the CES-D have shown excellent reliability and validity for use assessing depressive symptoms in adults.[18]

2.2.3 | PA and sedentary behaviour

Self-reported MVPA ($MVPA_{sr}$) was assessed with the Global PA Questionnaire (GPAQ).[19] Participants were asked to report the number of days and average duration they engaged in MVPA in transportation, leisure and work contexts, during the previous 7 days. The number of days per week was multiplied by the average duration to calculate the total minutes of MVPA within each context. The MVPA scores for transportation, leisure and work were summed to create the total minutes per week of $MVPA_{sr}$ score. Scores on the GPAQ have shown adequate reliability and validity for monitoring PA.[19]

Objective PA was assessed using the Actigraph wGT3X-BT triaxial accelerometer. Participants wore the device on their right hip during waking hours, except when swimming or bathing. Accelerometer data were downloaded in 10-second epochs and extracted using ActiLife software (version 6.13.3). Only data from participants with ≥4 consecutive valid wear days (defined as ≥9 hours of wear time on a given day) were retained for analyses. Non-wear time was defined as a period of ≥180 minutes of consecutive zeros.[20] Threshold values for the general population were used to determine time spent engaging in: ST (<100 counts per minutes [cpm]), light (100-1951 cpm), moderate (1952-5724 cpm) and vigorous intensity PA (>5724 cpm).[20] The variables derived from the accelerometer data were average hours of daily ST (ST_a), average hours of daily LPA (LPA_a), and weekly minutes of MVPA per week ($MVPA_a$).

2.2.4 | Social physique anxiety

The nine-item French translation of the Social Physique Anxiety (SPA) scale,[21] which has good construct validity and internal consistency,[22] was used to assess evaluative concerns about one's physical appearance. Participants were asked to rate how applicable each item was to them using a Likert scale ranging from 0 = "not at all" to 4 = "extremely" characteristic of me. Higher scores on the SPA scale indicate a greater presence of SPA.

2.2.5 | PA self-perceptions

Participants' perception of themselves as a person who is physically active assessed by asking them to indicate to what extent they consider themselves as "someone who exercises regularly," "someone who keeps in shape" and "someone who is physically active."[23] Response options were provided on a Likert scale with anchors at 0 = "do not agree", 5 = "somewhat agree" and 10 = "completely agree." Responses to all three questions were averaged to create a PA self-perception score. Higher scores indicate that the person considers PA to be congruent with their identity, independently of how much PA they engage in.

2.2.6 | Motives for PA and behavioural regulations

Two questionnaires were used to assess motives and behavioural regulations related to PA participation. First, participants completed the Exercise Motivations Inventory (EMI-2)[24] to assess motives to engage

in PA. Scores on the EMI-2 have shown good reliability.[24] Participants responded to 51 items using a Likert scale ranging from 0 = "not true at all for me" to 5 = "very true for me." Responses were used to calculate 14 subscale scores for analysis: stress management, revitalization, enjoyment, challenge, social recognition, affiliation, competition, health pressures, ill-health avoidance, positive health, weight management, appearance, strength and endurance and nimbleness.

Second, participants completed the second version of the Behavioural Regulation in Exercise Questionnaire (BREQ-2),[25] which has shown good internal consistency for all subscales.[25] This scale was comprised of 19 items that capture five behavioural regulations related to PA behaviour (ie, amotivation, external, introjected, identified and intrinsic). Response options were provided on a Likert scale ranging from 0 = "not true for me" to 4 = "very true for me." Based on participants' response to the BREQ-2, a relative autonomy index (RAI) representing overall motivation was calculated and used in the analyses.[26] Higher scores indicated greater salience of autonomous (or self-determined) regulations relative to controlled regulations.

