Weight Bias: Trends among the Canadian Public and Relationships with Physical Activity and Sedentary Behaviour

Vida Forouhar

A Thesis

in

The Department

of

Health, Kinesiology and Applied Physiology

Presented in Partial Fulfillment of the Requirements

for the Degree of Master of Science (Health and Exercise Science) at

Concordia University

Montreal, Quebec, Canada

August 2022

CONCORDIA UNIVERSITY

School of Graduate Studies

This is to certify that the thesis prepared

By: Vida Forouhar

Entitled: Weight Bias: Trends Among the Canadian Public and Relationships with Physical Activity and Sedentary Behaviour

and submitted in partial fulfillment of the requirements for the degree of

Master of Science (Health, Kinesiology and Applied Physiology)

complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the final examining committee:

Dr. Peter Darlington _____Chair

Dr. Simon Bacon _____ Examiner

*Dr. Ximena Ramos Salas*_____ Examiner

*Dr. Angela Alberga*_____ Thesis Supervisor

Approved by: _____

Dr. Geoff Dover, Graduate Program Director

August 15, 2022 _____

Dr. Pascale Sicotte, Dean of Faculty

ABSTRACT

Weight Bias: Trends among the Canadian Public and Relationships with Physical Activity and Sedentary Behaviour

Vida Forouhar

Introduction: Weight bias is a social justice issue in Canada. It is perpetuated by negative attitudes about individuals with obesity and about the causes of obesity. Research on the association between explicit and internalized weight bias and physical activity and sedentary behaviour is limited, especially among population-based samples. Data on weight bias internalization (WBI) and beliefs about the causes of obesity among Canadians is also lacking.

Objectives: The primary objectives of this study were to describe the level of WBI among Canadians and describe how Canadians attribute obesity to different causes; and to examine the relationships between weight bias and physical activity and sedentary behaviour.

Methods: A sample of Canadian adults (N = 942; 51% female; mean body mass index [BMI]= 27.3 ± 6.7 kg/m^2) completed an online survey. Questionnaires included the Anti-Fat Attitudes Questionnaire, Modified Weight Bias Internalization Scale, Causes of Obesity Questionnaire, International Physical Activity Questionnaire, and the Sedentary Behavior Questionnaire.

Results: WBI scores (3.38 ± 1.58) were higher among females and individuals with higher BMIs ($p < 0.001$ for all). Participants mainly endorsed behavioural causes of obesity. WBI was associated with more weekly hours of sedentary behaviour ($B = 0.85$, $p < .001$). Explicit weight bias was associated with more weekly minutes of vigorous physical activity ($B = 12.87$, $p < .05$).

Conclusions: This study highlights WBI as a problem that is associated with adverse health behaviours among all individuals across the weight spectrum. Future research should investigate the longitudinal impact of weight bias on health behaviours.

ACKNOWLEDGMENTS

Completion of my M.Sc. thesis would not have been possible without the help and support of the following people:

I would like to express my deepest gratitude to my supervisor, Dr. Angela Alberga, for her continuous encouragement and support throughout my master's degree. Thank you, Angela, for taking me on as a research volunteer three years ago and for seeing my potential enough to allow me to grow in your lab as a young academic. Thank you for believing in me, trusting me and giving me every opportunity to learn from you and work alongside you in various projects. The last three years have carved my passion for research, which I would not have been able to find without your direction and mentorship.

My special thanks are extended to my committee members, Dr. Simon Bacon and Dr. Ximena Ramos Salas, for your expertise and contributions to my thesis project. I know that my project has been greatly improved with your knowledge and guidance.

To my lab colleagues, old and new, (Erica, Iyoma, Matt, Trisha, Tiffany, Kimiya, Lauren, Sabrina, Martha and Kimm), it has been a wonderful experience working with all of you and building friendships that have set a fruitful foundation for the MILOH lab. A very special thank you to Trisha, my journey over the last three years in this lab started with you, and I could not thank you enough for your kindness, your friendship and the support you have always given me. Sabrina, you only joined us a year ago, but the lab would not be the same without you. I wish

you both the best of luck in the continuation of your degrees, I know you will both accomplish your goals and I look forward to working together and remaining friends in the future.

To my friends and family, thank you for being patient with me and encouraging me throughout this journey. Thank you to my sister, Mina, for undoubtedly believing in me and for inspiring me to strive for greatness. Finally, I'd like to thank my Mom and Dad, whose unconditional love and support have allowed me to get to where I am. Thank you for consoling me during frustrating times, for motivating me when I needed it the most, and for encouraging me to persevere.

AUTHOR CONTRIBUTIONS

Role of co-authors:

Conception and Design: Vida Forouhar, Iyoma Y. Edache and Angela S. Alberga

Data Collection: Iyoma Y. Edache

Data Analysis and Interpretation: Vida Forouhar

Drafting of the thesis: Vida Forouhar

Critical revision of the thesis for important intellectual content: Vida Forouhar, Simon L. Bacon, Ximena R. Salas and Angela S. Alberga

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CHAPTER 1: INTRODUCTION

1.0 General Introduction

Obesity is defined as excessive adiposity that may impair an individual's health [1]. In 2013, the American Medical Association declared obesity as a chronic disease and the Canadian Medical Association followed shortly after in 2015 [2]. This was done in order to introduce a new definition of obesity that encapsulates the health correlates of living with obesity. Included in the updated Canadian Adult Obesity Clinical Practice Guidelines, obesity is defined as excess weight or adiposity that impairs one's mental, physical and social health [3]. The ultimate goal behind this initiative was to shift the narrative around obesity and to alleviate the stigma of living in a larger body by promoting the notion that obesity is not solely characterized by a high body mass index (BMI) [3,4]. This update was fundamental in highlighting the complexity of obesity as a long-term, relapsing chronic disease that may be caused by environmental, physiological, psychological and psychosocial factors [3,5], in addition to the behavioural factors that it is commonly associated with [6]. Current literature suggests a widespread belief that obesity is a condition that is brought upon oneself [7], repercussions of which are harmful to individuals who are perceived as having excess weight.

Individuals living with overweight or obesity are often blamed for their weight status and are discriminated against (i.e. treated unfairly) in many facets of society, including in the media, education settings, employment settings, and interpersonal relationships [8–10]. Weight discrimination is related to weight bias or negative attitudes and beliefs about individuals simply due to their body shape or weight status [10,11]. Weight bias can be either explicit, implicit, or internalized, whereby explicit weight bias is a more overt or obvious endorsement of these beliefs and implicit weight bias is a more subtle or subconscious form of bias [12]. Weight bias internalization (WBI) occurs when individuals, with or without obesity, internalize these

negative attitudes about weight and believe that their value as a person is reliant on their weight [13]. As a result of these negative attitudes, individuals who are perceived to have excess weight are marginalized, creating a stigma around weight known as weight stigma [14]. Stereotypes that individuals in larger bodies are lazy, incompetent, less intelligent, and lack willpower are commonly endorsed and further contribute to the stigmatization of individuals with excess weight [10,15]. When these beliefs are manifested into behaviours, blatant discrimination such as verbal harassment, unequal opportunities for employment, or biased treatment from health care professionals can occur [16]. This form of discrimination is rampant in North American society and is grouped within the second most common forms of discrimination in Canada [17,18]. As weight discrimination is perpetuated by weight bias, it is incumbent to have an understanding of the prevalence of weight bias in Canada in order to better inform efforts to protect individuals from weight discrimination.

In a multinational study on American, Canadian, Australian and Icelandic adults and undergraduate students (N= 2866), findings demonstrated similar levels of weight bias in all countries as well as an attribution to personal responsibility for higher body weight status [19]. Participants with higher levels of weight bias attributed obesity more to behavioural factors. Similarly, in a large representative sample of Canadian adults, explicit weight bias was persistent and expressed through a fear of weight gain and a belief that weight gain is due to a lack of willpower [20]. Beliefs about the causes of obesity are related to weight bias, whereby the more individuals attribute obesity to factors within personal control, the more they endorse negative attitudes about weight [19,21]. While explicit and implicit weight bias have been documented among American and Canadian adults, the prevalence of WBI and the beliefs about the causes of obesity among a large representative sample of Canadian adults remain unknown.

1.1 Beliefs about the Causes of Obesity

A drive for the continual stigmatization of individuals with obesity lies within the misperception around the magnitude of attribution of different factors in causing obesity [15]. Particularly, the belief that obesity is caused mainly by unhealthy behaviours, such as eating too much and not exercising enough, that are solely within individual control [7]. In line with attribution theory, human behaviour is understood by the causes, either internal or external, involved in a particular behaviour [22]. If personal responsibility is attributed to the negative outcomes of a certain behaviour, the individual may face prejudice and negative affect from others [22]. Research demonstrates that attributing obesity to mainly behavioural factors, such as physical activity and diet, predicts higher explicit weight bias [19,21,23]. According to a systematic review by Sikorski et al., seven studies assessed causal beliefs about obesity on representative samples of American and German adults (N= 6,168) [21]. Among these samples, the causal attributions that were the most frequently endorsed were physical inactivity and dietary patterns, both of which are considered as behavioural factors [21]. One study found that 23.5% of participants endorsed negative attitudes about weight, and that attributing obesity to behavioural factors (i.e. binge eating or lack of physical activity) predicted higher stigmatizing attitudes [24]. Similarly, results from two other studies reflected the belief that obesity is mainly attributable to overeating, a lack of exercise or physical activity, and a lack of willpower [25,26]. Only one study, with a representative sample of 909 American adults, found that participants endorsed environmental factors (e.g. unavailability of healthy foods) more than factors related to a personal attribute (e.g. lack of willpower to diet or exercise), however, the difference was only marginal at 4.5% [27]. A more recent study that drew from the results of this systematic review aimed to compare public beliefs about the causal attributions of obesity between representative

adult samples from the USA and Germany (N= 1,802) [7]. The authors reported higher endorsement of environmental factors in the USA as compared to Germany, however, in both countries, the most agreed upon factors in contributing to obesity were behavioural, namely overeating and a lack of physical activity [7]. In both samples, causal attributions to behavioural factors were significantly less endorsed by individuals with higher BMIs. Individuals with higher weight may be more knowledgeable about the complexity of obesity, potentially through repeated weight loss attempts, suggesting a BMI difference in the beliefs about the causal attributions of obesity that should be further explored.

In a large multinational study of 2,866 adults conducted by Puhl and colleagues, different measures of weight bias were assessed across four countries including Canada, the United States, Australia and Iceland [19]. The Canadian sample in this study was drawn from members of Obesity Canada's (formerly known as the Canadian Obesity Network) panel of members, consisting of health care professionals (such as physicians, mental health professionals, dietitians, and nurses), policy makers, industry stakeholders, research trainees and students, and more [19]. Among all samples in this study, beliefs in the behavioural causes of obesity were associated with more negative attitudes and bias towards individuals with obesity [19]. Conversely, attributing obesity to physiological or psychological causes was related to lower weight bias. Findings also demonstrated higher levels of weight bias among those who endorsed stronger attribution of blame and a lack of willpower for higher body weight [19]. Among the Canadian and Icelandic samples, individuals with obesity demonstrated less weight bias compared to individuals with normal weight, suggesting a differential role of BMI that should be further explored [19].

1.1.1 ACTION Study

The attribution of obesity to individual behaviours such as unhealthy eating and lack of physical activity may contribute to the belief that obesity can be treated mainly through diet and exercise strategies. The Awareness Care and Treatment in Obesity MaNagement (ACTION) study assessed perceptions about obesity management practices among Canadians living with obesity (N= 2,000) as well as health care professionals who were experts in obesity management (N= 395) [28]. Results demonstrated that individuals with obesity believed the most effective weight management approaches were diet and exercise, despite low success rates with personal weight loss through these approaches [28]. Health care practitioners in the sample, consisting of family practitioners, general practitioners, dietitians, nurse practitioners, endocrinologists and bariatric surgeons similarly endorsed the belief that obesity is best managed through diet and exercise [28]. Furthermore, 64% of the participants living with obesity believed that weight loss was their own responsibility [28], reflecting the belief of a personal attribution of obesity [23]. Health care practitioners in this sample endorsed the belief that weight management is not discussed because individuals with obesity lack motivation to lose weight [28], which also corresponds with the belief that weight-related issues fall under the responsibility of the individual. These discrepancies demonstrate both a gap in communication between individuals with obesity and health care practitioners, and a lack of understanding of the complexity of obesity.

The ACTION study as well as the multinational study by Puhl et al are the only two studies that have assessed beliefs about obesity among Canadians. Both studies, however, were limited in their samples as they consisted of either primarily white males [28], or primarily white females [19], who were either individuals with obesity or experts in obesity and its care. Despite

this research providing data on Canadian attitudes about obesity and its causes, little is known about these beliefs among individuals across the weight spectrum. It is imperative to understand these beliefs among lay individuals of all weight statuses, to provide more insight on how weight-related biases are manifested among the general Canadian population.

1.2 Weight Bias Internalization (WBI)

1.2.1 Prevalence and Trends

Negative weight-related attitudes can also be self-directed through WBI, when individuals are aware of these beliefs, apply it to themselves and self-stigmatize as a result. Individuals who are perceived as having excess weight experience bias and discrimination more often, and as a result internalize negative weight-related attitudes more. WBI, however, can be experienced by individuals with or without obesity [29], as seen in a study of 2,529 American adults whereby experiences of WBI were expressed by 52% of participants with obesity, and 20% of those without obesity [30]. In Canada, the prevalence of WBI has been mostly measured among samples of individuals with overweight and obesity. These samples consisted of primarily white women who were involved in commercial weight management programs such as WW (Weight Watchers) [31]. The majority of the studies in the literature consist of American samples, aside from one multinational study that examined WBI on a sample of 13,966 participants across the US, UK, Canada, France, Australia and Germany [31]. Across all countries, higher internalization was associated with higher BMI and younger age, with higher mean scores among women as compared to men [31]. These trends have also been highlighted in a systematic review on weight bias internalization and health by Puhl and Pearl, which found an association between WBI and BMI and gender in multiple studies [32]. A total of 42 cross-

sectional studies assessed this relationship, and among the 33 studies with samples of individuals living with overweight and obesity (*n*= 14,191), 16 found a significant association between WBI and BMI, but the other 17 studies did not [32]. Among the nine studies that included samples of individuals with diverse weight statuses, the association between BMI and WBI was also significant, suggesting a relationship between higher weight status and higher WBI [32]. Three studies found a relationship between WBI and higher self-perceived weight status, regardless of objective weight status. Although these findings suggest that higher weight is associated with higher internalization of weight bias, they also suggest that individuals of all weight statuses may experience WBI to some extent [29,32].

Further, in four of the studies including samples of individuals with overweight and obesity, gender differences were found with higher mean weight bias internalization scores among women as compared to men. To the best of our knowledge there is only one Canadian study that measured these associations among a sample that is inclusive of diverse body weight statuses, results from which demonstrated the same trends for gender differences [33]. Although previous literature is more focused on gender differences in WBI, many studies have used gender and sex interchangeably, making it difficult to assess which of these constructs was actually captured. Nevertheless, there is a paucity of research that has examined differences in WBI between males and females. This warrants further investigation of the associations between WBI and BMI and of sex differences among a larger sample of Canadian adults that is more representative of the general population and inclusive of individuals across the weight spectrum.

1.2.2 Weight Bias Internalization and Health Correlates

Research has shown the various detrimental mental and physical health correlates of experiencing WBI [32,34]. According to a 2018 systematic review on WBI and health, several studies found associations between high levels of WBI and poor body image, body dissatisfaction, symptoms of anxiety and depression, and psychological distress [32]. Disordered eating, maladaptive eating behaviours and physical-health related quality of life were further associated with WBI [32]. While the negative mental health correlates of WBI are well-known [32], research on the association between WBI and health behaviours, like physical activity and sedentary behaviour, remains inconsistent and understudied.

1.2.3 Weight Bias Internalization and Physical Activity

The literature shows conflicting results surrounding the relationship between WBI and physical activity-related constructs. A recent systematic review on weight bias and physical activity highlighted 16 studies that examined the relationship between WBI and physical activity; out of these studies, only two used objective measures of physical activity, two studies examined WBI and frequency of exercise, two studies investigated WBI in relation to physical activity or exercise-related motivational factors (e.g. exercise self-efficacy) and 10 studies looked at WBI and self-reported physical activity levels measured by either the International Physical Activity Questionnaire (IPAQ) or the Godin Leisure-Time Exercise Questionnaire (GLTEQ) [35]. Among the studies that included subjective measures, six found direct negative associations between WBI and levels of physical activity, and five studies found no association between the two [35]. In four studies, WBI was also reported to have an indirect association with physical

activity, either as a moderator or mediator in relation to other factors specific to each study model [35].

In two studies, a mediating role of WBI was found in its relationship with physical activity and experienced weight stigma and general self-efficacy. In a cross-sectional study with a sample of 177 women living with obesity, results from self-reported questionnaires showed that experiencing weight stigma was associated with higher WBI levels, which was further associated with less engagement in physical activity [36]. In a sample of 179 bariatric surgery candidates, lower general self-efficacy predicted greater levels of weight bias internalization which further predicted lower levels of moderate and vigorous physical activity [37].

