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Examining the effects of a weight stigma induction on psychological stress and exercise outcomes

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Abstract

Weight stigma is highly prevalent as a motivational tool in exercise contexts. However, weight stigma experienced in this domain may contribute to lowered exercise engagement, particularly among higher-weight women. This thesis examined the effects of a weight stigma induction on psychological stress, intentions to exercise (ITE), and exercise behaviours. Higher-weight women (N = 170, M_{age} = 57.2) were randomly assigned to read a fictional news article (weight-stigmatizing vs neutral condition), and completed acute measures of psychological stress, ITE, and exercise behaviours 7-days later. Participants who were exposed to the stigmatizing content reported a significant increase in stress and lower acute ITE, compared to the control condition. There was no impact of study condition on self-reported exercise behaviours at follow-up. Further, stress did not mediate the relationships between study condition and exercise outcomes. This study extends the current research that weight stigma is harmful and contributes to health behaviour disengagement.

Keywords

weight stigma, weight-based social identity threat, psychological stress, women, exercise

Summary for Lay Audience

Weight stigma refers to the social devaluation of higher-weight individuals based on their size and shape which leads to weight-based prejudice, stereotyping and discrimination. Research suggests that weight stigma negatively impacts psychological and physical health, through reducing engagement in exercise behaviours. Women are particularly vulnerable to these outcomes, as they face more frequent experiences of weight stigma, and report less frequent engagement in exercise across the lifespan. Theorists suggest that when higher-weight women anticipate or experience weight stigma in exercise contexts, they experience stress, which can increase their motivation to avoid stigma in these contexts. While the link between weight stigma, stress, and exercise behaviours has been proposed, it has yet to be experimentally tested. Therefore, the aim of this study was to use a weight-related stigma induction to examine the relationships between weight stigma, psychological stress, intentions to exercise, and exercise behaviours. Middle aged to older adult women (N = 170) who identified as higher-weight were randomly assigned to read a fictional exercise-based article that was either designed to be stigmatizing (pertaining to weight) or that was designed to be neutral (pertaining to vaping). Women completed measures of psychological stress (before and after reading the article) and reported on their intentions to exercise (after reading the article). One week later, participants reported the frequency of exercise they had engaged in since reading the article. As expected, women who read the weight stigmatizing article experienced more stress and less intentions to exercise, compared to women who read the neutral article. Although reading the exercise-based weight stigmatizing content impacted women's immediate psychological experiences, it did not impact their exercise behaviours in the following week. This area of research highlights the negative influence of weight-based social identity threat and weight stigma on psychological stress and exercise intentions among middle aged to older adult women. Future research should aim to further understand and combat the negative effects of weight stigmatization to enhance women's psychological experiences with exercise.

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Chapter 1

1 Introduction and Rationale

The negative psychological and physical health consequences of weight stigma have been well-established in the research literature (Puhl & Heuer, 2010). Weight stigma encompasses the sociocultural devaluation of individuals based on their size and shape. Though lower-weight individuals may encounter experiences of weight stigma (Davies et al., 2020), "thinness" is widely considered to be a body image ideal in Western society and media (Martin, 2010). Weight stigma research primarily focuses on higher-weight individuals due to the pervasive prejudice and negative stereotyping experienced by this group. Higher-weight bodies are marginalized within Western society, and as a result, higher-weight individuals experience systematic discrimination in numerous domains of life (Puhl et al., 2008).

Studies have established consistent associations between weight stigma and negative health outcomes, including mood and anxiety disorders (Hatzenbuehler et al., 2009; Hackman et al., 2016), body image dissatisfaction (Wu & Berry, 2017), metabolic syndrome (Pearl et al., 2017) and all-cause mortality (Sutin et al., 2015). Women are especially at risk of these consequences, as they face more frequent experiences of weight stigma across a variety of domains, such as healthcare, fitness, employment, and education (Puhl et al., 2008; Tomiyama et al., 2018). It is important to note that research studying weight stigma among transgender women is extremely limited. Therefore, cisgender women are the focus of the current research.