2.2.7 | Self-efficacy for PA

The Self-Efficacy to Regulate Exercise scale was used to assess how confident participants were in their ability to engage in PA regularly in the face of different types of dissuading conditions.[27] Participants were presented with a list of 20 conditions that could affect their engagement in PA (eg, "I am too tired," "PA is too expensive") and asked to rate their confidence in their ability to engage in PA three or more times per week if each of the dissuading conditions were present using a scale ranging from 0 = "not confident at all" to 100 = "highly confident." The average score of responses to all items was calculated and used for analyses. Higher scores indicated greater self-efficacy for overcoming common dissuading conditions to PA.

2.2.8 | Stage of change

The PA Stages of Change Instrument[28] was used to assess participants' stage of change according to the transtheoretical model of health behaviour change. Participants were asked to respond "yes" or "no" to four questions regarding their current engagement and intentions to engage in PA. Based on scoring algorithms,[28] participants were categorized into one of the following stages of change: pre-contemplation, contemplation, preparation, action or maintenance. For the analysis, a dichotomous variable was created (ie, pre- [pre-contemplation, contemplation, preparation] vs post- [action, maintenance] action stage).

2.2.9 | Social support for PA

The Social Support Questionnaire-6[29] was used to assess participants' perceptions of social support for PA from friends and family. Participants were asked about how frequently they experienced supportive behaviours within the past 3 months. Response options ranged from 1 = "never" to 5 = "very often." The average score of all items was used for the analysis. Higher scores indicated a greater perception of social support.

2.2.10 | Quality of life

The validated Laval questionnaire was used to assess weight-related quality of life.[30] It includes 44 items grouped into six domains (ie, symptoms, activity and mobility, personal hygiene and clothing, emotions, social interactions and sexual life). Participants indicated to what extent each item applied to them using a Likert scale ranging from 0 = "never" to 6 = "very much." The scores for all subscales were added together to create a total quality-of-life score, which was used in the analyses. Higher scores overall indicated higher quality of life.

2.2.11 | Physical fitness

The 6-minute walk test (6MWT) was used to assess participants' physical submaximal fitness; it has previously been shown to be a valid measure of physical fitness in adults living with obesity.[31] The 6MWT is a submaximal exercise test that entails measurement of distance walked over a span of 6 minutes. Following the American Thoracic Society protocol, the assessment took place indoors on a marked 20-m course. Participants were asked to walk back and forth as far as possible within 6 minutes. Participants completed the test twice as recommended by the American Thoracic Society, with a 20-minute break in-between and the highest score was retained and used in the analyses.

2.3 | Statistical analyses

Data were analysed using SPSS version 25 (IBM Corp, New York). Results were considered statistically significant if $P < .05$. Initially, normality was assessed by dividing skewness and kurtosis values by the SE for each variable, where values greater than 1.96 indicated significant deviations from normality. Square root or log transformations were applied to non-normally distributed variables (ie, $MVPA_a$, $MVPA_{sr}$, EMI scores [ie, nimbleness, strength and endurance, weight management, competition, social recognition, challenge, revitalisation], social support for PA, number of comorbidities), which rectified the issues. Two outliers for $MVPA_{sr}$ scores were observed and replaced with a score 1 minute higher than the next highest in the distribution. Next, binary associations between outcomes (ie, $MVPA_a$, $MVPA_{sr}$, LPA_a, ST_a) and correlates were assessed using Pearson product correlation for continuous variables or point-biserial correlations and phi-correlations for dichotomous variables. Last, a separate stepwise multivariate linear regression model was tested for each outcome. Each model included correlates that were statistically significantly associated with the outcome variable in univariate analyses at $P < .05$), and were not collinear. Bold variables in the Tables 2–4 are variables selected for the

TABLE 2 Sociodemographic data and correlations with physical activity and sedentary time