Research has also demonstrated a moderating role of WBI with physical activity and other factors. A randomized controlled trial conducted on women with obesity who were participating in a lifestyle modification program (N= 80) found that the effectiveness of the intervention on changes in physical activity engagement was dependent on participants' levels of WBI [38]. In another study, among 111 American adults who self-identified as having overweight or obesity, the relationship between experiences of weight stigma and exercise avoidance was assessed [39]. For individuals with high WBI, experiencing weight stigma was associated with greater exercise avoidance [39].

Two other studies in the literature [33,40] that examined the association between WBI and physical activity were not included in this systematic review from 2021 [35]. In one study, among a community sample of 46 adults with overweight and obesity, experiences of weight stigma, WBI and constructed items of motivation to exercise were assessed. Results demonstrated a moderating effect of WBI on responses to weight stigma, where higher WBI was associated with less motivation to exercise after experiencing weight stigma, among the women

in the sample only [40]. A more recent cross-sectional study on a convenience sample of Canadian adults (n= 107) found a direct association between WBI and physical health measures [33]. A negative association between WBI and moderate and strenuous intensity physical activity was reported [33]. This study was also the only one to measure the relationship between WBI and sedentary behaviour, findings for which demonstrated a positive association between WBI and weekly hours spent in sedentary behaviour [33].

1.2.4 Weight Bias Internalization and Sedentary Behaviour

Insufficient attention has been given to sedentary behaviour as a potential health correlate with measures of weight bias. Sedentary behaviour has been considered a component of physical inactivity, however, a distinction between the two is evident as individuals may still meet the recommended daily requirements of physical activity and simultaneously spend a significant amount of time in sedentary behaviour [41,42]. Evidence gathered from multiple systematic reviews demonstrates an association between high levels of sedentary behaviour and depression, physical inactivity, poor cognitive function, and poor physical health-related quality of life [43]. These associations remain even after adjusting for factors like physical activity, emphasizing the distinction between the sedentary behaviour and physical activity. Aside from cognitive function, these unfavourable health outcomes have also been associated with WBI, even after adjusting for BMI [32]. In efforts to address both WBI and these outcomes, the relationship between WBI and sedentary behaviour must be elucidated. The fact that both are linked to poor health outcomes regardless of BMI also calls for the need to examine their association, along with that of physical activity and WBI, across the weight spectrum.

The majority of the studies in the literature highlighted an indirect relationship between WBI and physical activity, and only one study from our research group assessed its relationship with sedentary behaviour. These studies also differed by measures used, sample sizes and sample characteristics. Apart from three studies which examined levels of physical activity engagement using the International Physical Activity Questionnaires [37,44,45], most of the studies in the literature measured physical activity either by frequency of exercise using the Godin Leisure-Time Exercise Questionnaire [36,46–51], physical activity engagement through constructed items [38,52], exercise as a compensatory behaviour, intention or motivation to exercise [40,53], or exercise avoidance [54].

The majority of the samples included treatment seeking adults or individuals with overweight or obesity (N= 12 studies), with only a few studies on large representative samples (N= 2 studies). Only two studies included Canadian participants [31,33], neither of which were representative of the general Canadian population since participants were either members of the WW community or recruited from a convenience sample of individuals belonging to a research center. In the study with participants from WW (n=2708), 93% of the sample were female, 95% White and 78% were individuals living with overweight and obesity [31]. Although the Canadian study by Levy and colleagues had a relatively equal distribution of men and women and included more diverse weight statuses, more research is needed to understand how these associations are manifested in a larger and more representative sample of Canadians across the weight spectrum.

1.3 Explicit Weight Bias

1.3.1 Experiencing Weight Bias and Health Correlates

The internalization of negative weight-related attitudes is often exacerbated through experiences of weight bias from others. Individuals who experience negative weight-related encounters are adversely affected in several ways, whether they internalize weight bias or not. Research has shown that experiencing weight bias is associated with increased symptoms of depression and anxiety, psychological distress, low self-esteem and a poor body image [55]. In response to these harmful experiences, individuals may develop maladaptive coping behaviours including exercise avoidance [56] or severe eating pathology [57], which can reinforce some of the comorbidities associated with weight gain, weight cycling, and obesity. Contrary to common belief, shaming individuals for living in larger bodies does not motivate them to improve or change their health behaviours. Studies from a meta-analysis have found that shaming individuals for their body weight may exacerbate preexisting maladaptive behaviours or may lead to the avoidance of health promoting behaviours such as exercise [58]. A 2021 systematic review reported a direct negative association between experienced weight stigma and physical activity in six studies with samples consisting of older adults above the age of 50, adults with poorly controlled type 2 diabetes, or undergraduate students [35]. In two studies with similar samples of older adults, participants who had experienced weight discrimination were 30% and 20-25% less likely to engage in moderate-to-vigorous physical activity as compared to participants who did not report experiencing weight discrimination [59,60]. Among 168 adults with type 2 diabetes, those who had experienced weight discrimination reported only exercising twice a week compared to three times a week among those who had not experienced weight discrimination [61]. In one study where physical activity was objectively measured among 90

female college students, participants who reported a higher frequency of weight teasing spent only 25 minutes per week engaging in vigorous physical activity as opposed to 54 minutes per week among those who did not report weight teasing [62].

Other studies have assessed how individuals cope with weight stigmatizing experiences, results from which demonstrated how exercise behaviour is influenced. In a large sample of 11,924 American adults enrolled in a weight management program, participants reported coping with lifetime experiences of weight stigma through exercise avoidance [56]. Similarly, in a qualitative study conducted by Myre and colleagues, women living with overweight and obesity expressed that the fear and anxiety of anticipated stigma was sufficient enough to demotivate them from partaking in any form of physical activity [63].

The studies included in this systematic review demonstrate how experiences with weight stigma may influence physical activity and exercise behaviour, whether directly or indirectly. There is a paucity of research, however, that has examined whether one's own biases are related to physical activity and sedentary behaviour.

1.3.2 Endorsing Weight Bias and Health Behaviours

While research has shown that experiencing weight bias is associated with adverse health measures, it is unknown if endorsing negative attitudes about weight may be associated with one's own physical activity levels. Vartanian and Novak assessed whether WBI and explicit weight bias moderated the impact of experienced weight stigma on other health behaviours among a sample of 111 adults who self-identified as having overweight or obesity [39]. Results demonstrated a moderating effect of explicit weight bias where experiences with weight stigma were related to greater exercise avoidance among individuals who scored high in explicit weight

bias [39]. Similarly, among 58 adults with overweight and/or obesity who were enrolled in a behavioural weight loss program, attribution of more negative traits to individuals with obesity was associated with less energy expenditure after 6 and 18 weeks of treatment [64]. These findings suggest a possible relationship between weight bias and one's own exercise behaviour, which warrants further investigation of the potential relationship between explicit weight bias and physical activity.

1.4 Role of Body Mass Index

As previously demonstrated through a systematic review, studies in the literature suggest a relationship between WBI and BMI, whereby individuals living with overweight or obesity reported having higher levels of WBI [32]. Although many indirect associations were found, a relationship between WBI and physical activity exists nonetheless [35]. A large national study that collected objectively measured physical activity using accelerometry has also shown that individuals with overweight or obesity spend less time engaging in physical activity as compared to their peers with normal weight [65]. Given that individuals with obesity may experience more WBI and also partake in less physical activity, it is possible that BMI plays a role in the relationship between WBI and engagement in physical activity. Previous research has highlighted the need for studies with large representative samples to investigate the role of BMI in the relationships with WBI, physical activity and sedentary behaviour [33]. Many studies have included BMI as a covariate in their models when assessing the relationships between WBI and physical health correlates, however few have examined the possibility of BMI as a moderator in these associations. Findings from Levy and colleagues suggest a potential moderating role for

BMI, as the significant associations between WBI and physical activity and sedentary behaviour were no longer significant once BMI was added to the model [33].

Taking together the aforementioned associations that have been highlighted in the current literature, a theoretical framework has been constructed as a depiction of all the interrelated factors in the general relationship between weight bias and health behaviours. This framework has informed one of our secondary objectives, as well as the statistical analysis method that corresponds to this particular objective (see Figure 1a in Appendix). A visual representation of the results from Levy et al was added to this framework in order to further rationalize our objective (see Figure 1b in Appendix).

1.5 Objectives

To address the gaps in the literature, the objectives of this thesis were to:

1. To describe weight bias among Canadians, namely, to assess the level of WBI and to describe how Canadians attribute obesity to different factors.
    a. To assess BMI and sex differences in weight bias internalization scores.
    b. To assess BMI differences in the beliefs about the causes of obesity.
    c. To examine the relationship between explicit weight bias and beliefs about the causes of obesity.
2. To examine the relationship between measures of weight bias (explicit and internalized) among Canadians and (1) self-reported physical activity and (2) self-reported sedentary behaviour.
    a. To examine the role of BMI as a potential moderator in the hypothesized associations between explicit and internalized weight bias and physical activity and sedentary behaviour.

1.6 Hypotheses

We hypothesize the following:

1. Canadians will demonstrate WBI to some extent and will attribute obesity mainly to behavioural causes.
    a. Females and individuals with higher BMIs will have higher levels of WBI.
    b. Behavioural causes of obesity will be mainly endorsed by individuals with lower BMIs.
    c. Beliefs in behavioural causes of obesity will be associated with higher explicit weight bias.

2. Canadians with higher explicit or internalized weight bias will report less physical activity engagement and report more time spent in sedentary behaviour.
    a. These hypothesized associations will be stronger among individuals with higher BMIs.

CHAPTER 2: METHODS

2.0 General Methods

To achieve the objectives of this study, a secondary analysis was conducted on previously collected data from a cross-sectional sample of Canadian adults in the *Weight Bias and Support of Public Health Policies* study [20]. The aim of this study was to measure the association of explicit weight bias and public support of policy recommendations aimed to address the prevalence of obesity in Canada. All participants completed a 20-minute online questionnaire on SurveyMonkey. One manuscript has already been published from this study by Edache and colleagues [20].

2.1 Participants

Participants were recruited using an online market research company called Survey Sampling International (SSI). In order to allow for an approximation of Canadian demographics, quotas based on age, sex, and province of residence were gathered by SSI. The goal was to generate a sample with near approximation of Canadian demographics and to have a near equal representation of male and female participants. Individuals with other gender identities were also included. Eligibility included English speaking Canadian adults over the age of 18 who were registered as participants with SSI. A total of 42,080 eligible participants were invited to partake in this study, 1865 expressed initial interest by clicking on the survey invitation link, 1588 participants completed the demographic section of the questionnaire and finally a total of 1057 participants completed the survey beyond the demographic section. All participants who volunteered to take part in this study completed and signed an informed consent document prior to participation. Ethics approval for all aspects of this study was granted by the Concordia University Human Research Ethics Board in 2018 (Ethics certificate number: 30009752).

2.2 Data Preparation

Before the statistical analyses were conducted, data were screened for missingness, incompletion, and major outliers. In both manuscripts, participants were removed if they did not answer the questionnaire beyond the demographics section, if they skipped entire questionnaires, if their demographic data was missing or inconclusive (age, gender, ethnicity, height and weight), if they were considered major outliers in the assumptions checks, and if they were missing more than 5% of their data. Data from participants who were missing less than 5% were kept for analyses and were imputed. The breakdown of participant removal is depicted in table 1 in the appendix.

2.2.1 Manuscript 1: Data Preparation

Data were screened for incompletion, missingness, and major outliers. A total of 1588 participants responded to the survey beyond expressing initial interest. Participants who did not answer beyond the demographics section (n=531) were removed. An additional 29 participants were removed from analyses due to skipping certain questionnaires completely. Sixty participants were further removed due to incomplete/inconclusive demographic information (missing age, ethnicity, gender, or implausible height/weight information). Lastly, 29 participants were removed due to missing more than 5% of data from the questionnaires included in this manuscript. Data from participants who were missing less than 5% were kept for analyses and were imputed using a multiple imputation method [66,67]. For the linear regression only, 21 participants were removed as they were major outliers in more than two of the following measures for the regression model: cook's distance, mahalanobis, and leverage scores.

2.2.2 Manuscript 2: Data Preparation

Before the regressions were conducted, data were screened for missingness, incompletion, and major outliers. Out of the 1865 participants who clicked on the survey link, a total of 1588 actually responded to the questions. Participants were removed if they did not answer the questionnaire beyond the demographics section (n=543). Participants who skipped entire questionnaires were further removed (n=27). An additional 50 participants were removed from analyses due to missing or inconclusive demographic data (age, gender, ethnicity, height and weight). Twenty-two more participants were removed due to missing or implausible physical activity data from the IPAQ. Sixteen more participants were removed as they were multivariate outliers. A further 22 participants were removed due to missing more than 5% of data from the questionnaires in this manuscript. A multivariate imputation method was used to impute missing data for participants who were missing less than 5% of their data [66]. For each series of linear regressions, participants were removed from analyses if they were major outliers in more than two of the following measures for the regression model: cook's distance, mahalanobis, and leverage scores.

CHAPTER 3: RESULTS

Manuscript 1: Weight Bias Internalization and Beliefs about the Causes of Obesity Among the Canadian Public

Vida Forouhar, BSc[1], Iyoma Y. Edache[2], Ximena R. Salas, PhD[3], and Angela S. Alberga, PhD[1]

[1] Department of Health, Kinesiology and Applied Physiology, Concordia University, Montreal, Quebec, Canada

[2] School of Population and Public Health, University of British Columbia, British Columbia, Vancouver, Canada

[3] Obesity Canada, University of Alberta, Edmonton, Alberta, Canada

Formatted in preparation to be submitted to Frontiers in Psychology in September 2022

Corresponding author:

Angela S. Alberga, PhD

Associate Professor, Department of Health, Kinesiology, and Applied Physiology, Concordia University
Adjunct Professor, Department of Pediatrics, Faculty of Medicine, McGill University
Concordia University
7141 Sherbrooke Street West
Office: SP-165.31
Montreal, Quebec, H4B1R6
Canada
Email: angela.alberga@concordia.ca

Phone: (514) 848-2424 ext. 3371

Fax: (514) 848-8681

Abstract

Background: Individuals who are perceived as having excess weight are the subject of weight-based discrimination worldwide. This form of discrimination is perpetuated through negative attitudes and beliefs toward individuals due to their weight status, known as explicit weight bias, as well as through misconceptions about the causes of obesity. Individuals may also internalize these negative attitudes and self-stigmatize, which is a self-directed form of weight bias known as weight bias internalization (WBI). Weight bias, internalized or experienced, is associated with adverse mental and physical health measures and contributes to poor overall health and wellbeing. The prevalence of these attitudes and beliefs about obesity among a representative Canadian sample across the weight spectrum remains unknown.

Methods: A Canadian sample of adults over the age of 18 years (N = 942; 51% Females; mean age group= 45-54 years; mean body mass index [BMI]= 27.3 ± 6.7 kg/m^2) completed an online questionnaire as part of a previous study. Participants completed the Modified Weight Bias Internalization Scale, the Anti-Fat Attitudes Questionnaire, and the Causes of Obesity Questionnaire as part of the survey.

Results*:* Mean WBI score within the entire sample was 3.38 ± 1.58, and females had higher mean scores as compared to males ($p < 0.001$). Mean scores were also higher among individuals with obesity (4.16± 1.52), as compared to individuals with overweight (3.40 ± 1.50), and normal weight/underweight (2.81 ± 1.44) ($p < 0.001$ for all). Forty four percent of Canadians attributed obesity to mainly behavioural causes, 38% to environmental causes, 28% to physiological and 27% to psychosocial causes. Attribution to behavioural causes was associated with higher levels

of weight bias. No BMI differences were reported on the four different subscales of the causes of obesity.

Conclusions: Weight bias internalization is prevalent among Canadians across all body weight statuses, and the public endorses behavioural causes of obesity, namely physical inactivity and overeating, more than its other causes. Findings warrant the reinforcement of efforts aimed at mitigating weight bias by educating the public about the complexity of obesity and by highlighting weight bias as a systemic issue that affects all Canadians living in diverse body weight statuses.

Introduction

Weight bias is a social justice concern in Canada [1], with 61% of Canadian adults reporting experiences of weight-based discrimination throughout their lives [2]. Weight bias is defined as negative attitudes and beliefs about individuals due to their weight status [3] and affects the lives of individuals perceived as having excess weight on a daily basis, be it in the workplace, in education settings, in the media, or even in healthcare settings [4,5]. This form of bias is related to the socially acceptable stereotypes that individuals in larger bodies, particularly individuals with overweight and obesity, are lazy, incompetent, and lack willpower [6,7]. Weight bias also derives from societal misconceptions surrounding the causal attributions of obesity [8], namely that obesity is mainly attributed to behavioural factors that are solely within individual control, such as physical inactivity [9]. Individuals may also internalize these negative societal beliefs and apply it to themselves at the detriment of their own self-efficacy [10]. This self-directed form of weight bias, known as weight bias internalization (WBI), affects not only individuals with obesity but all individuals across the weight spectrum [11,12]. According to a systematic review on WBI and health, experiences of WBI were associated with several physical and mental health measures, including psychological distress, poor body image, binge eating, and reduced motivation to exercise [13]. Despite WBI persisting across the weight spectrum, findings suggested an association between higher body mass index (BMI) and higher WBI, which should be further explored [13]. WBI also differs by gender, as studies have reported higher levels among women as compared to men. The majority of the studies in the literature, however, consist of samples with treatment seeking women with overweight and obesity, and few studies have investigated sex differences. There is a paucity of research on WBI in samples with an even distribution of males and females, that are inclusive of diverse body weight

statuses. Furthermore, one study with three samples of American adults found lower WBI scores in the two representative population samples as compared to the sample with individuals with obesity, however comparisons between these samples are not entirely plausible [14]. In Canada, only one study assessed the prevalence of WBI among a convenience sample of adults and found that participants internalize weight bias to some extent, with higher levels among women as compared to men [15]. More research on WBI among large population-based samples is warranted.