Currently, middle aged and older adult women are understudied in weight stigma research, with most studies focusing predominantly on younger adult women (Puhl & Suh, 2015). Among middle aged and older adults, weight stigma has been associated with poorer physical and psychological health, as well as higher levels of C-reactive protein (Sutin et al., 2014; 2015). Despite the negative associated consequences, weight stigma continues to be highly prevalent in Western society (Lessard et al., 2021), and may have particularly deleterious consequences for higher-weight women. Middle and older adult

women may be more likely to experience weight stigma and identify as higher-weight due to age-related and menopause-related shifts changes in body composition (Douchi et al., 2002). Indeed, postmenopausal women are three times more likely to be classified as "obese" than before menopause (Kwasniewska et al., 2012).

Researchers have hypothesized that rates of physical inactivity may be disproportionately larger in higher-weight women due to pervasive experiences of weight stigma in these contexts (Thiel et al., 2020). Higher-weight individuals face stereotyping and discrimination from fitness professionals (Dimmock et al., 2009), as well as other exercisers (Flint & Reale, 2015). Therefore, it is possible that higher-weight women are unable to garner the potential psychological, physiological, and social benefits of physical activity due to experiences of weight-based stigma (Hunger et al., 2015).

According to the weight-based social identity threat model (Hunger et al., 2015), higher-weight individuals who encounter weight stigma may be motivated to avoid situations in which they have previously encountered or anticipate experiencing weight stigma. This model posits that weight-based social identity threat is experienced when an individual who perceives themselves to be aligned with the social identity of higher-weight is concerned they have or will face stigma associated with this identity (Hunger et al., 2015). The weight-based social identity threat model may describe why higher-weight women engage in lower levels of exercise behaviour. This is particularly concerning for postmenopausal women, as physical activity plays a protective role to combat the physiological declines associated with aging (Kendall & Fairman, 2014). Menopause may also exacerbate the negative consequences of physical inactivity among middle-aged and older adult women.

Cross-sectional research has demonstrated that individuals exposed to weight stigma are more motivated to avoid exercise, particularly public exercise (Vartanian & Shaprow, 2008; Vartanian & Novak, 2011), and that weight discrimination is associated with lower engagement in exercise (Jackson & Steptoe, 2017). A review by Puhl and Suh (2015) identified understanding the extent that weight stigmatization affects exercise behaviours as a key research question to study for the health consequences of weight stigma. Among

adults, they also specifically called for research to explore the consequences of weight stigma and discrimination in physical activity settings. However, there are no experimental studies that demonstrate that weight stigma in the domain of exercise negatively impacts exercise outcomes in higher-weight women.

Several mechanisms have been implicated to delineate the relationship between weight stigma and exercise outcomes. Researchers have hypothesized that weight-based social identity threat may undermine the cognitive resources needed to maintain regular exercise (Hunger et al., 2015). Experiencing weight stigma is psychologically stressful and coping with that stress requires effort which may impair engagement in behaviours that require self-regulation (Major et al., 2018). After being primed with weight-related stereotypes, higher-weight women reported lower intentions to exercise (ITE) and exercise self-efficacy than those who did not receive the prime (Seacat & Mickelson., 2009). Weight stigma may function through weight-based social identity threat and the psychological stress response to decrease ITE and engagement in exercise behaviours (Hunger et al., 2015). Currently, this tenet is based primarily on cross-sectional research among young adult women. Experimental research is needed to establish that (i) weight stigma negatively impacts exercise intentions and behaviours and (ii) psychological stress mediates these relationships.

1.1 Overview of Research Aims

The objective of this research is to study the relationship between weight stigma and exercise intentions and behaviour, and the potential mechanistic effects of psychological stress. Specifically, the present study will explore the extent to which (i) a weight-based social identity threat induction contributes to psychological stress, exercise intentions and behaviours, and if (ii) the association between weight-based social identity threat and exercise outcomes is mediated by psychological stress.