	Descriptives		Dependant variables			
	n	n (%) or mean (SD)	$MVPA_a$ r	LPA r	ST r	$MVPA_{sr}$ r
Sex (% women)	44	35.0 (79.5)	.07	.28	−.25	.02
Age (year)	44	50.5 (13.3)	−.26	.01	**.34****	.17
Ethnicity: white (%)	44	36.0 (81.8)	−.15	.07	.25	.05
Civil state: couple life (%)	44	27.0 (61.4)	**−.33****	.10	−.07	−.09
Education: ≥ high school diploma (%)	44	42.0 (95.5)	.03	−.00	.13	.18
Income: ≥ CA$75 000	38	13.0 (34.2)	.10	.04	−.08	−.10
Professional status: employed	44	24.0 (54.5)	.30	.02	−.04	−.06
Social status perception	44	5.66 (2.23)	.06	.17	.11	−.05

Note: Bold variables are variables selected for the multivariable analysis.
Abbreviations: LPA, light physical activity; MVPA, moderate-to-vigorous physical activity; $MVPA_a$, MVPA accelerometer data; $MVPA_{sr}$, self-reported MVPA; ST, sedentary time.
*$P < .05$.

TABLE 3 Biological/medical data and correlations with physical activity and sedentary time

	Descriptives		Dependant variables			
	n	n (%) or mean (SD)	$MVPA_a$ r	LPA r	ST r	$MVPA_{sr}$ r
Body mass index (kg/m^2)	44	44.3 (7.8)	−.15	**−.40****	−.10	−.04
Depression/anxiety (%)	44	17.0 (38.6)	−.18	−.21	.12	−.09
Sleep apnoea (%)	44	17.0 (38.6)	−.23	−.10	.22	.02
Asthma (%)	44	14.0 (31.8)	−.07	−.22	.32*	−.07
Arthritis and/or arthrosis (%)	44	14.0 (31.8)	−.14	.16	.08	−.02
Hypertension (%)	44	11.0 (25.0)	−.04	−.15	.33*	−.19
Type 2 diabetes (%)	44	8.0 (18.2)	.05	−.18	.26	−.05
Dyslipidaemia (%)	44	6.0 (13.6)	.06	−.15	.45*	.15
Heart and vascular diseases (%)	44	3.0 (6.8)	−.33*	−.35*	.31*	−.22
Number of comorbidities	44	2.0 (1–3)	−.21	−.24	**.51****	−.13
Depression/anxiety (CES-D) (%)	44	12.0 (27.3)	−.12	−.26	.25	−.04
Daily pain during last 3 month	44	19.0 (43.2)	**−.35****	−35*	.22	−.19

Note: Bold variables are variables selected for the multivariable analysis.
Abbreviations: CES-D, Center for Epidemiologic Studies Depression Scale; LPA, light physical activity; MVPA, moderate-to-vigorous physical activity; $MVPA_a$, MVPA accelerometer data; $MVPA_{sr}$, self-reported MVPA; ST, sedentary time.
*$P < .05$.; **$P \leq .005$.

multivariable analysis. No adjustment with sociodemographic variables was performed due to the absence of significant binary association between sociodemographic and PA or ST data, and the small sample size, except with age for ST and civil status for $MVPA_a$.

3 | RESULTS

3.1 | Sample characteristics

Initially, 89 people expressed interest in the study; however, 22 (25%) were ineligible, 12 (13%) declined to participate, 11 (12%) could no longer be reached, leaving 44 (49%) who consented to participate. Reasons for ineligibility were: BMI < 35 kg/m^2 (n = 16; 73%), unable or unwilling to attend assessment at designated location (n = 3; 14%), temporarily unable to engage in PA (n = 2; 9%), and not French-speaking (n = 1; 4%). Characteristics of the 44 participants are presented in Tables 2–4.