Endorsing as well as internalizing negative attitudes about weight are related to the beliefs about the underlying factors that contribute to obesity or weight gain. High levels of WBI may stem form strong beliefs surrounding the controllability of weight, or that it is mainly attributable to behavioural factors [16]. Research demonstrates that the more an individual attributes obesity to mainly behavioural factors, such as physical inactivity and poor diet, the more they will endorse negative attitudes about weight and about people with obesity [9,17]. For instance, in a large multinational study measuring weight bias across four countries including Canada, the United States, Iceland, and Australia, stronger beliefs in behavioural factors of obesity were associated with more negative attitudes and stigma towards individuals with obesity [16]. Further, findings suggested potential BMI differences, as individuals with obesity in the Canadian and Icelandic samples demonstrated lower levels of weight bias. Considering the consistency between weight bias and causal attributions of obesity, BMI differences on the beliefs about the causal attributions of obesity should be further explored.

In a systematic review by Sikorski et al., seven studies assessed American and German public beliefs and they found that the most frequently endorsed factors that contribute to obesity among these samples were behavioural factors, including physical inactivity and dietary patterns.

One of the studies in this review found that attributing obesity to behavioural factors predicted higher stigmatizing attitudes against individuals with obesity. The studies included in this systematic review varied in the measures used to assess these beliefs, with most studies using primarily constructed items [18–22] and few using validated scales [23,24]. The authors urged future research to investigate beliefs about the factors that contribute to obesity among the general public, with an emphasis on comparisons between internal and external factors. One cross-sectional study assessed similar attitudes among Canadians with obesity and Canadian health care professionals involved in the treatment of obesity, and revealed a general belief among both samples that obesity is best managed through diet and exercise [25]. If Canadians living with obesity as well as health care practitioners, who are considered experts in obesity management, have misconceptions about the factors that contribute to obesity, it begs the question of whether the rest of the Canadian public shares these beliefs as well.

To the best of our knowledge, only two studies have measured these attitudes among Canadians, both of which had samples of either predominantly white males or predominantly white females who were experts in obesity, further limiting the generalizability of the findings. Thus, little is known about these beliefs among a public sample of adults across the weight spectrum. Given that negative attitudes about obesity and misconceptions about the factors related to obesity can contribute to weight discrimination, it is important to understand the prevalence of these beliefs among Canadians in order to better address weight bias as a systemic issue. These data could help to bring awareness to this social justice issue, to inform public anti-discrimination policies and to design future weight bias reduction interventions.

The primary objectives of the present study were to: (1) assess the prevalence of internalized weight bias among Canadians, and (2) to describe how Canadians attribute obesity

to different causes. The secondary objectives of this study were to assess whether there are differences in mean WBI scores between males and females and according to BMI, and if beliefs about the causes of obesity differ according to BMI. Further, the relationship between explicit weight bias and the different causes of obesity was assessed. It is hypothesized that Canadians will demonstrate weight bias internalization to some extent and will attribute obesity mainly to behavioural causes. It is also hypothesized that females and individuals with higher BMIs will have higher levels of weight bias internalization and that behavioural causes of obesity will be most endorsed by individuals with lower BMIs. Those with higher levels of weight bias will endorse behavioural factors more compared to other factors.

Method

Participants and Procedure

A secondary analysis was conducted on previously collected data as part of the cross-sectional study, *Weight Bias and Support of Public Health Policies* [26]. Potential participants were recruited using an online market research company, known as Survey Sampling International (SSI), in order to generate a representative sample of French and English-speaking Canadian adults over the age of 18. To allow for an approximation of Canadian demographics, quotas based on age, sex, and province of residence were gathered by SSI. Prior to official recruitment, a total of 42,080 eligible participants were invited to complete a survey and received emails describing the study purpose, length of the survey, and compensation for participation. Initial interest in participation was expressed by 1865 participants who clicked on the survey. Individuals who did not complete the full survey were removed, leaving a total of 942 participants (response rate: 51%). All participants who volunteered to take part in this study

completed an informed consent form prior to participation. Ethics approval for all aspects of this study was granted by a Research Ethics Board (Ethics certificate number: 30009752)

Measures

Demographic Variables. The demographics section of this questionnaire consisted of questions assessing age, gender, ethnicity, and self-reported measures of height and weight to calculate BMI.

Weight Bias Internalization. The Modified Weight Bias Internalization Scale (WBIS-M) was used in order to assess the extent to which individuals internalize negative attitudes about weight [27]. The 11 items on this questionnaire are rated using a 7-point Likert scale (1=strongly disagree, 7=strongly agree), with higher scores indicating higher WBI. Items 1 and 9 reflect positive attitudes about weight, therefore these items are reversed scored. An example of one of the items from this questionnaire is "I feel anxious about my weight because of what people might think of me". In two distinct studies assessing psychometric properties of this questionnaire, the first item: "Because of my weight, I feel that I am just as competent as anyone" did not show adequate internal consistency, and once it was removed from analysis the overall internal consistency was improved. For the purpose of this study, internal consistency was assessed with and without the first item, and the results concurred with these previous studies. The overall internal consistency improved from a Cronbach's alpha score of 0.92 to 0.94, thus the first item was removed from further analyses.

Causes of Obesity. The Causes of Obesity Questionnaire (COB) was used in order to assess beliefs about the different causes of obesity. This questionnaire consists of 14 items that

responders have to rate in terms of how important they believe they are in causing obesity. Items on the COB are assessed on a 5-point Likert scale (1=not at all important, 5=extremely important) [28]. The 14 different items were divided into subscales according to a factor analysis. The four main subscales derived from this factor analysis were behavioural causes (e.g. physical inactivity), environmental causes (e.g. pricing of foods), physiological causes (e.g. metabolic disorder), and psychosocial causes (e.g. psychological problems). In this study, the COB demonstrated strong internal consistency with Cronbach's alpha scores for the behavioural, environmental, physiological and psychosocial causes of 0.80, 0.70, 0.83, and 0.74 respectively, and 0.88 for the entire scale.

Explicit Weight Bias. The Anti-Fat Attitudes Questionnaire (AFA) was used to assess explicit weight bias. This questionnaire contains 13 items separated into three subscales that represent the three main domains of explicit anti-fat attitudes: Dislike (n= 7 items), Fear of Fat (n= 3 items) and Willpower (n= 3 items). The Dislike subscale assesses negative attitudes toward individuals with obesity, (e.g. "I really don't like obese people much"). The Fear of Fat subscale assesses an individual's fear of gaining weight (e.g. "I feel disgusted with myself when I gain weight"). The Willpower subscale assesses perceptions that weight gain or obesity is within individual control (e.g. "Some people are obese because they have no willpower"). All of the items in each subscale are rated on a 10-point scale (0= very strongly disagree, 9= very strongly agree). A total score above zero represents the presence of weight bias, with higher scores indicating greater weight bias or more anti-fat attitudes. In this study, the AFA demonstrated strong internal consistency with Cronbach's alpha scores for the *Dislike*, *Fear of Fat*, and *Willpower* subscales of 0.88, 0.85, and 0.81 respectively, and 0.87 for the entire scale.

Data Analysis

All statistical analyses were conducted using R and JASP. An exploratory factor analysis was conducted in order to separate the items on the Causes of Obesity Questionnaire into separate subscales according to similarity. The 14 different items on the questionnaire were separated into the following four subscales: behavioural causes, environmental causes, physiological causes, and psychosocial causes. Descriptive statistics were used to describe the data for means and standard deviations for weight bias internalization and beliefs about the causes of obesity. Frequency tables were used to compare the percentage of endorsement on each separate cause of obesity, as well as on the subscales, and an ANOVA was run to assess BMI differences. Mean WBI scores were analyzed for differences among males and females using an independent t-test, as well as for BMI differences using a one-way between measures ANOVA. A correlational analysis was done to determine the relationship between BMI and WBI. Participants who scored 1 standard deviation (SD) above the mean WBI were categorized as having "high" WBI, those who scored at the mean were categorized as "average" and those who scored 1SD below the mean were categorized as having "low" WBI. A linear regression was conducted to determine the relationship between mean scores on the Anti-Fat Attitudes Questionnaire and the four different factors of the Causes of Obesity Questionnaire.

For the purpose of analyses in this paper, participants' BMIs were calculated using their self-reported measures of height and weight and were classified into different groups according to the guidelines from Health Canada: underweight (BMI <18.5 kg/m^2), normal weight (BMI = 18.5-24.9 kg/m^2), overweight (BMI = 25.0-29.9 kg/m^2), and obesity (BMI > 30.0 kg/m^2) [29]. Few participants were originally classified as living with underweight (n = 36) and were therefore grouped into the normal weight category for analyses, in order to have a more even

distribution between three groups. The three final BMI groups for analyses were normal and underweight, overweight, and obesity.

Results

Descriptive Characteristics

The study's sample characteristics are described in Table 1 (see Appendix). SSI generated a sample that was as representative of the Canadian public as possible. A total of 942 participants were included in the final sample. Fifty one percent of participants in the sample were females (*n*= 484), while 48% were males (*n*= 450), and a few participants identified as "other", at 0.85% (*n*= 8). The average age range of the sample was 45-54 years, and average BMI was 27.3 ± 7 kg/m^2. The majority of the sample were White (74.3%), followed by Asian (10.6%), South Asian (3.0%), Black/African/Caribbean (2.9%), Aboriginal Peoples (2.6%), Other (2%), Middle Eastern (1.3%), Southeast Asian (1.3%), Hispanic/Latin American (1.1%), Biracial/Biethnic (0.9%), and Pacific Islander (0.2%). A binary sex comparison was made between males and females, but no gender analyses were conducted as individuals who identified as "other" were removed due to insufficient representation. Data from these individuals were included in all other analyses.

Weight Bias Internalization

Within our entire sample, the mean WBI score was 3.38 ± 1.58, with significantly higher mean scores among females (3.58 ± 1.65) as compared to males (3.16 ± 1.48, $p < 0.001$). The majority of the sample fell within the mean range for WBI at 63%, with 19% of participants categorized as having "low" WBI, and 18% as having "high" WBI. To assess BMI differences

on mean WBI scores, participants were classified into three different groups: normal weight and underweight (n = 370), overweight (n= 311), and obesity (n= 261). Among the participants who had high WBI scores, 51% were classified in the obesity BMI group, 29% were individuals classified in the overweight BMI group, and 20% were classified in the normal weight and underweight BMI group. A depiction of high WBI scores by BMI group can be seen in Figure 1 (see Appendix). Mean scores were statistically significantly different between BMI groups, F (2, 940) = 125.9, $p < 0.001$, $\eta^2 = 0.12$. WBI scores were lower for the normal weight and underweight group (M = 2.81, SD = 1.44) as compared to the overweight group (M = 3.40, SD = 1.50), and the obesity group had the highest WBI scores (M = 4.16, SD = 1.52). Post hoc analysis with a Bonferroni correction showed that the difference in mean scores between the normal/underweight group and overweight group, the normal/underweight group and obesity group, and between the overweight group and obesity group, were all statistically significant ($p <$ 0.001 for all).

Beliefs about the Causes of Obesity and Explicit Weight Bias

Canadians attribute obesity mainly to behavioural causes as compared to other causes. Forty four percent of the sample believed that behavioural factors are very or extremely important in causing obesity, compared to 38% for environmental causes, and only 28% and 27% for physiological and psychosocial causes, respectively. Among the most endorsed causes of obesity were overeating, physical inactivity, and a high fat diet, at 71%, 67%, and 59% of the sample, respectively. Among the least endorsed causes were endocrine disorders, repeated dieting, and metabolic factors, at 35%, 38%, and 41% of the sample, respectively. An ANOVA revealed no statistical differences between the mean scores of the four subscales according to

BMI categories. Beliefs in behavioural causes of obesity were positively associated with explicit weight bias scores ($B = 0.46$, $t(921) = 5.58$, $p < .001$), while beliefs in physiological causes of obesity were negatively associated with explicit weight bias scores ($B = -0.16$, $t(921) = -2.14$, $p < .05$). Explicit weight bias was not associated with beliefs in psychosocial or environmental causes of obesity ($p = 0.50$, $p = 0.37$). All these results are shown in Figures 2a and 2b, and Table 2 (see Appendix). The *Lack of Willpower* item on the Causes of Obesity Questionnaire was correlated with the *Dislike, Fear of Fat,* and *Willpower* subscales on the Anti-Fat Attitudes Questionnaire ($r = 0.11$, $r = 0.21$, $r = 0.42$; respectively).

Discussion

Results from this study showed that Canadians demonstrated WBI to some extent and endorsed behavioural causes of obesity more than physiological, psychosocial and environmental causes. Females and individuals with higher BMIs had higher mean WBI scores, however a considerable portion of the sample who were categorized under the normal weight and underweight BMI category also expressed high levels of WBI. Beliefs in behavioural causes of obesity were associated with more explicit weight bias, while beliefs in physiological causes of obesity were associated with less explicit weight bias. The endorsement of the different causes of obesity did not differ by BMI.

Our study adds to the literature by providing comparable results to the few studies that measured WBI in population-based samples. The mean WBI of 3.38 in our study sample was only slightly higher in comparison to mean WBI in a sample of 2529 American adults ($M = 3.36$) generated from SSI, and another sample of 519 American adults ($M = 3.31$) generated from an online data source called Mechanical Turk [14]. These mean scores are lower in comparison to

samples of individuals who reported struggling with their weight, treatment seeking adults with obesity, and individuals considering bariatric surgery (*M*= 4.72, *M* = 4.60, and *M* = 4.54, respectively); an expected result given the association between BMI and WBI. Only 18% of the participants in the study sample scored within the "high" WBI category, relative to the sample mean. Among these participants, 20% were individuals with a BMI in the normal weight and underweight category. Although these results are only relative within our sample mean, they demonstrate the persistence of WBI, even at high levels, among those who have a BMI in the normal or underweight range.

Levels of WBI differed according to sex with higher mean scores among females as compared to males. This finding is consistent with studies in the literature measuring WBI among samples of adults with overweight and obesity [11,30–32] as well as in one sample with Canadian adults of all body weight statuses [15]. However, direct comparisons are difficult to make as these previous studies reported gender differences between men and women. Due to societal pressures to conform to beauty standards, women are typically more vulnerable to biases based on physical appearance [13,16]. The idealization of, and drive for, attaining a "thinner" body among women may contribute to this internalization of negative attitudes toward weight and weight gain [31]. Women also express more body weight and shape concerns than men, which can play a role in weight bias internalization [30,33,34]. The relationship between WBI and body satisfaction should also be noted, as research has shown a strong, negative correlation between the two factors [13]. The majority of the studies assessing this relationship found no gender differences in this relationship, however most samples consisted of mainly women with overweight and obesity [31,33,34]. Future research would benefit from accurately capturing sex and exploring sex differences in WBI according to levels of body satisfaction as well as body

image and body weight concerns, among representative samples of the general population. Future studies should also be inclusive of individuals with diverse gender identities and appropriately capture gender to determine these differences in WBI.

Higher WBI was also found among individuals with higher BMIs, consistent with previous research that has documented this association [13,30,31,33]. Individuals living with overweight and obesity are subjected to weight bias and discrimination and are therefore more susceptible to internalizing negative attitudes about weight and tying their identity to their weight [13,31]. Results from the ACTION study showed that individuals with obesity believe that obesity management falls under the responsibility of the individual, reinforcing the notion of personal blame for one's condition, which may be reflective of internalizing weight bias. This association was demonstrated in a cross-sectional study on weight controllability beliefs and internalized weight stigma in a large representative sample of American adults [35]. When adjusting for age, sex, race, education, income and BMI, greater beliefs in personal controllability of weight were indirectly related to more internalized weight stigma [35]. Although weight bias internalization does differ by BMI, it does not dispute the finding that individuals with normal weight and underweight also experience WBI to some extent. This is important to note in efforts to change the narrative around obesity, as it alleviates the misconception that only individuals with higher body weight are affected by the perils of weight bias, and further highlights this as a larger systemic issue affecting the wellbeing of all individuals regardless of weight or size.

Consistent with our hypotheses, our results showed that Canadians endorsed behavioural causes of obesity more than they endorsed environmental, physiological, and psychosocial causes. Specifically, the top three most endorsed causes within the sample were overeating,

physical inactivity, and a high fat diet; all behavioural causes. Explicit weight bias was positively associated with beliefs in behavioural causes of obesity and negatively associated with beliefs in physiological causes of obesity. Conversely, findings showed no statistical difference in mean scores on the beliefs about the different causes of obesity between different BMI groups.