Chapter 2

2 Review of Literature

2.1 Weight Stigma

Weight stigma is pervasive in Western society and a major driver of health inequities (Puhl & Suh, 2015). Weight stigma subsumes anti-fat attitudes, fatphobia, weight bias, and fat prejudice (Puhl & Brownell, 2001) and can be defined as negative attitudes and behaviours directed primarily towards higher-weight individuals based on their weight and/or size (Puhl & Heuer, 2010). Generally, stigma is conceptualized as a process in which a group of people are labelled as deviant, stereotyped, and separate from the "normal" group, and thus are vulnerable to status loss and experiences of discrimination (Link & Phelan, 2001). For example, higher-weight individuals are often stereotyped as lazy, undisciplined, and inactive (Rogge et al., 2004), and viewed as burdens on society and the economy (Pausé, 2017). Stereotypes against higher-weight individuals are harmful and lead to weight stigma and discrimination in numerous domains. While there is evidence that lower-weight individuals may encounter weight stigma (Malloy et al., 2012), lower-weight bodies are idealized in Western society (Martin, 2010), particularly among women (Pearl & Wadden, 2010), and therefore are less culturally stigmatized and stereotyped. Higher-weight bodies are marginalized in Western society, leading to systematic, institutionalized, and interpersonal discrimination in areas including employment, healthcare, education, media, dating, and physical activity spaces (Puhl & Brownell, 2001; Puhl & Heuer, 2009; Brownell et al., 2005). As such, this thesis focuses specifically on stigma against higher-weight individuals.

Weight stigma can be divided into three categories: enacted stigma (discrimination), perceived stigma and self-stigma (Major et al., 2018). Enacted weight stigma refers to explicit behaviours or policies that come from bias towards higher-weight individuals. Examples of enacted stigma can include social exclusion, teasing, bullying, harassments, and policies and programs that unfairly disadvantage higher-weight individuals (Major et al., 2018). Perceived weight stigma is a result of exposure to

negative portrayals of higher-weight individuals in media and culture, and observation of enacted stigma against higher-weight individuals.

The social identity of higher weight is often endorsed later in life. Prior to developing this identity, individuals had years to develop negative stereotypes and attitudes towards higher-weight individuals, without the personal relevance. Higher-weight differs from other social identities (i.e. racial or ethnic identities) which are often shared or celebrated with peers. Overall, this can lead to higher-weight individuals endorsing negative stereotypes about weight and attributing these negative evaluations to themselves, developing self-stigma. In fact, the more higher-weight individuals believe that weight is controllable and that individuals are personally responsible for their weight, the higher anti-fat biases they display (Crandall, 1994). Research suggests that higher-weight individuals both experience and internalize weight stigma (Durso & Latner, 2008).

Weight stigma is often considered socially "acceptable", likely due to this pervasive belief that higher-weight individuals are personally responsible for their weight (Puhl & Brownell, 2003). It is widely believed that weight is controllable (Crandall, 1994) and as a result, the ridicule and shaming of higher-weight individuals is seen as justified (Major et al., 2018). Weight stigma is viewed as motivating for higher-weight individuals to adopt healthier lifestyle behaviours, such as exercise. Even health policy scholars have argued for the use of stigmatization to create social pressure and encourage weight loss (Callahan, 2013). Weight stigma is a common tool in anti-obesity campaigns which often feature stigmatizing images and messages (Puhl & Heuer, 2010; Brochu et al., 2014; Heuer et al., 2011). However, research suggests that weight stigma may be a mechanism that negatively impacts the health of higher-weight individuals (Tomiyama et al., 208) and leads to weight gain (Sutin & Terracciano, 2013).

2.1.1 Prevalence of Experienced Weight Stigma

Though most of the research on weight stigma has been based in the United States (US), higher-weight individuals face a high prevalence of weight stigma across the Western world, whereby more than half of a research sample residing in Australia,

Canada, France, Germany, the United Kingdom (UK) and the US reported experiencing weight stigma (Lessard et al., 2021). Experiences of stigma are reported in daily life. For example, an ecological momentary assessment study of 46 higher-weight individuals in Australia found that 91% of the participants reported a weight-related stigmatizing situation in the 2-week study period (Vartanian et al., 2014). Participants in this study reported an average of 11.12 stigmatizing incidents across the 2-weeks. This high prevalence is particularly concerning, as experiencing high rates of weight stigma in one's daily life is highly predictive of concern and anxiety of encountering future weight stigma (Major et al., 2020).