3.2 | PA and ST

Three participants did not provide valid accelerometer data because the device was lost (n = 1), they were unwilling to wear the device

TABLE 4 Psychosocial data and correlations with physical activity and sedentary time

	Descriptives		Dependant variables			
	n	n (%) or mean (SD)	$MVPA_a$ r	LPA r	ST r	$MVPA_{sr}$ r
Social physique anxiety	44	3.3 (0.9)	**−.45****	−.29	−.05	−.01
PA self-perception	44	3.4 (1.9)	.30	**.41****	−.19	**.70****
Amotivation	44	1.4 (0.7)	−.21	.03	−.29	−.28
External motivation	44	1.9 (1.1)	−.09	−.35*	.01	−.27
Introjected motivation	44	2.8 (1.3)	−.22	−.20	.02	.15
Identified motivation	44	3.5 (1.0)	.04	−.03	−.17	.34*
Intrinsic motivation	44	3.4 (1.2)	.08	.08	−.23	.44*
Relative autonomy index	44	6.6 (6.6)	.20	.18	−.09	**.49****
EMI-pleasure	44	3.9 (1.5)	.16	.11	**−.32****	**.44****
EMI-stress management	44	4.0 (1.4)	−.04	.09	−.12	.30
EMI-vitality	44	4.6 (1.3)	.07	−.09	.23	−.32*
EMI-challenge	44	4.3 (1.5)	−.04	.01	.22	−.21
EMI-social recognition	44	2.4 (1.4)	−.12	−.12	−.12	−.08
EMI-affiliation	44	3.0 (1.5)	.18	.09	**−.33****	.14
EMI-competition	44	2.1 (1.2)	.22	.06	−.26	.15
EMI-obligatory health	44	3.2 (1.2)	.05	.14	−.12	.09
EMI-health prevention	44	5.4 (1.0)	.00	.07	−.05	.05
EMI-better health	44	5.4 (1.1)	−.06	.13	−.15	.13
EMI-weight management	44	5.3 (1.0)	.16	.04	.05	−.02
EMI-appearance	44	4.0 (1.3)	−.21	.15	−.26	−.12
EMI-strength and endurance	44	4.4 (1.5)	0.12	−.15	.14	−.25
EMI-agility	44	4.6 (1.6)	−.02	−.25	−.03	−.27
Self-efficacy for PA	44	41.2 (22.6)	.25	**.36****	.07	.41*
Stage of change (% action or maintenance)	44	20 (45.5)	**.33****	.30	.02	**.69****
Social support for PA	38	2.7 (0.8)	.23	−.19	.02	.28
Quality of life	44	4.6 (1.3)	.28	**.43****	−.22	.25

Note: Bold variables are variables selected for the multivariable analysis.
Abbreviations: EMI, Exercise Motivations Inventory; LPA, light physical activity; MVPA, moderate-to-vigorous physical activity; $MVPA_a$, MVPA accelerometer data; $MVPA_{sr}$, self-reported MVPA; ST, sedentary time.
*$P < .05$.; **$P \leq .005$.

TABLE 5 Behavioural data and correlations with physical activity and sedentary time

	Descriptives		Dependant variables			
	n	n (%) or mean (SD)	$MVPA_a$ r	LPA r	ST r	$MVPA_{sr}$ r
LPA (h/d)	41	2.6 (0.9)	.39*	/	−.34*	
$MVPA_a$ (min/wk)	41	209.2 (145.2)	/	.39*	−.01	.37*
$MVPA_{self}$ (min/wk)	41	702.5 (832.3)	.37*			/
Sendentary time (h/d)	41	10.5 (1.4)	−.01	−.34*	/	
6-min walk test distance (m)	44	475.9 (105.7)	**.53****	−.30	−.00	.14

Note: Bold variables are variables selected for the multivariable analysis.
Abbreviations: LPA, light physical activity; MVPA, moderate-to-vigorous physical activity; $MVPA_a$, MVPA accelerometer data; $MVPA_{sr}$, self-reported MVPA; ST, sedentary time.
*$P < .05$.; **$P \leq .005$.