Although our hypothesis that individuals with lower BMIs would endorse behavioural causes of obesity more was not met, the study findings are in line with existing literature on the beliefs about the causes of obesity. According to a systematic review by Sikorski et al., findings across six samples of American adults and one sample of German adults showed that behavioural factors such overeating and a lack of willpower were the most endorsed causal attributions of obesity [9]. In one of the studies in this systematic review [23], as well as in a multinational study assessing weight bias across Canada, Iceland, Australia and the United States [16], beliefs in behavioural causes of obesity were associated with higher explicit weight bias; comparable to the results found in our study. Attributing obesity to behavioural factors lies within the belief that obesity is a condition within individual control, which reinforces negative stereotypes about these individuals and perpetuates weight bias. Previously published results from this dataset in a Canadian representative sample reported higher mean scores on the *Willpower* subscale of the Anti-Fat Attitudes Questionnaire [26]. This subscale is reflective of the belief that weight is within individual control, which is comparable to the findings in our study on behavioural attributions of obesity. Direct comparisons with previous studies are difficult to make as our study was the only one to use a validated questionnaire to assess these beliefs among a representative sample. The majority of the studies in the systematic review used scales that were constructed for the purpose of their study [19,21–24], one study measured these beliefs through literature-based metaphors [18], and one study measured stigmatizing attitudes towards obesity

using a component of a previously validated scale [23]. Future research should consider the use of validated scales, like the Causes of Obesity Questionnaire, to elucidate public beliefs on causal attributions of obesity.

There were no differences in BMI between the four subscales, this may be due to an engrained societal belief, among individuals of all body weight statuses, that obesity is primarily a behavioural problem that is caused by an inability to have control over one's weight. This finding may also be linked to the level of weight bias internalization, as individuals who internalize more negative attitudes about their own weight might also endorse the belief that obesity and weight gain are primarily behavioural problems and under individual control. Experimental research should explore whether WBI plays a role in the association between BMI and beliefs about the causes of obesity.

To the best of our knowledge, this is the first study to describe beliefs about the causes of obesity and levels of weight bias internalization among a sample of Canadian adults taken from the general population, inclusive of individuals across the weight spectrum. Our study had an equal representation of males and females, unlike other studies on weight bias internalization, which had samples of predominantly females or women living with overweight and obesity. This study was also the first to assess beliefs about the causes of obesity using a validated questionnaire. However, the findings in this study should be interpreted within the context of its limitations. Given the nature of a cross-sectional study, no causal relationships can be deduced. There were also no objective measures of any of the variables measured, as self-reported questionnaires are susceptible to social desirability bias and inaccuracies, particularly for height and weight measurements. Research shows that individuals tend to under-report their weight and over-report their height, which could have affected the BMI data reported in this study [36].

Moreover, there is no way of knowing if the participants in this study were given a clinical obesity diagnosis, since BMI was used a proxy measure to reflect obesity. Additionally, results on the beliefs about the causes of obesity might be slightly biased, as the Causes of Obesity Questionnaire (COB) itself has a larger representation of behavioural causes of obesity (*n*= 5 items) as compared to psychological (*n*= 4 items), physiological (*n*= 3 items), and environmental causes (*n*= 2 items). This is not ideal for measuring these beliefs as there are multiple causes of obesity from all of these subscales and having an unequal representation of the factors could bias the results toward the most represented subscale, in this case for behavioural causes. This calls for future research to develop new scales that improve upon the limitations of the COB, in order to account for more factors that reflect other causes of obesity like environmental, psychosocial, and physiological causes. These new scales should also demonstrate the multifactorial and complex nature of obesity by considering that obesity is caused by an interaction of these factors rather than singling them out. Another important limitation of this study is that experiences of weight bias were not measured within the sample. As experiences with weight bias have been linked to weight bias internalization, including this information would have allowed for a greater understanding of how these measures of weight bias interrelate among a general population sample of adults in Canada.

Conclusion

Our study provides a comprehensive overview of attitudes on the various causes of obesity as well as insight into levels of weight bias internalization among a large sample of lay Canadian adults. Weight bias internalization is prevalent among Canadians across all body weight statuses, with higher levels among females as compared to males. Moreover, Canadians

mainly endorse behavioural causes of obesity as compared to environmental, physiological, and psychosocial causes, which is related to more negative attitudes and bias against individuals with obesity. Results from this study may urge policy makers to educate the public on the complex causes of obesity beyond behavioural factors and push forward the agenda of changing the narrative around obesity, particularly around weight bias, as it is a social justice concern that extends beyond just individuals with obesity.

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Funding/Support: New Investigator Research Grant from the corresponding author's provincial government.

Acknowledgments: The corresponding author gratefully acknowledges her provincial government New Investigator Research Grant and Salary Award. The first author acknowledges two university graduate student scholarships.

APPENDIX

Table 1.
Sample Characteristics

Measure	Total Sample (N=942)	
	n	**%**
Age		
18-24	106	11.2
25-34	171	18.1
35-44	168	17.8
45-54	204	21.6
55-64	169	17.9
65+	124	13.2
Sex		
Male	450	47.8
Female	484	51.4
Other Gender Identities	8	0.85
Body Mass Index		
Underweight	36	3.8
Normal Weight	334	35.5
Overweight	311	33.0
Obesity	261	27.7
Race/Ethnicity		
White	700	74.3
Non-White	242	25.7
Asian	100	10.6
South Asian	28	3.0
Black/African/Caribbean	27	2.9
Aboriginal Peoples	24	2.6
Other	19	2.0
Middle Eastern	12	1.3
Southeast Asian	12	1.3
Hispanic/Latin American	10	1.1
Biracial/Bi-Ethnic	8	0.9
Pacific Islander	2	0.2
	M	**SD**
Weight Bias Internalization Scores		
Total Sample	3.38	1.58
Males	3.16	1.48
Females	3.58	1.65

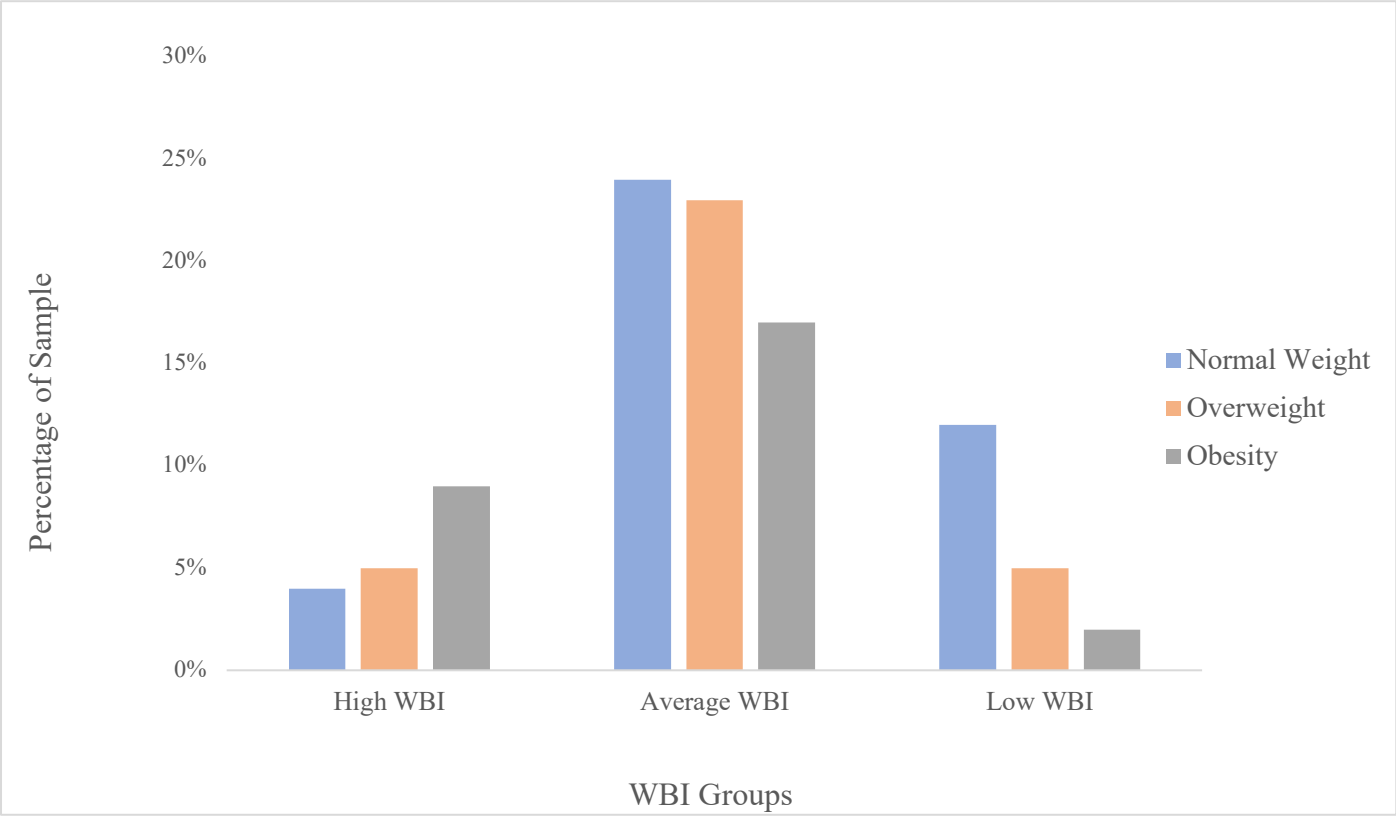
Normal Weight & Underweight	2.81	1.44
Overweight	3.40	1.50
Obesity	4.16	1.52
Causes of Obesity Subscale Scores		
Behavioural Causes	3.70	0.82
Psychosocial Causes	3.36	0.82
Environmental Causes	3.34	1.03
Physiological Causes	3.28	0.92

Table 2.
Linear Regression: Explicit Weight Bias and Beliefs about the Causes of Obesity

Variable	Explicit Weight Bias (*B*) (*SE*)
	Sample (*N*= 921)
COB Subscale mean scores	
Behavioural Causes	0.46 (0.82)***
Physiological Causes	-0.16 (0.73)*
Psychosocial Causes	0.06 (0.95)
Environmental Causes	0.56 (0.06)

Note. B = parameter estimate, COB = Causes of Obesity. * $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .0001$ Adjusted for age, gender, ethnicity and body mass index (BMI).

Figure 1. Mean Weight Bias Internalization by Body Mass Index



Note. WBI = Weight Bias Internalization

Figure 2a. Frequency of Endorsement of the Causes of Obesity by Subscale

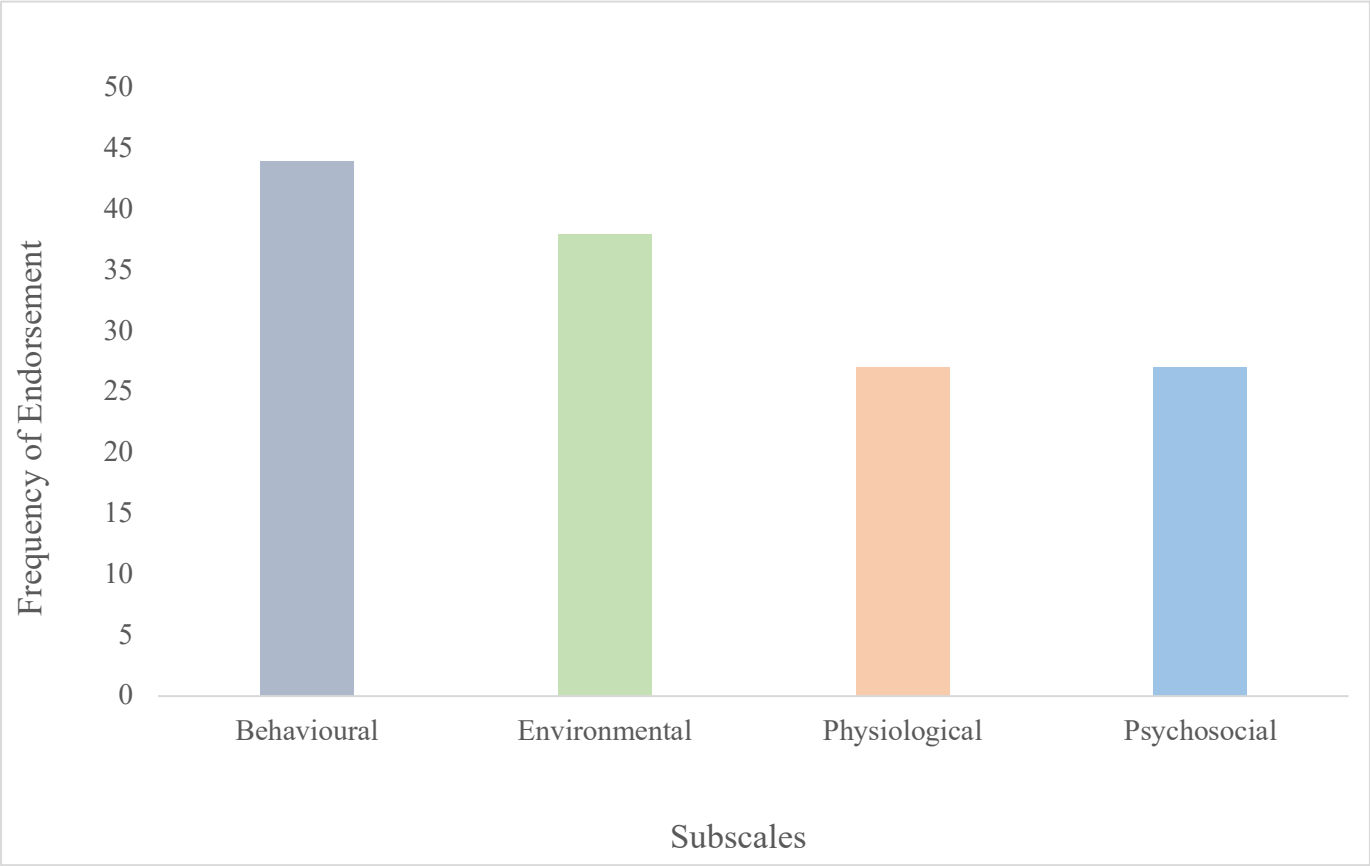
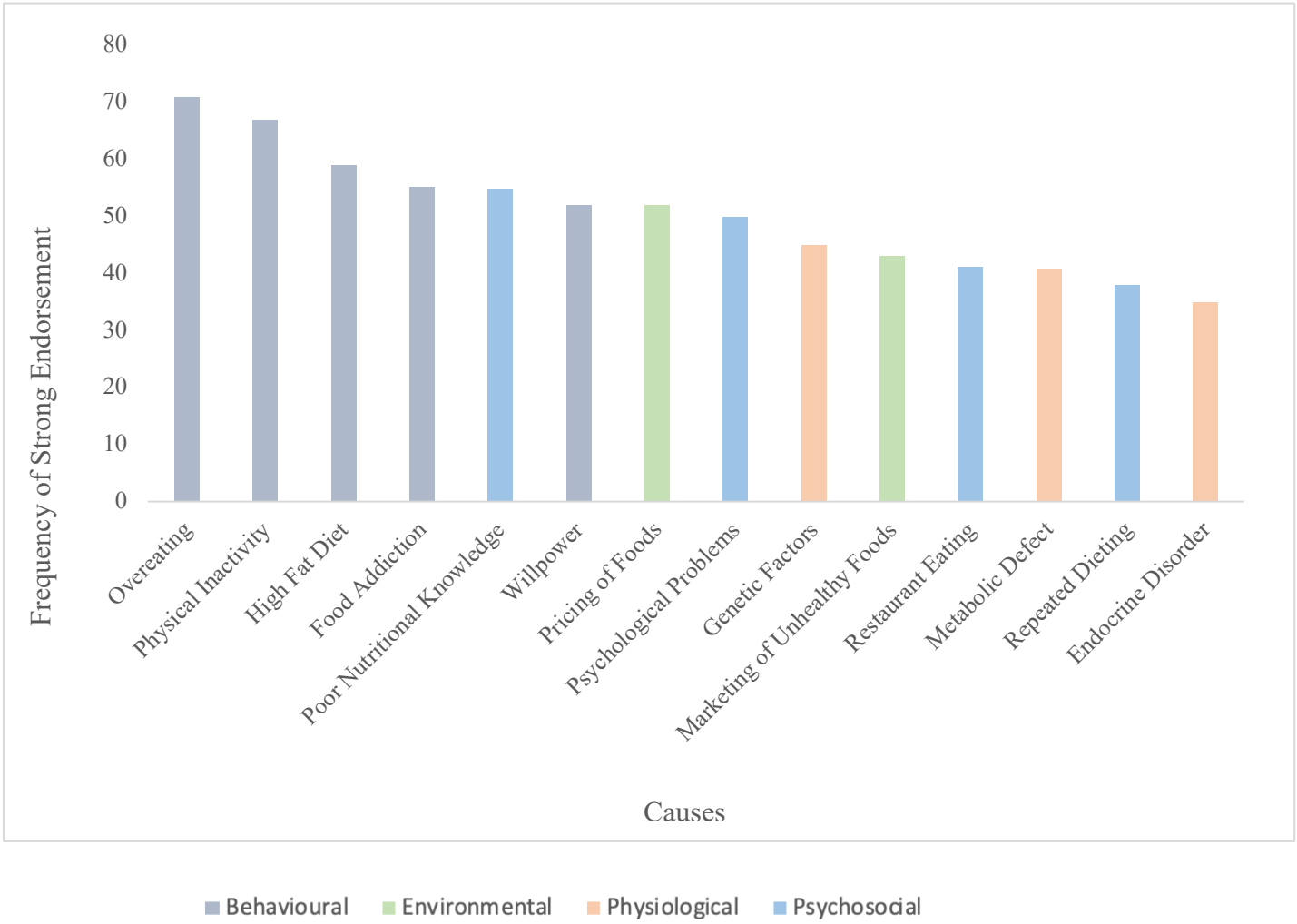


Figure 2b. Frequency of Endorsement of the 14 Causes



Manuscript 2: Weight Bias: Relationships with physical activity and sedentary behaviour

Vida Forouhar, BSc[1], Iyoma Y. Edache[2] and Angela Alberga, PhD[1*]

[1]Department of Health, Kinesiology and Applied Physiology, Concordia University, Montreal, Quebec, Canada

[2]School of Population and Public Health, University of British Columbia, Vancouver, British Columbia, Canada

Formatted in preparation to be submitted to *The International Journal of Behavioural Nutrition and Physical Activity* in September 2022

***Corresponding author:**

Angela S. Alberga, PhD
Associate Professor, Department of Health, Kinesiology, and Applied Physiology, Concordia University
Adjunct Professor, Department of Pediatrics, Faculty of Medicine, McGill University
Concordia University
7141 Sherbrooke Street West
Office: SP-165.31
Montreal, Quebec, H4B1R6
Canada
Email: angela.alberga@concordia.ca
Phone: (514) 848-2424 ext. 3371
Fax: (514) 848-8681

Abstract

Background: The majority of Canadian adults are not meeting the recommended physical activity guidelines and are spending more time in sedentary behaviour. Previous studies have highlighted experiences of weight bias, or facing prejudice because of one's weight status, as a potential barrier to physical activity and an enabler of sedentary behaviour. Few studies have examined whether endorsing or internalizing weight bias is associated with physical activity and sedentary behaviour.