Women and girls report more experiences of weight stigma (Puhl et al., 2008) and perceive themselves as 'overweight' at lower BMI (body mass index) values than men (Crawford & Campbell, 1999). Research suggests that adults with multiple aspects of their social identity that are experienced as sources of discrimination (i.e., higher-weight women), are more likely to report experiencing stigma and rate those experiences as more stressful (Grollman, 2014). Though men still encounter weight stigma, women are particularly vulnerable to the negative effects of stigma, such as depressive symptoms (Brewis et al., 2018). Indeed, higher-weight women are especially stigmatized for their weight across many domains, including employment, education, and romantic relationships (Tomiyama et al., 2018). Women also report higher levels of weight bias internalization than men (Himmelstein et al., 2017). Notably, men with BMI in both the "underweight" and "overweight" ranges report experiencing explicit weight stigma (Himmelstein et al., 2018). It has been suggested that weight stigma among men may represent a "U-shape" pattern whereby both the lowest and highest weight ranges are stigmatized, whereas stigmatization among women is primarily among higher-weight individuals (Pearl & Wadden, 2018). Previous weight stigma research has focused largely on younger women (Puhl & Suh, 2015). Among middle aged and older adults, experiences of discrimination, such as weight stigma, are still highly prevalent (Spooner et al., 2018). Studies of middle aged and older adults have found associations between reported experiences of weight stigma and poorer physical and psychological health (Sutin et al., 2014; 2015). In terms of physical activity, it is suggested that experiences of weight stigma negatively impact the participation of higher-weight middle aged and older

adults in physical activity. Specifically, weight stigma has been found to mediate the relationship between objective BMI, and moderate to vigorous physical activity participation in higher-weight middle aged and older adults (Phibbs et al., 2019). Establishing the mechanisms through which weight stigma influences psychological and physical health are particularly important for this understudied and vulnerable population.

2.1.2 Correlates and Consequences of Weight Stigma

Among higher-weight individuals, weight stigma has been shown to have negative psychological and physiological outcomes (Major et al., 2018). A systematic review of these outcomes found that weight stigma was positively associated with eating disturbances, depression, anxiety, and body image dissatisfaction among higher-weight individuals (Wu & Berry, 2017). Perceived weight discrimination and concerns about weight stigma have been found to mediate the association between BMI and self-reported physical health, and the relationship between BMI and self-reported psychological health in an adult sample (Hunger & Major, 2015). For older adult research participants (aged 50+), weight discrimination was associated with an increase in mortality risk of almost 60%, unrelated to common physical and psychological risk factors (Sutin et al., 2015). Weight stigma predicted this increase in mortality risk more strongly than other forms of discrimination, at a level comparable to established mortality risk factors such as smoking (Sutin et al., 2015). There is also evidence that diseases thought to co-occur with body weight (e.g., hyptertension, osteoarthritis, diabetes) have the highest prevalence among groups which are most stigmatized for being “overweight” (i.e., younger individuals, Caucasians, and women) (Muennig, 2008). Overall, the negative health outcomes associated with weight stigma are well established in correlational research.

A systematic review found weight bias internalization to be linked with greater depression, anxiety, binge eating, and cardiometabolic risk, and lower health- and mental health-related quality of life (Pearl & Puhl, 2018). Internalized weight bias (IWB) has also been found to mediate the relationship between experienced weight stigma and adverse outcomes, such as body shame (Forbes & Donovan, 2019). It is important to consider IWB in weight-based social identity threat research as self-stigma can exacerbate the negative effects of social identity threat. For higher-weight women, even

being described as higher-weight can be stigmatizing and have negative consequences. Essayli et al. (2017) randomly labelled 113 female undergraduates as either “normal weight” or “overweight”. Being labelled as “overweight” negatively influenced participants’ body image, affect, and perceived health, particularly among higher-weight participants (Essayli et al., 2017).

Other experimental research has been conducted to show the negative influence of direct weight stigma. In laboratory-based studies, weight stigma has been shown to increase physiological stress, via the hypothalamic-pituitary-adrenal axis, (Himmelstein et al., 2015), increase caloric consumption (Schvey et al., 2011), and decrease self-regulation (Major et al., 2014). These effects are most pronounced among individuals who identify as higher-weight, but weight stigma may still exert a negative influence in weight-diverse research samples. For example, Simpson et al (2019) randomized undergraduate participants to view either a weight-focused or weight-neutral obesity prevention campaign. Participants who viewed the weight-focused campaign subsequently reported lower self-efficacy for health behaviour change and increased negative perceptions of “obesity” (Simpson et al., 2019). Interventions to reduce internalized weight stigma may also help reduce some of these observed consequences. A recent 10-week mindfulness and compassion-based intervention designed to decrease self-stigma among higher-weight women, also reduced psychopathological symptoms compared to the control group (Palmeira et al., 2017). In summary, there is consistent observational and experimental research to show that weight stigma is associated with negative psychological and physiological outcomes, however the mechanisms underlying these associations are not well-studied.