TABLE 6 Stepwise analysis to explain objective measures of moderate-to-vigorous and light physical activity variability in people with severe obesity (n = 40)

	Beta values (partial *P*-values)						Beta values (partial *P*-values)			
MVPA correlates	6MWT	Couple life	SPA	Model R^{2a}	Model *P*-values	LPA correlates	Quality of life	Self-efficacy for PA	Model R^{2a}	Model P-values
6MWT	0.53 (<.001)			0.27	<.001	Quality of life	0.43 (.005)		0.17	.005
6MWT, Civil status	0.53 (<.001)	−0.33 (.013)		0.36	<.001	Quality of life, Self-efficacy for PA	0.42 (.004)	0.36 (.018)	0.26	.001
6MWT, Civil status, SPA	0.45 (.001)	−0.35 (.006)	−0.34 (.008)	0.46	<.001					

Abbreviations: 6MWT, 6-minute walk test distance; LPA, light physical activity; MVPA, moderate-vigorous PA; SPA, social physique anxiety.
[a]Adjusted for the number of variables.

(*n* = 1), or the device was not worn properly (*n* = 1). Means for LPA, $MVPA_a$, $MVPA_{sr}$ and ST are presented in Table 5.

3.3 | Univariate and multivariate analyses

Based on the univariate correlations (Tables 2–4), the stepwise multiple regression model for $MVPA_a$ included civil status, daily pain during past 3 months, SPA, stage of change and physical fitness as correlates. Civil status, physical fitness and SPA were significant correlates, whereby those who were single, had better physical fitness and experienced lower levels of SPA had higher levels of $MVPA_a$ (R^2 = 0.46, P < .001; Table 6). The model for $MVPA_{sr}$ included the RAI, pleasure motives, stage of change and PA self-perceptions as correlates (Tables 2–4). Only PA self-perceptions was a significant correlate (R^2 = 0.47, β = 0.07, P < .001), indicating that participants who perceived PA as congruent with their identity had higher levels of self-reported MVPA. The model for LPA_a included BMI, PA self-perceptions, quality of life and self-efficacy for PA as correlates (Tables 2–4). Quality of life and self-efficacy for PA were the only significant correlates (R^2 = 0.26, P = .001), whereby those who had a high quality of life and self-efficacy for PA engaged in more LPA_a (Table 6). Finally, the model for ST_a included affiliation motives, pleasure motives, number of comorbidities and age as correlates (Tables 2–4). Only the number of comorbidities was a significant correlate (R^2 = 0.25, P < .001), whereby those with more comorbidities spent more time sedentary.

4 | DISCUSSION

Engaging in PA and avoiding excessive ST is important for people with severe obesity because it may aid in weight management and reduce the risks of numerous chronic diseases and all-cause mortality.[2] The aim of this study was to identify biopsychosocial correlates of PA and ST among adults living with severe obesity, a population that is generally both insufficiently active and sedentary.[6] Different biopsychosocial correlates were associated with each behavioural outcome, which has implied that practitioners may need to use distinct strategies for promoting LPA and MVPA, and for reducing ST in this population.

An important finding of the current study is that greater objective MVPA was significantly associated with greater physical fitness, being single and having lower levels of SPA in multivariate analyses. While hypothesized to predict MVPA herein because poor physical fitness may be a barrier to MVPA,[32] future research must disentangle the direction of this relationship using longitudinal research designed in the future because poor fitness may also be a consequence of low MVPA. Further, although inconclusive results have been found overall among adults[8] being single was associated with higher levels of MVPA in the current study, which is in accordance with another study conducted with post-bariatric participants.[33] This association could be explained, in part, by the notion that single people may have more time to engage in PA, or they may use PA socialize with others. Additionally, a partner's poor health behaviour may negatively influence one's own behaviour, thereby making it more difficult to initiate or maintain positive health behaviour change.[34] Involving partners in PA behaviour change interventions may be helpful for adults living with severe obesity who are in a relationship. Finally, this study found that SPA was inversely associated with objective MVPA. Theoretical perspectives and empirical research suggest that people's concerns about their physical self being negatively evaluated by others may lead to avoidance of PA.[35] This finding aligns with previous research showing that people who have a higher BMI tend to exhibit higher levels of SPA[36] and that SPA may be a barrier to PA among individuals with obesity.[37] Efforts to reduce bias, stigma and discrimination related to excess weight, and to reduce SPA could help to increase PA among adults living with severe obesity.