Method: A secondary analysis was conducted on data from a sample of Canadian adults (N = 925) 52% Females, mean age group= 45-54 years; mean body mass index [BMI]= 27.04 ± 6kg/m^2). Participants completed the International Physical Activity Questionnaire, the Sedentary Behaviour Questionnaire, the Modified Weight Bias Internalization Scale, and the Anti-Fat Attitudes Questionnaire. A series of linear regressions were conducted to determine the relationships between weight bias internalization (WBI) and explicit weight bias and physical activity and sedentary behaviour.

Results: WBI was positively associated with more weekly hours spent in sedentary behaviour ($F(6,897) = 14.73$, $p < .001$, $R^2 = .09$) and explicit weight bias was positively associated with more weekly minutes of vigorous physical activity ($F(6,891) = 5.42$, $p < .001$, adj. $R^2 = .03$). WBI was not significantly associated with vigorous, moderate, or mild physical activity. Explicit weight bias was not significantly associated with sedentary behaviour, or moderate and mild physical activity.

Conclusions: Findings suggest that WBI and explicit weight bias are related to health behaviours like sedentary behaviour and physical activity. Our results warrant further study on other factors that may play role in the relationships between weight bias and health behaviours. Future research should include longitudinal studies as well as interventions that investigate if weight bias impacts physical activity and sedentary behaviour.

Introduction

Physical inactivity among adults is an important global health concern. Worldwide, adults are engaging in less physical activity and spending more time in sedentary behaviour [1]. In Canada, only 16.4% of adults meet the physical activity guidelines of 150 minutes of moderate-to-vigorous physical activity per week [2], and the average adult is spending 9.5 hours of their day in sedentary behaviours [3]. Leading a physically active life improves overall health and wellbeing, improves cognitive function, reduces stress, anxiety, risk of type 2 diabetes, cardiovascular disease and reduces risk of premature mortality [4–6]. Despite widespread awareness of these benefits, a multitude of barriers exist which prevent individuals from meeting the recommended physical activity guidelines, including symptoms of anxiety and depression, low socioeconomic status, lack of facilities or affordability of facilities, lack of knowledge on health benefits of physical activity, cultural and familial beliefs, negative mood and affect and a lack of belief in one's skills and abilities to exercise [7]. A growing body of research has investigated the role of weight bias as a potential barrier to physical activity [8]. Explicit weight bias is defined as negative attitudes and beliefs about individuals due to their weight status [9]. This stems from negative societal stereotypes about individuals perceived as having excess weight, which marginalizes these individuals and leads to a stigma known as weight stigma [10]. When behaviorally manifested, individuals who hold these negative attitudes towards others may discriminate against others due to their weight [11,12]. Weight bias can also be self-directed, known as weight bias internalization (WBI), and manifests itself when individuals apply negative stereotypes about weight to themselves and self-stigmatize [13]. Weight bias internalization can be experienced by individuals of all body weights and sizes, extending its detrimental effects beyond individuals living in larger bodies [8]. Experiencing weight bias,

whether internalized or perceived from others, is associated with adverse physical and mental health issues, including anxiety and depression [14,15], psychological distress [15], binge eating [13,16,17], and physical activity avoidance [10,18]. A recent systematic review highlighted the direct association between experienced and internalized weight stigma and physical activity levels. Six studies demonstrated a direct negative association between experiences of weight stigma and physical activity. For instance, a qualitative study on women living with overweight and obesity found that the fear and anxiety surrounding anticipated weight stigma was enough to demotivate individuals from partaking in physical activity [19]. A similar study of American adults involved in a commercial weight program found that lifetime experiences of weight stigma were associated with exercise avoidance as a coping strategy [20]. Concerning the relationship between internalized weight stigma and self-reported physical activity, six studies included in the systematic review found a direct negative association, while five others found no association between the two variables. In a sample of 177 women with overweight and obesity, less weekly physical activity levels were reported among those with higher levels of WBI [21]. Similarly, in a clinical sample of 112 patients who had received bariatric surgery, WBI was associated with less moderate physical activity per week [22]. Weight bias internalization has also been found to have a moderating and mediating effect on the relationship between physical activity and other factors, including general self-efficacy or the motivation to adhere to lifestyle interventions [21,23,24]. All of the studies in the systematic review that found this association had small effect sizes and the majority included samples of treatment seeking women with overweight or obesity, or bariatric surgery candidates or patients.

Aside from experienced or internalized weight stigma, explicit weight bias may be a potential variable of interest related to these physical health behaviours. To date, only one study

by Vartanian and Novak found a moderating effect of explicit weight bias in the relationship between experiences of weight stigma and exercise avoidance. This finding warrants further investigation on how endorsing negative weight-related attitudes towards others may be associated with one's own physical activity levels.

In Canada, the direct relationship between weight bias internalization and physical activity has only been assessed in one cross-sectional study using a convenience sample of Canadian adults [25]. Findings demonstrated a negative association between weight bias internalization and moderate and vigorous levels of physical activity. This study also assessed the relationship between weight bias internalization and sedentary behaviour, results from which demonstrated a positive association between both variables [25]. Aside from this study, the direct relationship between weight bias internalization and sedentary behaviour is vastly understudied, especially in large representative samples of adults. To the best of our knowledge, there are also no studies that have examined the association between explicit weight bias and sedentary behaviour. The adverse health measures associated with weight bias are well known, however its relationship with sedentary behaviour has not been sufficiently studied. Individuals may meet the recommended physical activity requirements yet spend a significant amount of time in sedentary behaviour concurrently [26,27]. There is robust evidence demonstrating an association between high levels of sedentary behaviour and higher risk of all-cause mortality or mortality from cardiovascular disease, independent of leisure-time physical activity [28–30]. As one study has shown, high WBI was associated with more time spent in sedentary behaviour in adults [25]. Further investigation of this health behaviour is necessary to provide a more comprehensive understanding of how different health behaviours are associated with weight bias. It is imperative

to understand the underlying factors that may act as barriers for physical activity engagement or facilitators of more sedentary behaviour to inform future behavioural interventions.

The primary objectives of this study were to examine the relationship between measures of weight bias (explicit and internalized) among Canadians and (1) self-reported physical activity and (2) self-reported sedentary behaviour. The role of BMI as a potential moderator in the relationships between explicit and internalized weight bias and physical activity and sedentary behaviour was investigated as a secondary objective. It is hypothesized that Canadians with higher weight bias, explicit or internalized, will engage in less physical activity and spend more time in sedentary behaviour. Further, these hypothesized associations are expected to be stronger among individuals with higher BMIs.

Method

Participants and Procedure

To achieve the objectives of this study, a secondary data analysis was conducted on a previous cross-sectional study entitled *Weight Bias and Support for Public Health Policies* study [31]. Participants were English speaking Canadian adults over the age of 18 years and were recruited through a market research company known as Survey Sampling International (SSI). A near representative sample was generated by SSI using quotas based on age, sex, and province of residence from the general Canadian public. One criterion for achieving a more representative sample was that there would be an even distribution between male and female participants. Individuals who identified with other gender identities were included, nonetheless. Emails were sent to 42080 participants which included information on the study purpose, length and compensation. A total of 1,865 participants initially clicked on the survey but a final sample of

925 participants (50% response rate) responded to the entire survey, completed and signed informed consent documents and were included in analyses. This study received ethical approval by a Research Ethics Board (Ethics certification number: 30009752).

Measures

Demographic Variables. The demographic section of the questionnaire consisted of questions assessing participants' age, gender, race/ethnicity and self-reported height and weight.

Weight Status. The participants' BMIs were calculated using their self-reported height and weight and were further categorized into their respective weight status groups using the classification guidelines from Health Canada: underweight (BMI <18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (BMI 25.0-29.9 kg/m^2) and having obesity (BMI > 30 kg/m^2) [32]. It is important to note that in population studies, as in this present study, BMI is used as a proxy measure for obesity, however, it is not a diagnostic tool for obesity. It is unknown if the participants that fall under the "obesity" category for BMI were clinically diagnosed with obesity by their healthcare providers, therefore BMI descriptors were given to describe the participants' weight statuses.

Explicit Weight Bias. The Anti-Fat Attitudes Questionnaire (AFA) was used to assess explicit weight bias. This questionnaire contains 13 items separated into three subscales that represent the three main domains of explicit anti-fat attitudes: *Dislike* (n= 7 items), Fear of Fat (n= 3 items) and Willpower (n= 3 items). The Dislike subscale assesses negative attitudes toward individuals with obesity, (e.g. "I really don't like obese people much"). The Fear of Fat subscale assesses an individual's fear of gaining weight (e.g. "I feel disgusted with myself when I gain

weight"). The Willpower subscale assesses perceptions that weight gain or obesity is within individual control (e.g. "Some people are obese because they have no willpower"). All of the items in each subscale are rated on a 10-point Likert scale (0= very strongly disagree, 9= very strongly agree). A total score above zero represents the presence of weight bias, with higher scores indicating greater weight bias or more anti-fat attitudes. In this study, the AFA demonstrated strong internal consistency with Cronbach's alpha scores for the *Dislike*, *Fear of Fat*, and *Willpower* subscales of 0.87, 0.85, and 0.81 respectively, and 0.87 for the entire scale.

Weight Bias Internalization. The level of weight bias internalization was assessed using the Modified Weight Bias Internalization Scale (WBIS-M) [33]. Respondents rate eleven items on this questionnaire on a scale from 1-7 (1=strongly disagree; 7=strongly agree), with higher scores indicating more severe WBI. The first and ninth items in this scale must be reversed scored as they indicate positive self-reflection of one's weight. To achieve a final score for each respondent, a mean score between one and seven is calculated per respondent, and a final mean score for the entire sample is derived as well. Studies have reported that the first item on this questionnaire: "Because of my weight I feel that I am just as competent as anyone", is problematic as it did had poor internal consistency with the rest of the items [34]. Within this study sample, internal consistency of this questionnaire was determined with and without the this item. The internal consistency improved once this item was removed (Cronbach's alpha from 0.92 to 0.94). Given the trend in previous studies as well as this marginal improvement in this study sample, the first item was removed from further analyses.

Physical Activity. The short form (seven-item) version of the International Physical Activity Questionnaire (IPAQ) was used to measure participants' levels of physical activity engagement. This questionnaire consists of items that measure the number of days per week, and time spent per day, in minutes and hours, doing mild intensity (e.g. walking), moderate intensity (e.g. cycling at a regular pace), or vigorous intensity (e.g. aerobics) physical activity over the last seven days [35]. Respondents must report all the activities they engage in as part of five main domains of physical activity: occupational, transportation, housework, recreational or sport and leisure related, as well as time spent sitting. The psychometric properties of all the different forms of this questionnaire have been tested among adult samples across 12 different countries, including Canada [36]. The short form 7-day questionnaire had acceptable reliability with coefficients ranging from 0.50-0.87 [36].

Sedentary Behaviour. The Sedentary Behaviour Questionnaire (SBQ) was used to measure time spent in nine different sedentary behaviours (watching television, playing computer/video games, sitting listening to music, sitting talking on the phone, sitting reading, playing a musical instrument, doing arts and crafts, working on the computer, and sitting during transportation) on a typical weekday or weekend day [37]. Participants indicate the time spent in these behaviours on an interval of 0 to 6 hours or more (none, 15 mins or less, 30 mins, 1 hr, 2 hrs, 3 hrs, 4 hrs, 5 hrs, 6 hrs or more). The lowest response category (15 mins or less) is top coded to reflect 15 minutes, and the highest response category (6 hrs or more) is bottom coded to reflect 6 hours for that particular behaviour. The time in minutes is converted to hours in order to derive a total score of sedentary behaviour hours per week. The scale is separated into weekday and weekend sedentary time to derive a weekday score (hours multiplied by 5), a weekend score

(hours multiplied by 2), and a total week score (weekday and weekend hours summed). In a sample of adults with Obesity, the SBQ was shown to have good-to-excellent intraclass correlation coefficients (ICC's) for the overall scale and for each individual item (0.51 to 0.93) [37]. In this study, the SBQ showed good-to-excellent reliability with Cronbach's alpha scores of 0.55 for the all items on the weekday form, 0.63 for all items on the weekend form, and 0.87 on total weekend and total weekday scores.

Data Analysis

All statistical analyses were conducted using R and JASP. A series of multiple linear regressions were conducted to determine the associations between the two different measures of weight bias (explicit and internalized) and weight bias internalization and (1) physical activity and (2) sedentary behaviour. All regression models were adjusted for age, gender, BMI and ethnicity. Additionally, a bivariate moderation analysis was conducted to determine the role of BMI in the association between explicit weight bias and physical activity and similarly in the association between weight bias internalization and sedentary behaviour. Certain participants were considered extreme cases for the moderate (n=17) and mild (n=40) physical activity data and were therefore removed for analyses in the respective regressions.

Results

Descriptive Characteristics

The study sample characteristics are described in Table 1 (see Appendix). A total of N=925 participants were included in the final sample. The sample consisted of primarily White individuals (75%) where 52% were females, 47% were males, and less than 1% identified as

other. The majority of the sample fell within the 45-54 age range and in the normal weight category for BMI, however, the average BMI of the sample was 27.27 ± 6.88 kg/m^2. On average, participants reported 846 minutes of total weekly physical activity and spent an average of 19 hours in sedentary behaviour per week.

Physical Activity, Explicit Weight Bias and Weight Bias Internalization

Vigorous Physical Activity. In the regression model for weekly minutes of vigorous physical activity and explicit weight bias, greater explicit weight bias scores were significantly associated with an increase in weekly minutes of vigorous physical activity (B = 12.87, $t(899)$ = 2.20, $p < .05$) (Table 2). The model including weight bias internalization revealed that mean WBI scores were not associated with vigorous physical activity (p = 0.58).

Because this model was significant for explicit weight bias scores, a separate linear regression was conducted including the three subscales of the anti-fat attitudes questionnaire (Table 2). For every unit increase in *Dislike* scores, weekly vigorous physical activity increased by 14 minutes (B = 14.99, $t(899)$ = 2.41, $p < .05$), and for every unit increase in *Fear of Fat* scores, weekly vigorous physical activity decreased by 13 minutes (B = -12.99, $t(899)$ = -3.01, $p < .05$). Scores on the *Willpower* subscale were not associated with weekly minutes of vigorous physical activity (p= 0.063).

Moderate Physical Activity. Weekly minutes of moderate physical activity were not associated with WBI scores nor with explicit weight bias when adjusting for age, gender, BMI and ethnicity in either regression (p=0.83, p=0.34) (Table 2).

Walking. Similarly, total weekly minutes of walking was neither associated with WBI scores nor with explicit weight bias scores when adjusting for all other variables (p= 0.84, p= 0.59) (Table 2).