The correlates of self-reported MVPA differed from those of objective MVPA, which is consistent with recent contentions that self-reported and objective PA each provide distinct valuable information and should be considered separately.[38] The only significant correlate of self-reported MVPA in multivariate analyses was PA self-perceptions. This study found that those who perceive themselves as a persons who exercise regularly were more likely to self-report higher levels of MVPA. Interestingly, PA self-perceptions were not significantly correlated with objective MVPA. While this may

suggest that PA self-perceptions are not necessarily congruent with the total amount of movement a person engages in on average, reasons for this discrepancy warrant further investigation. It is possible that PA self-perceptions are more strongly related to voluntary movement, which is likely what people self-report whereas devices capture both voluntary and non-voluntary movement.

Since increasing evidence suggests there are benefits to engaging in LPA,[14] this study also explored correlates of LPA in adults living with severe obesity. The study found that higher LPA was associated with higher quality of life and self-efficacy for PA. In contrast to objectively measured MVPA, which was associated with only the physical functioning domain of quality of live (as indicated by the 6MWT),[31] LPA was better associated with the global quality of life score. These results suggest that physical limitations may prevent people from engaging in MVPA, and that lower overall quality of life may inhibit LPA. Thus, when PA interventions target adults living with severe obesity who report poorer quality of life, more attention should be paid to improve self-efficacy for PA and enhance quality of life in order to initiate and increase LPA. Inversely, our results could also suggest that LPA may be a mechanism to improve quality of life and self-efficacy for PA among people with severe obesity. The benefits of LPA may be due to different mechanisms than those underlying MVPA. The latter is more challenging and could result in muscle soreness or negative affect associated with high-intensity exercise[39] leading to feeling of incompetence and reduced physical, emotional and social well-being. More studies are needed to try and disentangle the relationships between LPA, quality of life and self-efficacy among people with severe obesity, as this understanding will be essential to prescribing the most effective PA intervention for this population.

Regarding ST, the total number of comorbidities remained the only significant correlate in multivariate analysis. This finding is unsurprising considering that excessive ST is an independent risk factor for many of the chronic diseases measured in this study.[2,7] In addition, this result is in accordance with other studies showing that health and number of comorbidities are inversely associated with ST in healthy adults.[40] However, a factor contributing to the limited number of psychosocial correlates identified for ST is most of the questionnaires used were specific to PA rather than ST. It is likely that participants responded to these questionnaires by reflecting on their time spent in PA, yet lack of PA is not the opposite of ST (ie, one can both engage in PA frequently and have high ST). Therefore, additional factors could influence ST in adults living with severe obesity and warrant identification.

This study provided a broad analysis of potential biopsychosocial factors that could be associated with LPA, MVPA and ST. Examining correlations with each PA outcome is a strength of the current study considering that objective and self-reported MVPA may have distinct correlates. Several limitations of this study must also be acknowledged. First, the cross-sectional design of this study prevents conclusions regarding causality between behavioural outcomes and correlates. Second, a convenience sample was used which may reduce the generalizability of the sample to the broader population of adults living with severe obesity. Finally, the scope of this study only examined intrapersonal variables, whereas social and environmental variables may also influence PA and ST in this population.

In conclusion, this study provides a preliminary understanding of factors associated with LPA, MVPA, and ST in adults living with severe obesity. Additional research is needed to examine correlates of PA and ST in adults living with severe obesity and to establish causality. In the meantime, health behaviour change interventions may look to target adults living with severe obesity who have several comorbidities, and may focus to reduce SPA, improve physical fitness, enhance self-efficacy for PA and foster quality of life in order to increase PA and reduce ST.

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CONFLICTS OF INTEREST

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AUTHOR CONTRIBUTIONS

AB, AJR and JB conceived the project. AB carried out experiments, and AB with MB analysed the data. All authors were involved in interpreting the data, writing the paper and had final approval of the submitted and published versions.

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REFERENCES

1. Sallis JF, Bull F, Guthold R, et al. Progress in physical activity over the Olympic quadrennium. *Lancet*. 2016;388(10051):1325-1336.
2. Lee IM, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*. 2012;380(9838):219-229.
3. Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. *Appl Physiol Nutr Metab*. 2010;35(6):725-740.
4. Tremblay MS, Aubert S, Barnes JC, et al. Sedentary behaviour research network (SBRN)—terminology consensus project process and outcome. *Int J Behav Nutr Phys Act*. 2017;14(1):75.
5. Fryar CD, Carroll MD, Ogden CL. Prevalence of Overweight, Obesity, and Severe Obesity among Adults Aged 20 and over: United States, 1960–1962 through 2015–2016. 2018. https://www.cdc.gov/nchs/data/hestat/obesity_adult_15_16/obesity_adult_15_16.htm
6. Bastin A, Romain AJ, Marleau J, Baillot A. Health behaviours, intentions and barriers to change among obesity classes I, II and III. *Clin Obes*. 2018;9(1):e12287.
7. King WC, Chen J-Y, Courcoulas AP, et al. Objectively-measured sedentary time and cardiometabolic health in adults with severe obesity. *Prev Med*. 2016;84:12-18.

8. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJF, Martin BW. Correlates of physical activity: why are some people physically active and others not? *Lancet*. 2012;380(9838):258-271.
9. Teixeira PJ, Carraça EV, Marques MM, et al. Successful behavior change in obesity interventions in adults: a systematic review of self-regulation mediators. *BMC Med*. 2015;13:84.
10. Godin G, Amireault S, Bélanger-Gravel A, Vohl MC, Pérusse L. Prediction of leisure-time physical activity among obese individuals. *Obesity*. 2009;17(4):706-712.
11. Wouters EJ, Larsen JK, Zijlstra H, Van Ramshorst B, Geenen R. Physical activity after surgery for severe obesity: the role of exercise cognitions. *Obes Surg*. 2011;21(12):1894-1899.
12. Hunt HR, Gross AM. Prediction of exercise in patients across various stages of bariatric surgery: a comparison of the merits of the theory of reasoned action versus the theory of planned behavior. *Behav Modif*. 2009;33(6):795-817.
13. Warburton DE, Bredin SS. Health benefits of physical activity: the evidence. *CMAJ*. 2017;174(6):801-809.
14. Colley R, Michaud I, Garriguet D. Reallocating time between sleep, sedentary and active behaviours: associations with obesity and health in Canadian adults. *Health Rep*. 2018;29(4):3-13.
15. Silva SG, Elsangedy HM, Krinski K, et al. Effect of body mass index on affect at intensities spanning the ventilatory threshold. *Percept Mot Skills*. 2011;113(2):575-588.
16. Rhodes RE, Kates A. Can the affective response to exercise predict future motives and physical activity behaviour? A systematic review of published evidence. *Ann Behav Med*. 2015;49(5):715-731.
17. Adler NE, Epel ES, Castellazzo G, Ickovics JR. Relationship of subjective and objective social status with psychological and physiological functioning: preliminary data in healthy, White women. *Health Psychol*. 2000;19(6):586-592.
18. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Measur*. 1977;1(3):385-401.
19. Armstrong T, Bull F. Development of the World Health Organization global physical activity questionnaire (GPAQ). *J Public Health*. 2006;14(2):66-70.
20. King WC, Li J, Leishear K, Mitchell JE, Belle SH. Determining activity monitor wear time: an influential decision rule. *J Phys Act Health*. 2011;8(4):566-580.
21. Martin KA, Rejeski WJ, Leary MR, McAuley E, Bane S. Is the social physique anxiety scale really multidimensional? Conceptual and statistical arguments for a unidimensional model. *J Sport Exerc Psychol*. 1997;19(4):359-367.
22. Motl RW, Conroy DE. Validity and factorial invariance of the social physique anxiety scale. *Med Sci Sports Exerc*. 2000;32(5):1007-1017.
23. Kendzierski D. Self-schemata and exercise. *Basic Appl Soc Psychol*. 1988;9(1):45-59.
24. Markland D, Ingledew DK. The measurement of exercise motives: factorial validity and invariance across gender of a revised exercise motivations inventory. *Br J Health Psychol*. 1997;2(4):361-376.
25. Markland D, Tobin V. A modification to the behavioural regulation in exercise questionnaire to include an assessment of amotivation. *J Sport Exerc Psychol*. 2004;26(2):191-196.
26. Ryan RM, Connell JP. Perceived locus of causality and internalization: examining reasons for acting in two domains. *J Pers Soc Psychol*. 1989;57(5):749-761.
27. Bandura A. Guide for constructing self-efficacy scales. In: Urdan T, Pajares F, eds. *Self-efficacy beliefs of adolescents*. Greenwich: Information Age Publishing; 2006:307-337.
28. Nigg CR, Hellsten L, Norman G, et al. Physical activity staging distribution: establishing a heuristic using multiple studies. *Ann Behav Med*. 2005;29(2):35-45.
29. Sallis JF, Grossman RM, Pinski RB, Patterson TL, Nader PR. The development of scales to measure social support for diet and exercise behaviors. *Prev Med*. 1987;16(6):825-836.
30. Therrien F, Marceau P, Turgeon N, Biron S, Richard D, Lacasse Y. The laval questionnaire: a new instrument to measure quality of life in morbid obesity. *Health Qual Life Outcomes*. 2011;9(1):66.
31. Baillot A, Baillargeon J-P, Brown C, Poder T, Langlois M-F. The 6-min walk test reflects functional capacity in primary care and obese patients. *Int J Sports Med*. 2015;36(6):503-509.
32. Rimmer JH, Hsieh K, Graham BC, Gerber BS, Gray-Stanley JA. Barrier removal in increasing physical activity levels in obese African American women with disabilities. *J Womens Health*. 2010;19(10):1869-1876.
33. Bergh I, Kvalem IL, Mala T, Hansen BH, Sniehotta FF. Predictors of physical activity after gastric bypass—a prospective study. *Obes Surg*. 2017;27(8):2050-2057.
34. Homish GG, Leonard KE. Spousal influence on general health behaviors in a community sample. *Am J Health Behav*. 2008;32(6):754-763.
35. Hart EA, Leary MR, Rejeski WJ. The measurement of social physique anxiety. *J Sport Exerc Psychol*. 1989;11(1):94-104.
36. Brewer BW, Diehl NS, Cornelius AE, Joshua MD, Van Raalte JL. Exercising caution: social physique anxiety and protective self-presentational behaviour. *J Sci Med Sport*. 2004;7(1):47-55.
37. Treasure DC, Lox CL, Lawton BR. Determinants of physical activity in a sedentary, obese female population. *J Sport Exerc Psychol*. 1998;20(2):218-224.
38. Colley R, Butler G, Garriguet D, Prince SA, Roberts KC. Comparison of self-reported and accelerometer-measured physical activity in Canadian adults. *Health Rep*. 2018;29(12):3-15.
39. Ekkekakis P, Parfitt G, Petruzzello SJ. The pleasure and displeasure people feel when they exercise at different intensities. *Sports Med*. 2011;41:641-671.
40. O'Donoghue G, Perchoux C, Mensah K, et al. A systematic review of correlates of sedentary behaviour in adults aged 18–65 years: a socio-ecological approach. *BMC Public Health*. 2016;16(1):163.

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