Sedentary Behaviour, Explicit Weight Bias and Weight Bias Internalization

Sedentary behaviour was significantly associated with WBI but not with explicit weight bias. For every unit increase in WBI, weekly hours of sedentary behaviour increased by 0.9 hours (B = 0.85, t(902) = 3.90, p < .001), while adjusting for gender, age, BMI and ethnicity (Table 3). The association between explicit weight bias scores and weekly hours of sedentary behaviour was not significant when adjusting for age, gender, BMI or ethnicity (p = 0.60) (Table 3).

Moderation Analysis

In line with the secondary objective of this study, two moderation analyses were conducted to determine the role of BMI in the relationship between WBI and sedentary behaviour and in the relationship between explicit weight bias and vigorous physical activity. The first moderation analysis revealed that the interaction between WBI and BMI was not significant in predicting weekly hours of sedentary behaviour (B=-0.04, t(891)= -1.11, p =0.27).

The second moderation analysis similarly revealed that the interaction between explicit weight bias and BMI was not significant in predicting weekly minutes of vigorous physical activity (B= -0.70, t(895)= -0.73, p=0.46).

Discussion

This study revealed that explicit weight bias was significantly positively associated with vigorous physical activity, specifically, higher *Dislike* scores were associated with an increase in weekly minutes of vigorous physical activity whereas higher *Fear of Fat* scores were associated with a decrease in weekly minutes of vigorous physical activity. Explicit weight bias was not significantly associated with weekly hours of sedentary behaviour, moderate or mild intensity physical activity. Additionally, WBI was not associated with mild, moderate or vigorous intensity physical activity per week, however, a significant positive association with weekly hours of sedentary behaviour was found. Further, BMI was not a significant moderator in the association between WBI and sedentary behaviour, nor in the relationship between explicit weight bias and vigorous physical activity.

Contrary to our hypothesis and eight studies in the literature, our study found no relationship between WBI and any intensity of physical activity [10]. Out of the eight studies in the literature that found a direct negative association between the two [21–23,25,38–41], only three used the IPAQ as the measure of physical activity [22,23,41]. In all three of these studies, participants were living with overweight or obesity or had undergone bariatric surgery. There is a component of self-efficacy related to physical activity engagement [42], particularly among individuals living with overweight or obesity [10,23,43]. Among 179 bariatric surgery candidates, general self-efficacy mediated the association between WBI and reduced physical activity. Individuals with overweight or obesity in this study had less general self-efficacy and less exercise related self-efficacy, which in turn predicted exercise avoidance or lower physical activity levels. This may explain the significant results found among these samples, as these individuals may already experience a diminished self-efficacy to exercise or to achieve other

goals such as weight loss [44]. Individuals who also have past experiences with weight re-gain or persistent weight cycling throughout their lives may have lower self-efficacy, exacerbating the relationship of WBI on their health behaviours [21,44,45]. One of the studies that used the GLTEQ found a significant interaction in the model with past experiences of weight stigma, weight bias internalization and reduced exercise behaviour [21]. Future research should explore how exercise self-efficacy and experiences of weight stigma interact with WBI in large representative samples to see if these factors are better predictors of physical activity levels.

Unexpectedly, our results showed that explicit weight bias was positively associated with more time spent performing vigorous physical activity per week. The direct association between explicit weight bias towards others and one's own physical activity levels has not been previously assessed. In a cross-sectional study of 187 female undergraduate students who were separated into restrained and unrestrained eaters, stronger beliefs that exercise is a determinant of body weight were associated with more weekly exercise among both groups [46]. Although not a direct measure of explicit weight bias, beliefs about the determinants of weight play a role in negative attitudes about weight (i.e. explicit weight bias). If individuals have negative attitudes about people with obesity and believe that exercise is important in determining body weight, they may participate in more physical activity as a means to control their own weight. This is further highlighted through our results as higher scores on the *Dislike* subscale were associated with higher levels of vigorous physical activity. The rampant negative stereotyping of individuals with obesity has marginalized them in society, driving the sense of dislike toward this population [11,12]. Endorsing these attitudes may lead to adapting certain health behaviours as a means to separate oneself from this stigmatized group. In efforts to control one's weight, individuals may engage in vigorous physical activity more as opposed to moderate or mild

intensities. Contrarily, results from the *Fear of Fat* subscale demonstrated a negative association with weekly minutes of vigorous physical activity. There is a common misconception that the fear around weight gain or "becoming fat" is a strong motivator for participating in more physical activity, as a means to lose weight or to achieve the "ideal body weight" [46]. The fear around one's weight status and possible weight gain may be associated with negative affect, especially if individuals strongly endorse societal standards of beauty and thinness, which has been related to less physical activity [7]. This has also been observed in a study of 111 American adults who self-identified as having overweight or obesity, where findings suggested a moderating effect of explicit weight bias on the relationship between experiences of weight stigma and avoidance of exercise. Furthermore, exercise-related behaviours are not the sole behaviours driven by a fear of weight gain. Certain eating behaviours, like restrained eating, that characterize eating disorders, like anorexia nervosa and bulimia, often stem from an extreme fear of gaining weight [47]. This particular aspect of weight bias may be more related to one's eating behaviours rather than exercise-related behaviours, which were not taken into account in this study. These two distinct findings demonstrate the complexity behind explicit weight bias and how these negative beliefs may influence one's own personal health behaviours. Given the inconsistent findings in our study as well as those in the literature, it appears that there are several different pathways through which explicit weight bias may influence one's health behaviours. The findings reported in this paper suggest that there may be factors other than explicit and internalized weight bias that are related to physical activity engagement. Other factors, such as the beliefs about the determinants of body weight[48], experiences of weight stigma [21], and eating behaviours may be important to examine further in relation to explicit weight bias and physical activity.

The results regarding sedentary behaviour are consistent with findings from a previous cross-sectional study that demonstrated a positive relationship between WBI and weekly sedentary behaviour in a convenience sample of Canadian adults [25]. These findings were significant when adjusting for BMI, meaning that WBI is associated with higher sedentary behaviour, regardless of weight status. These results highlight both sedentary behaviour and WBI as health concerns that extend beyond individuals with obesity. In the study by Levy and colleagues, there was also a negative association between WBI and moderate and vigorous levels of physical activity, an association that was not significant in our study results [25]. This difference in results may be attributable to the difference in sample size and characteristics. Our study included a larger sample of Canadian adults that was more representative of the general population than the previous study.

Interestingly in our study, BMI was not a significant predictor in any of the linear regression models including WBI, meaning that when adjusting for age, gender and ethnicity, BMI was not associated with total weekly sedentary behaviour nor weekly minutes of physical activity at any intensity. BMI was also not a moderator in any of the relationships between health behaviours and measures of weight bias. This may help to debunk some of the preexisting misconceptions that individuals with higher body weight statuses spend more time in sedentary behaviour and are not as physically active as their peers with normal weight. WBI is often framed as a concern that is harmful to the health behaviours of those with overweight or obesity, however, our results highlight that these adverse associations exist regardless of individual BMI. It may be important for health care professionals who are involved in the management of obesity to be aware of these assumptions that can form unconscious biases towards individuals living in larger bodies, in order to provide more effective care and appropriate treatment for their patients.

Even though BMI was not a moderator in the relationships between weight bias and health behaviours, previous documented associations between BMI and WBI in particular warrant further investigation of the interaction between these factors [8]. If individuals with higher BMIs internalize weight bias more, which in turn is associated with less physical activity [10], future research should assess the potential role of BMI as a mediator in this association.

There are some important limitations to consider when interpreting the results from this study. With the nature of a cross-sectional design, our results do not demonstrate causality. There is a potential social-desirability bias and self-report bias as all of the demographic and health behaviour data were self-reported through questionnaires. Data on physical activity and sedentary behaviour were also self-reported and thus not objective measures of health behaviours. Although physical activity data were self-reported, the International Physical Activity Questionnaire has been shown to have excellent psychometric properties and a widely used too for assessing physical activity in population-based samples [35,36]. Another limitation of our study, pertaining to the measures, is that experiences of weight stigma were not assessed. Including this data alongside explicit and internalized weight bias would have allowed for a better understanding of the relationships that different measures of weight bias have with physical activity and sedentary behaviour. These associations may be stronger if coupled with experiences of weight stigma, as shown in the literature [21,24]. More complex models could better explain these relationships than linear regressions, specifically a moderated mediation model with all of these factors is proposed. Longitudinal studies could provide insight into the impact that explicit and internalized weight bias may potentially have on health behaviours. Despite these limitations, this study is the first Canadian study to explore the relationships between measures of weight bias and physical activity and sedentary behaviour in a sample of

adults that is inclusive of diverse body weight statuses. Our study has defined explicit and internalized weight bias as factors that are associated with physical activity and sedentary behaviour, allowing future studies to draw upon these results and evaluate the causal relationships between these factors. This study was also the first to include BMI as a potential moderator in the linear regressions rather than just as a covariate, allowing for better understanding of the role that one's weight status plays in the relationship between negative attitudes about weight and certain health behaviours. Our sample was inclusive of individuals with diverse body weight statuses, had an equal representation of males and females compared to a predominantly female body of literature, and had a good demographic approximation of the general Canadian population.

Conclusion

The results from this study demonstrate how weight bias, whether explicit or internalized, was related to one's health behaviours. Particularly, this study adds to the literature by informing future interventions aimed at addressing WBI to determine if there is an impact on sedentary behaviour in the first place. Healthcare practitioners, particularly exercise specialists, can be informed from the results of our study by understanding that WBI and weight bias are factors that should potentially be screened for with patients when discussing health behaviours. Future research should include longitudinal assessment of these associations to determine causality and should also examine objective measures of sedentary behaviour and physical activity in relation to WBI and explicit weight bias. Factors such as exercise self-efficacy, beliefs about the determinants of body weight and past experiences of weight stigma as well as weight cycling should be further explored in these associations. Although explicit weight bias was associated

with increases in vigorous physical activity, other aspects of weight bias tend to be associated with reduced physical activity and increased sedentary behaviour, creating a complex relationship with health behaviours. Negative attitudes about weight and one's own weight status are psychological components of health and may not necessarily be related to health behaviours. Our results warrant further study on other factors that may play a role in the relationship between weight bias internalization, explicit weight bias and health behaviours. Previous research has called for public health to take action in addressing weight bias as it is harmful to the mental and physical health of those who experience weight stigma. Our study builds upon this by demonstrating that weight bias may be harmful, regardless of weight or BMI, to one's own health behaviours which have an influence on mental and physical health.

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APPENDIX

Table 1.
Sample Characteristics

Measure	Total Sample (N=925)	
	n	**%**
Age		
18-24	103	11.14
25-34	161	17.41
35-44	167	18.05
45-54	198	21.41
55-64	166	17.95
65+	130	14.05
Sex		
Male	438	47.35
Female	480	51.89
Other Gender Identities	7	0.76
Body Mass Index		
Underweight	33	3.57
Normal Weight	337	36.43
Overweight	304	32.86
Obesity	257	27.78
Race/Ethnicity		
White	697	75.35
Non-White	228	24.65
Asian	94	10.16
Black/African/Caribbean	29	3.14
South Asian	25	2.70
Aboriginal	20	2.16
Other	18	1.95
Southeast Asian	12	1.30
Middle Eastern	11	1.19
Hispanic/Latin American	9	0.97
Biracial/Biethnic	8	0.86
Pacific Islander	2	0.22
	M	**SD**

BMI (kg/m^2)	27.27	6.88
	Sample (N=880)	
Weekly Physical Activity (total weekly minutes)		
Mild physical activity (walking)	399.46	598.08
Moderate physical activity	243.19	452.07
Vigorous physical activity	203.39	404.52
Sedentary Behaviour (total weekly hours)		
Weekday sedentary behaviour	10.07	5.79
Weekend sedentary behaviour	9.30	5.84
Total week sedentary behaviour	19.36	10.93

Table 2.
Multiple Linear Regressions: Physical Activity and Weight Bias Internalization (WBI) and Explicit Weight Bias

Variable	Weekly walking (*B*) (*SE*)	Weekly moderate PA (*B*) (*SE*)	Weekly vigorous PA (*B*) (*SE*)
	Sample (*N* = 871)	Sample (*N* = 888)	Sample (*N* = 904)
Mean WBI	-2.28 (11.32)	-1.74 (8.00)	-3.66 (6.58)
		Sample (*N* = 889)	Sample (*N* = 905)
Mean AFA	5.54 (10.01)	6.62 (7.00)	12.87 (5.75)*
Dislike	-	-	14.99 (6.23)*
Fear of Fat	-	-	-12.96 (4.30)**
Willpower	-	-	10.14 (5.44)

Note. B = parameter estimate, PA = physical activity. * $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .0001$ Adjusted for age, gender, ethnicity and body mass index (BMI).

Table 3.
Multiple Linear Regressions: Sedentary Behaviour and Weight Bias Internalization (WBI) and Explicit Weight Bias

Variable	SB total weekly hours (*B*) (*SE*)
	Sample (*N* = 908)
Mean WBI	0.85 (0.22)***
	Sample (*N* = 900)
Mean AFA	0.10 (0.19)

Note. B = parameter estimate, SB = sedentary behaviour. * $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .0001$ Adjusted for age, gender, ethnicity and body mass index (BMI).

CHAPTER 4: DISCUSSION

4.0 Discussion

The overall objective of this thesis was to describe the level of weight bias among Canadian adults and to examine whether their attitudes were associated with their self-reported levels of physical activity and sedentary behaviour. Manuscript 1 described the level of weight bias internalization and the beliefs about the causes of obesity among Canadian adults. Differences in WBI between males and females and different BMI categories were assessed, and BMI differences on beliefs about the causes of obesity were also assessed. Manuscript 2 examined the relationships between weight bias (explicit and internalized) and self-reported physical activity and sedentary behaviour, and how these relationships changed according to BMI. Results on the primary outcomes from both manuscripts are described in Chapter 3 of this thesis. This chapter discusses the overall results from both manuscripts and highlights future research directions and practical implications from this thesis.

Results demonstrated that Canadians internalized weight bias to some extent, and that obesity was mainly attributed to behavioural factors as opposed to physiological, psychosocial and environmental factors. Females and individuals with higher BMIs had higher mean WBI scores. WBI as well as explicit weight bias were also associated with certain health behaviours. Higher WBI scores were associated with more time spent in sedentary behaviour, regardless of BMI, however, no association was found with physical activity at any intensity. Explicit weight bias, on the other hand, was associated with more time spent in vigorous physical activity, regardless of BMI, however no association was found with moderate or mild physical activity or with sedentary behaviour.

The first manuscript is the only known study to describe the level of WBI in a near representative sample of Canadian adults. WBI was only previously assessed among a sample of

2,708 Canadian adults who were members of the WW community, and in another study conducted by our research group among a convenience sample of Canadian adults. Results from the WW sample were higher than those found in our sample, however mean WBI from the convenience sample were lower than those in our study[31]. Direct comparisons with previous studies are difficult to make given that neither of these samples were representative of the general public. Although individuals with higher BMI had higher WBI scores, approximately 20% of the participants who had high WBI scores in our sample were categorized in the normal weight or underweight BMI group. These findings suggest that individuals in normal weight or underweight categories can endorse high levels of WBI as well, highlighting WBI as a concern that extends beyond clinical and treatment seeking samples. Not only was WBI prevalent in our sample, but it was also related to more time spent in sedentary behaviour. Longitudinal studies are needed to determine causality as well as directionality between WBI and sedentary behaviour, and similarly between explicit weight bias and vigorous physical activity.

The first manuscript of this thesis was the first study to report beliefs about the causes of obesity among a sample of Canadian adults taken from the general population. Specifically, overeating, physical inactivity, a high fat diet, were the three most endorsed causes of obesity while endocrine disorders, repeated dieting and metabolic factors were the three least endorsed causes. A previous systematic review has also highlighted higher endorsement of behavioural causes as opposed to environmental, physiological or psychosocial causes of obesity [21]. The beliefs about the causes of obesity are associated with weight bias, as demonstrated in a large multinational study where stronger endorsement of behavioural causes were associated with higher levels of explicit weight bias [19]. This association was also found in our study. Moreover, the fact that there were no BMI differences in the beliefs about the causes of obesity

indicates that individuals with higher weight statuses similarly endorse behavioural factors as compared to their peers with lower weight statuses. The same way individuals with lower weight statuses place blame on individuals with obesity for their weight, those with higher weight statuses might also believe that weight is controllable and therefore a behavioural problem. This could also explain why individuals with higher weight have higher WBI; their experiences with weight bias coupled with the belief that weight is controllable may contribute to a higher level of internalized weight bias. Previous research has called for action to be taken to mitigate weight bias through public health intervention [68], these potential interventions could further be informed from the results of this study. One way in which weight bias could be addressed is through education on the complex etiology of obesity and the controllability of weight by highlighting equally important factors that influence weight other than behavioural factors.

Furthermore, explicit weight bias was associated with more time spent performing vigorous physical activity. This was an unexpected finding, as a previous study demonstrated a moderating role of explicit weight bias in the positive association between experiences of weight stigma and exercise avoidance [39]. However, this was only a moderation model, and the direct relationship between explicit weight bias and physical activity has not been examined in previous studies. This novel finding may inform researchers and healthcare professionals on the behavioural correlate of endorsing negative attitudes about obesity and about individuals with obesity. Previous research from a systematic review has demonstrated how experiencing weight stigma is related to reduced physical activity [35], however, our study highlights that endorsing these negative attitudes towards others can be related to one's own exercise-related behaviour as well. Although it may seem that endorsing these attitudes is associated with a positive health behaviour, the self-directed aspect of weight bias has been shown to be negatively associated

with these same health behaviours [35,69]. Those who have higher explicit weight bias toward others may also self-stigmatize, which could in turn predict poor health behaviours. Future research should examine how explicit and internalized weight bias interact with one another in relation to health behaviours such as physical activity and sedentary behaviour, to see if there is an indirect pathway in which explicit weight bias may negatively influence these health behaviours. The contrasting results from the different subscales of the Anti-Fat Attitude Questionnaire further demonstrate the complexity of explicit weight bias in relation to health behaviours. Higher scores on the *Dislike* subscale were associated with more time spent in vigorous physical activity while higher scores on the *Fear of Fat* subscale were associated with less time spent in vigorous physical activity. The *Fear of Fat* subscale is the only subscale in the AFA with self-directed items rather than items assessing attitudes towards others. Taken together with the positive association between WBI and sedentary behaviour, we can speculate that internalized or self-directed weight bias is adversely associated with certain health behaviours and is manifested differently in comparison to weight bias towards others.

No associations were found between WBI and physical activity at any intensity, nor between explicit weight bias and moderate or mild physical activity or sedentary behaviour. The effect sizes of the significant associations found in our study were also small, indicating that the model created is not a perfect fit for our data. It is possible that other factors that were not included in this study are related to physical activity and sedentary behaviour. The inconsistency of the literature as well as the results from our study highlights the complexity of both different weight bias measures and different health behaviours. Experiences of weight stigma, disordered eating behaviours, weight cycling, and weight perception may all be important factors that individually or in unison may be related to these health behaviours.

Although many studies in the literature have included BMI as a covariate when examining weight bias, few studies have considered the potential role that BMI might have beyond simply as a correlate. In this study, BMI was therefore considered as a potential moderator in the significant associations between both WBI and sedentary behaviour, and explicit weight bias and vigorous physical activity. Neither one of the two moderation analyses with BMI as a moderator was significant. This suggests that the existing relationships between higher levels of WBI and more time spent in sedentary behaviour, and that of higher levels of explicit weight bias and more weekly minutes of vigorous physical activity remain the same regardless of the individual's weight status. This unique and important finding allows researchers to better understand the role of BMI in relation to weight bias. Explicit and internalized weight bias do not exclusively relate to the health behaviours of those with higher BMIs. These existing relationships may be influenced by factors other than BMI. Considering that individuals with higher weight statuses are more susceptible to experiencing weight stigma, perhaps it is these experiences rather than one's actual weight status that would moderate these associations. Future research should investigate the role of experiences of weight stigma as a potential moderator in the relationships between explicit and internalized weight bias and physical activity and sedentary behaviour, specifically in representative samples with individuals across the weight spectrum. This could lead to the development of interventions aimed at promoting physical activity and reducing sedentary behaviour while taking these factors into consideration.

The findings reported in both studies should be considered within context of their limitations. Although a strength of this thesis was that the sample was inclusive of individuals across the BMI spectrum, the fact that this sample did not include individuals with a clinical diagnosis of obesity poses as a limitation. The trends in relation to individuals categorized in the

“obesity” BMI group are not generalizable to individuals with obesity, as an obesity diagnosis requires full medical assessment by healthcare professionals and BMI is only a proxy measure for obesity. However, this derives from a more recent definition of obesity taken from the 2020 Canadian Clinical Practice Guidelines for management of adult obesity [3]. The data for this study was collected in 2018, before these recommendations were published, thus the BMI measure for this study was deemed appropriate. Future studies that use self-report assessments should perhaps include a question to see if participants have a clinical diagnosis of obesity. Further, even though a large sample with a near approximation of Canadian demographics was used, our findings are not entirely generalizable, and our sample is not entirely representative. Although Survey Sampling International allows for effective recruitment of representative samples through specified quotas on population census, the sample drawn may not necessarily be a perfect representation of the Canadian public as it is limited to individuals who are registered as respondents of SSI and their affiliate organizations, requiring access to a computer and internet connection [20]. The demographic characteristics of these individuals may be different than the general population resulting in an underrepresentation of individuals from lower income households. This introduces a selection bias in the study sample and also reduces the external validity of the results. Roughly 30% of participants who were initially recruited had to be removed from analyses as they only completed the demographic section of the survey. Losing these participants may have altered the representativeness of the sample, as the quotas to generate what was considered a representative sample were based on demographic characteristics. Our sample also lacked diversity in both ethnicity as well as different gender identities, with 76% of the sample identifying as white and less than 1% of the sample identifying as “other” genders. However, in comparison to the demographics of the Canadian

population, these distributions provide a near approximation with a slight overrepresentation of individuals identifying as white. With a more even distribution of diverse ethnicities, stratification analyses could be conducted to see how the associations found in this study would differ among different ethnic backgrounds as the literature has shown different levels of explicit and internalized weight bias among ethnic groups. A major limitation of this study was that other gender identities, such as non-binary and two-spirit, were not included in the list of options to choose from in our questionnaire. For this reason, it was not possible to conduct gender analyses and only binary sex analyses between males and females were conducted. The associations pertaining to sex found in this study may need to be further examined as sex differences in relation to WBI are lacking. Moreover, gender differences must be examined among samples that accurately capture gender and are more diverse and inclusive of different gender identities.

The findings reported in this thesis have important implications for clinical and public healthcare settings and provide informed directions for future research. Participants endorsed behavioural causes of obesity the most, which was related to explicit weight bias, and also demonstrated self-stigma. It is important to raise awareness about the prevalence of weight bias and WBI among Canadians as well as to educate the public on the complexity of obesity. Since these results were from a representative sample, healthcare organizations like Health Canada or the Public Health Agency of Canada could utilize the results of our study for knowledge translation outputs. The results from this study could also inform public policy makers about the relationship between weight bias and health behaviours, which is important to note not only for future research to investigate the causal relationship but to be aware of the perils of weight bias, whether self-directed or towards others.

A considerable portion of the sample demonstrated high WBI, which was further associated with more time spent in sedentary behaviour. Although longitudinal studies are needed to determine the causality of this relationship, healthcare professionals should be aware of the potential role that internalized weight bias can have on health behaviours such as sedentary behaviour. Encouraging participation in more physical activity and less sedentary behaviour should not be restricted to weight management settings. Internalized and explicit weight bias were associated with these health behaviours regardless of the participants' BMIs, which highlights these attitudes as more of a concern than higher weight in relation to health behaviours. Recent interventions on self-stigma reduction have been conducted in the context of weight management or weight loss [70,71], however our results suggest that it may be important to design interventions that target stigma-reduction for all individuals across the weight spectrum. Future research should also investigate how different aspects of weight bias, such as a fear of weight gain, dislike for individuals with obesity and beliefs about the controllability of weight, are related to physical activity. Assessing individual reasons for motivation to engage in physical activity may further allow for a better understanding of how explicit weight bias is related to this health-promoting behaviour. Future research should also investigate the predictors that pertain to high WBI specifically, in order to better understand how higher levels of WBI are manifested among individuals with different experiences of weight bias and differing beliefs about the causes of obesity.

According to the Obesity-Related Behavioural Intervention Trials (ORBIT) model for developing behavioural health-related treatments, a series of ordinal phases are constructed for different types of studies that ultimately lead to efficacy trials for the development of certain treatments [72]. In order to reach the ultimate goal of developing efficacy trials and public health

policy implementation, small scale interventions that are informed by studies like ours are required [72]. Before guidelines can be informed for addressing long-term changes in physical activity and sedentary behaviour, the underlying components related to these health behaviours must first be identified [72]. In the grand scheme of basic behavioural and social science research, our study was a phase I design that defined WBI and explicit weight bias as potential factors related to health behaviours like physical activity and sedentary behaviour. This thesis includes an adapted theoretical ORBIT model of the different phases that could potentially lead to screening recommendations to assess weight bias (see Figure 2a in Appendix). The figure depicts how this thesis fills certain knowledge gaps and directs future research (See Figure 2b in Appendix).

Future directions should begin with longitudinal studies including objective measures of physical activity and sedentary behaviour in order to evaluate the effect of weight bias on these health behaviours. These studies should measure all components of weight bias, including past experiences of weight bias, which may have an influence on how WBI and explicit weight bias relate to physical activity and sedentary behaviour. These studies should also include samples of adults across the weight spectrum, in order to make comparisons based on weight status as well as obesity diagnosis. Physical activity should not be solely promoted as a means to lose weight, therefore future interventions should look beyond the commonly used weight loss programs and instead focus on how screening for and addressing explicit and internalized weight bias may affect the health behaviours of all individuals. This would allow for the refinement of these relationships from which future studies can begin to design interventions. Before large scale interventions and efficacy trials can be conducted, pilot interventions comparing the effect of self-stigma and bias reduction on physical activity and sedentary behaviour would have to be

tested. All of these aforementioned research steps could lead to the development of guidelines and recommendations for health care practitioners as well as policy makers on how to address weight bias and health behaviours in adults.

CHAPTER 5: CONCLUSION

5.0 Conclusion

This thesis was the first to describe the level of weight bias internalization and beliefs about the causes of obesity among a sample of Canadian adults. It is also the first to assess the direct relationships between explicit weight bias and physical activity and sedentary behaviour. This study adds to the literature by assessing the relationship between internalized weight bias and physical activity and sedentary behaviour in a larger sample of lay individuals.

Our study has several important implications. Future small-scale interventions can be informed for who to target and what elements to highlight in weight stigma-reduction programs. Females and individuals with obesity are particularly vulnerable to high levels of WBI, however, all individuals across the weight spectrum should be considered. Results from studies like this one could educate public policy makers about the complexity of obesity as well as the health correlates of weight bias. This could urge policy makers to push forth the agenda to highlight the complex and multifaceted etiology of obesity and aim to mitigate weight bias. Canadians endorse behavioural factors that contribute to obesity more than its other factors, which perpetuates weight bias and negative attitudes about individuals with obesity. This highlights the need to introduce education and awareness initiatives to the public on obesity and to highlight the perils of weight bias. This could be achieved through knowledge translation outputs that are aimed at improving the awareness and understanding of obesity and weight bias.

Our findings further indicate an association between higher levels of WBI and time spent in sedentary behaviour, regardless of BMI. Spending more time in sedentary behaviour in relation to internalized weight bias is a concern in behavioural medicine that would require further research to examine how screening for WBI and addressing WBI in interventions could relate to changes in this health behaviour. Small-scale interventions are a necessary next step

towards the ultimate goal of designing evidence-based interventions aimed at reducing WBI to help promote health and wellbeing.

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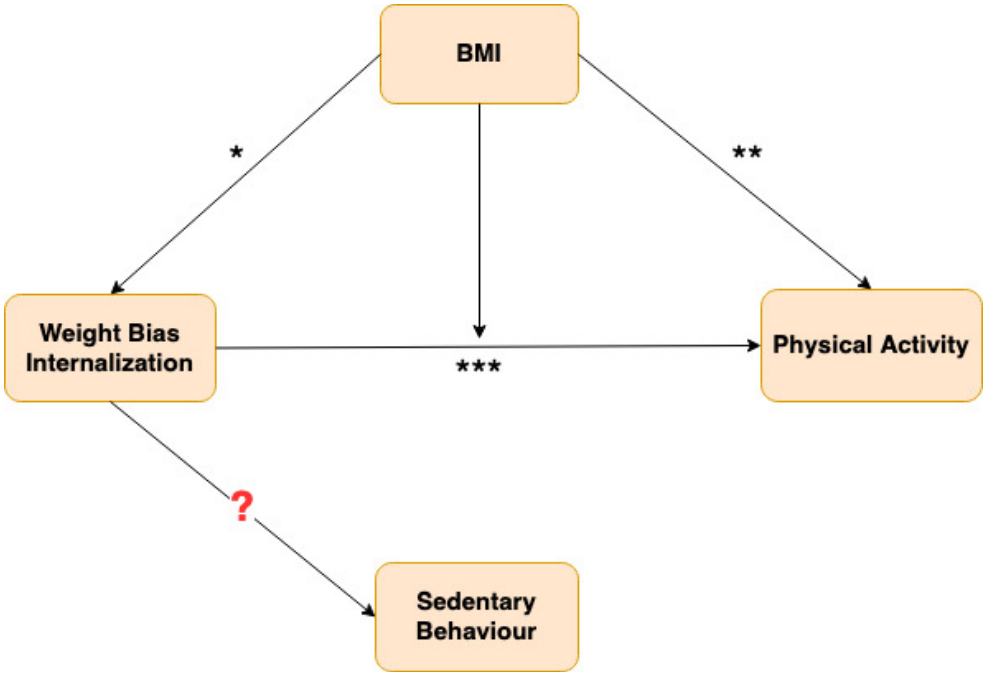
APPENDIX

Figure 1a.
Theoretical Framework to demonstrate the relationship between WBI, PA, SB and BMI

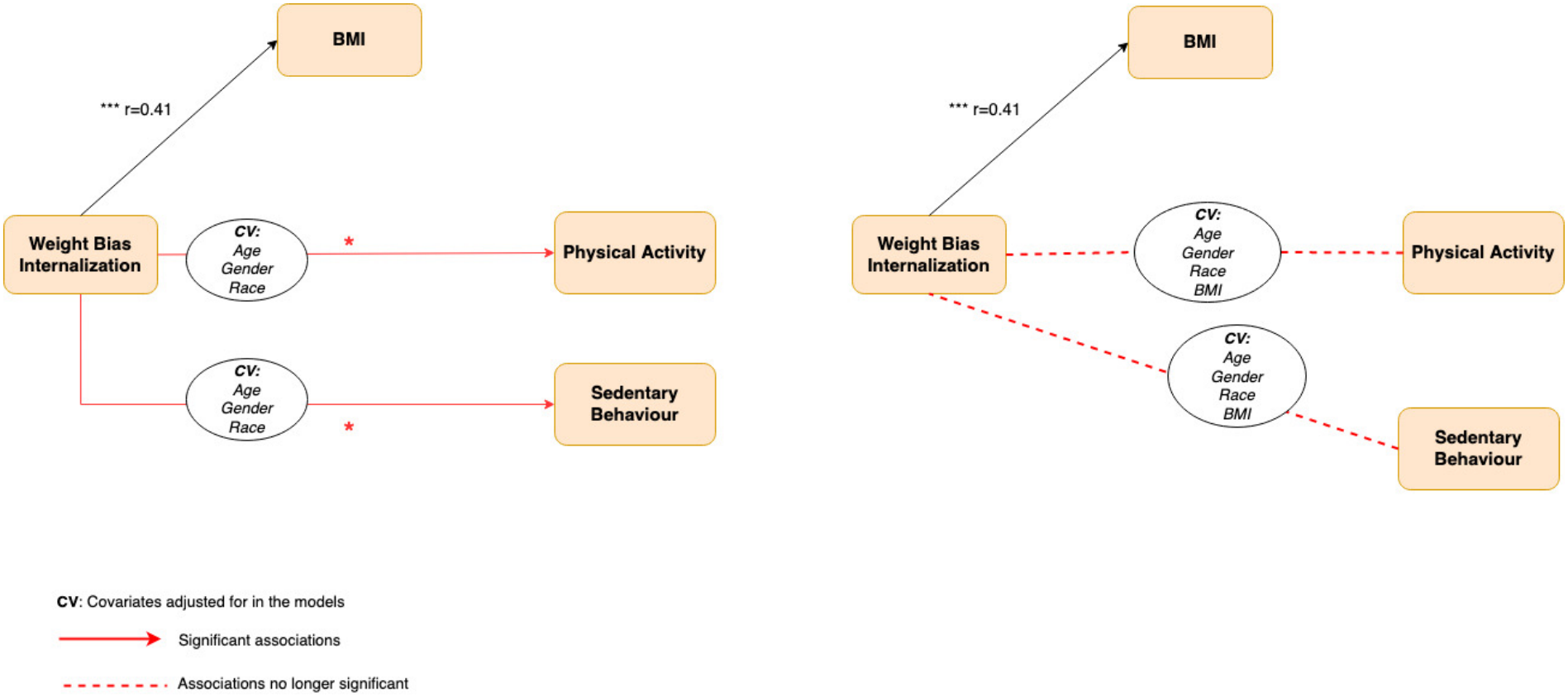


Note.

* n= 17 studies have shown that BMI is positively correlated with WBI
** Numerous studies in the literature have shown that individuals with higher BMI partake in less PA
*** n=7 studies have demonstrated a direct negative association between WBI and PA

Figure 1b.

Visual representation of results from Levy et al., 2021 – Relationships between WBI, PA, SB and BMI



Note. * $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .0001$

Figure 2a. ORBIT Model for Behavioural Treatment Development [72]

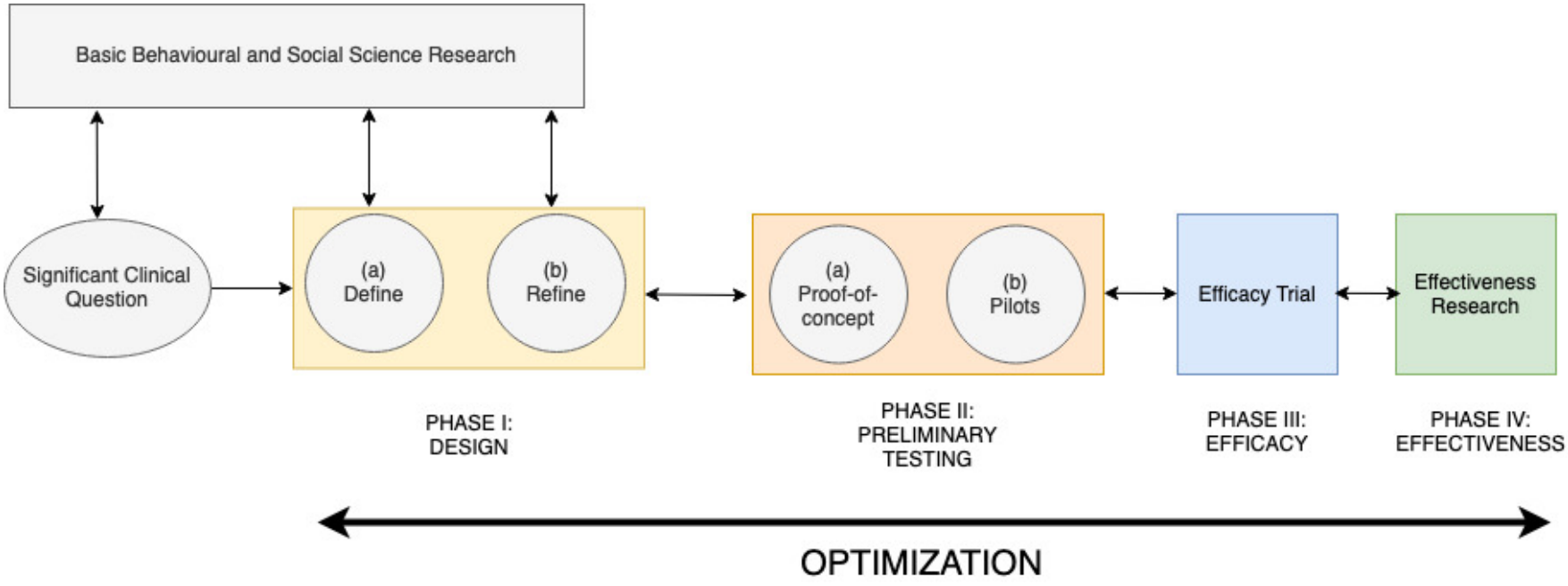


Figure 2b. ORBIT Model for Thesis and Future Research on Weight Bias and Health Behaviours (adapted from [72])

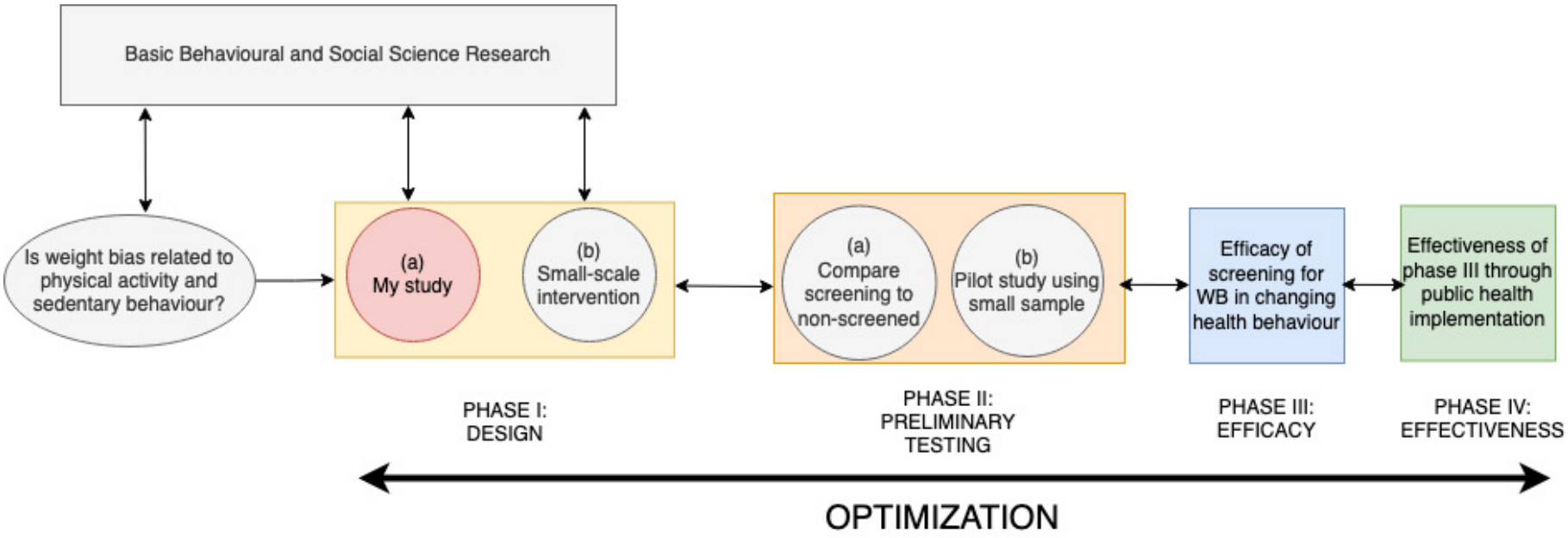


Table 1. Protocol for Participant Removal

	MANUSCRIPT 1 N=942	**MANUSCRIPT 2 N=925**
Did not respond beyond demographic data	543	543
Missing demographic data (age, gender, ethnicity or BMI)	19	22
Did not answer entire questionnaires	29	27
Missing more than 5% of data on questionnaires used	24	21
Implausible data	30	49

Online Survey

Section 1: Demographics

Gender:
Male___
Female ___
Other___

Age: _____

Height: ___ ft ___ in

Weight: ___ lbs

City: _____

Race/Ethnicity:
Asian
Black/African/Caribbean
Caucasian/White
Indigenous Hispanic/Latin American
Middle Eastern
Pacific Islander
Southeast Asian
South Asian
Biracial/Biethnic
Other

Province of residence:
Ontario
Quebec
British Columbia Alberta
Manitoba
Saskatchewan
Nova Scotia
New Brunswick
Newfoundland and Labrador
Prince Edward Island
Northwest Territories
Nunavut
Yukon

ANTI-FAT ATTITUDES QUESTIONNAIRE (AFA) (CRANDALL, 1994)

I really don't like obese people much.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

I don't have many obese friends.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

I tend to think that obese people are a little untrustworthy.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

Although some obese people are surely smart, in general, I think they tend not to be quite as bright as normal weight people.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

I have a hard time taking obese people too seriously.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

Obese people make me somewhat uncomfortable.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

If I were an employer looking to hire, I might avoid hiring an obese person.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

I feel disgusted with myself when I gain weight.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

One of the worst things that could happen to me would be if I gained 25 pounds.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

I worry about becoming fat.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

People who weigh too much could lose at least some part of their weight through a little exercise.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

Some people are obese because they have no willpower.

0	1	2	3	4	5	6	7	8	9

Very strongly disagree | Very strongly agree

Obese people tend to be fat pretty much through their own fault.

0	1	2	3	4	5	6	7	8	9
Very strongly disagree									Very strongly agree

MODIFIED WEIGHT BIAS INTERNALIZATION SCALE (PEARL & PUHL, 2014)

Please rate your agreement with each item**:**

	Strongly disagree (1)	**Disagree (2)**	**Slightly disagree (3)**	**Neither agree nor disagreed (4)**	**Slightly agree (5)**	**Agree (6)**	**Strongly agree (7)**
1. Because of my weight, I feel that I am just as competent as anyone	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. I am less attractive than most other people because of my weight.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. I feel anxious about my weight because of what people might think of me.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. I wish I could drastically change my weight.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Strongly disagree (1)	**Disagree (2)**	**Slightly disagree (3)**	**Neither agree nor disagreed (4)**	**Slightly agree (5)**	**Agree (6)**	**Strongly agree (7)**
5. Whenever I think a lot about my weight, I feel depressed.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. I hate myself for my weight.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

7. My weight is a major way that I judge my value as a person.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. I don't feel that I deserve to have a really fulfilling social life, because of my weight.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. I am OK being the weight that I am.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. Because of my weight, I don't feel like my true self.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. Because of my weight, I don't understand how anyone attractive would want to date me.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

CAUSES OF OBESITY (FOSTER ET AL., 2003)

Please rank the following factors in terms of how **important you think** they are in causing obesity.

Use the following scale to record your answers.

(1) = Not at all Important (2) = Somewhat Important (3) = Moderately Important (4) = Very Important (5) = Extremely Important

	Not at all Important	Somewhat Important	Moderately Important	Very Important	Extremely Important
1. Physical Inactivity	1	2	3	4	5
2. Overeating	1	2	3	4	5
3. High Fat Diet	1	2	3	4	5
4. Genetic Factors	1	2	3	4	5
5. Poor Nutritional Knowledge	1	2	3	4	5
6. Psychological Problems	1	2	3	4	5
7. Repeated Dieting (Weight Cycling)	1	2	3	4	5
8. Restaurant Eating	1	2	3	4	5
9. Lack of Willpower	1	2	3	4	5
10. Metabolic Defect	1	2	3	4	5
11. Endocrine Disorder	1	2	3	4	5
12. Food addiction	1	2	3	4	5
13. Marketing/advertising of unhealthy foods	1	2	3	4	5
14. Pricing of foods (e.g., inexpensive unhealthy foods, more expensive healthier foods)	1	2	3	4	5

<u>INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE</u> (BOOTH, 2000)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **<u>last 7 days</u>**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, the activities as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   _____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   _____ **hours per day**

   _____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   _____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

SEDENTARY BEHAVIOR (ROSENBERG ET AL., 2010)

On a typical WEEKDAY, how much time do you spend (from when you wake up until you go to bed) doing the following?

	None	15 min or less	30 min	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs or more
Watching television (including videos on VCR/DVD)	1	2	3	4	5	6	7	8	9
Playing computer or video games	1	2	3	4	5	6	7	8	9
Sitting listening to music on the radio, tapes, or CDs	1	2	3	4	5	6	7	8	9
Sitting and talking on the phone	1	2	3	4	5	6	7	8	9
Doing paperwork or computer work (office work, emails, paying bills, etc)	1	2	3	4	5	6	7	8	9
Sitting reading a book or magazine	1	2	3	4	5	6	7	8	9
Playing a musical instrument	1	2	3	4	5	6	7	8	9
Doing artwork or crafts	1	2	3	4	5	6	7	8	9
Sitting and driving in a car, bus, or train	1	2	3	4	5	6	7	8	9

On a typical WEEKEND DAY, how much time do you spend (from when you wake up until you go to bed) doing the following?

	None	15 min or less	30 min	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs or more
Watching television (including videos on VCR/DVD)	1	2	3	4	5	6	7	8	9
Playing computer or video games	1	2	3	4	5	6	7	8	9
Sitting listening to music on the radio, tapes, or CDs	1	2	3	4	5	6	7	8	9
Sitting and talking on the phone	1	2	3	4	5	6	7	8	9
Doing paperwork or computer work (office work, emails, paying bills, etc)	1	2	3	4	5	6	7	8	9
Sitting reading a book or magazine	1	2	3	4	5	6	7	8	9
Playing a musical instrument	1	2	3	4	5	6	7	8	9
Doing artwork or crafts	1	2	3	4	5	6	7	8	9
Sitting and driving in a car, bus, or train	1	2	3	4	5	6	7	8	9

Title of research project: Primary Investigator (PI):

PI Contact Information:

Supervisor:
Supervisor Contact Information:

Source of funding for the study:

1. Introduction.

Canadian Public Support for Obesity Public Policies

Iyoma Edache, B.Sc., M.Sc. Candidate, Department of Exercise Science, Concordia University

Loyola campus SP building 7141 Sherbrooke St. West Science Pavilion, Room 165.26 Montreal, QC H4B 1R6 Phone: (514) 848-2424 x 5186

Angela Alberga Ph.D., Researcher, Department of Exercise Science, Concordia University

Loyola campus SP building 7141 Sherbrooke St. West Science Pavilion, Room 165.31 Montreal, QC H4B 1R6 Phone: (514) 848-2424 x 3371

Concordia University Faculty of Arts and Science Research Start-up
FRQ-S Chercheur Boursier Junior 1 Research Grant

INFORMATION FORM AND CONSENT

We invite you to participate in this research project. However, before agreeing to participate, please take the time to read, understand and carefully consider the following information.

This form may contain words that you do not understand. We invite you to ask any questions you may have to the researcher responsible for the research project or a member of their research staff and ask them to explain any word or information that is not clear. The contact information of the primary research investigators can be found at the start of this document.

2. Nature and objectives of the research project.

The purpose of this research project is to assess public support or opposition of recommended obesity public policies. For this project, we expect to recruit approximately 1000 French and English-speaking Canadian adults over the age of 18.

3. How the research project will proceed. 3.1 Duration and number of visits.

Your participation in this research project will involve a one-time completion of a 30- 45-minute online survey.

3.2 Nature of your participation.

The first section of the online survey will ask you to provide some personal information. Questions in the first section of the survey relate to personal information (age, race, sex, education, income etc.) and information about your health behaviours. In the second section of the survey, you will be asked questions on your attitudes and beliefs about weight. In the third section of the survey, you will be asked to indicate your level of support or opposition for a number of recommended obesity public policies.

4. Advantages associated with the research project.

By sharing your perceptions of recommended obesity public policies, you have the potential to influence future development and implementation of obesity public policies in Canada. This research gives participants an opportunity to express their support or opposition of different of obesity public policies that may be implemented in Canada.

5. Risks associated with the research project. 5.1 Risk of fatigue.

It is estimated that the entire survey will take 30-45 minutes to complete. This may cause fatigue for participants. If you feel tired at any time, you may stop and take a break. If you decide to take a break from the survey, as long as you do not close the survey webpage, you can continue answering the questions from where you left off.

5.2. Risk of psychological discomfort.

Some of the questions in the survey involve personal and sensitive information. You do not have to answer any questions that you are not comfortable with. If you consent to partake in this study, you can still submit an incomplete survey.

6. Confidentiality.

While you are taking part in this research project, the principal investigator of this project will collect information about you that is necessary to meet the scientific objectives of this research project. We will not allow anyone to access the information, except people directly involved in conducting the research**.** All the information collected will remain confidential to the extent provided by law.

The principal investigator of this research project will keep this research data for at least five years. The research data may be published or be the subject of scientific discussions, but it will not be possible to identify you.

7. Voluntary participation and possibility of withdrawal.

Your participation in this research project is voluntary. You are free to refuse to participate. You may also withdraw from this project at any time, without giving a reason, by simply **not** clicking the "submit" button to submit the completed survey.

If you submit an incomplete survey, the information already collected in the context of this project will nevertheless be kept, analyzed or used to ensure the integrity of the project.

8. Future research projects.

By participating in this research, you are agreeing that your research data may be used to carry out other research projects. These research projects will be evaluated and approved by the Research Ethics Board at Concordia University prior to their realization. Please note that your research data will be kept securely by the researcher responsible for this research project on Concordia University's computer servers. Your research data will be retained for as long as it can be useful for the advancement of scientific knowledge. When it is no longer needed, your research data will be destroyed. Please note that at any time you may request that your research data not be used by contacting the researcher responsible for this research project.

Your research data may be published or be part of scientific discussions, but it will not be possible to identify you.

9. Compensation.

You will receive compensation for your participation from the market research company, Survey Sampling International.

10. Participant's Declaration
Title of research project: Canadian Public Support of Obesity-Related Public Policy

I have read and understood this form. I have had the chance to ask questions and any questions have been answered. I agree to participate in this research under the conditions described.

By clicking the "Next" button below, you are consenting to partake in this research study.

If you have questions about the scientific or scholarly aspects of this research, please contact the primary investigator. Their contact information is on page 1.

If you have concerns about ethical issues in this research, please contact the Manager, Research Ethics, Concordia University, 514.848.2424 ex. 7481 or oor.ethics@concordia.ca.

"Next"

CERTIFICATION OF ETHICAL ACCEPTABILITY

FOR RESEARCH INVOLVING HUMAN SUBJECTS

Name of Applicant: Iyoma Edache

Department: Faculty of Arts and Science\Health, Kinesiology, and Applied Physiology

Agency: N/A

Title of Project: Canadian Public Support for Obesity Public Policies

Certification Number: 30009752

Valid From: July 20, 2018 To: July 19, 2019

The members of the University Human Research Ethics Committee have examined the application for a grant to support the above-named project, and consider the experimental procedures, as outlined by the applicant, to be acceptable on ethical grounds for research involving human subjects.

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Dr. James Pfaus, Chair, University Human Research Ethics Committee