2.2 Weight-Based Social Identity Threat

Social identity threat has been proposed to explain the relationship between weight stigma and negative psychological and physical health outcomes among higher-weight individuals (Hunger et al., 2015). A social identity is defined as “the portion of an individual’s self-concept derived from perceived membership in a category or social group” (Hunger et al., 2015, pg 2). Weight-based social identity threat is a psychological state experienced when an individual who perceives themselves to be aligned with the

threatened identity (i.e., classifying as higher-weight) is concerned they have or will face the discrimination, rejection, or stereotyping associated with this social identity (Hunger et al., 2015). Weight-based social identity threat is common in Western societies, where lean bodies are socially "normalized" and equated with health, while larger bodies are equated with ill-health (Thiel et al., 2016). As a result, higher-weight individuals may internalize the cultural devaluation of their body size, and of the negative stereotypes that are associated with their social identity (Puhl et al., 2008).

Weight based social identity threat may be activated through direct experiences of discrimination, as well as situational cues or cultural assumptions about the likelihood of negative stereotypes being applied towards them during a specific activity (Steele et al., 2002). For higher weight individuals, even in the absence of experienced stigma, situations in which appearance is important and salient (i.e., meeting new people, dating, job interviews) are identity threatening (Major et al., 2012). Simply having one's weight visible in a situation where higher-weight individuals anticipate weight stigmatization, can activate weight-based social identity threat and expectations of social rejection (Blodorn et al., 2016). This contrasts with lower-weight individuals who may react positively to having their weight visible in an appearance-salient context (Blodorn et al., 2016). During an experience of social identity threat, an individual will be vigilant for signs of stigmatization (Steele et al., 2002).

Middle-aged and older adult women may be particularly at risk of experiencing weight-based social identity threat due to menopause and aging-related changes in body composition. Indeed, women are more likely to be labelled as "obese" during menopause than before menopause (Kwaśniewska et al., 2012). As such, more women in this age range are likely to identify as higher-weight, yet the majority of weight-based social identity threat research currently focuses on younger adult women.

2.2.1 Self-Perceived Weight Status vs. Objective Weight Status

Identifying as part of a socially stigmatized group increases one's vulnerability to weight-based social identity threat (Major & O'Brien, 2005; Steele et al., 2002; Hunger et al., 2015). It is important to note that while higher-weight individuals who do not

perceive themselves as higher weight may still undergo experiences of weight stigmatization , they would be unlikely to experience weight-based social identity threat. While these individuals are aware of the negative experiences of higher-weight individuals, they do not identify themselves as part of this group, and therefore do not associate the discrimination and stereotypes associated with this identity with themselves. Researchers hypothesize that self-perceived weight status is a more relevant measure when participants are exposed to weight stigma in private (Major et al., 2014), whereas objective weight-status (e.g., BMI) may be a more relevant measure in interpersonal research where higher-weight individuals are seen by another person who may categorize them as overweight (Blodorn et al., 2016). As such, perceptual weight status (i.e., belief that one belongs to a social identity group that is socially threatened) may be more relevant in eliciting weight-based threats compared to an anthropometric measurement weight-status.

2.2.2 Weight-Based Social Identity Threat Research – Experimental Vignettes

The use of experimental vignettes has been a popular method to study weight-based social identity threat. Major et al (2014) assigned female undergraduates to read a fictional news article either about how weight or smoking negatively impacts an individual's employment prospects. Similarly, Shentow-Bewsh et al (2016) randomized female undergraduates to either a weight stigma condition or one of two control conditions. The weight stigma condition involved reading a sham article describing the "obesity epidemic" which endorsed several negative stereotypes about higher-weight individuals, and included first-person accounts of experienced interpersonal stigma. More recently, Meadows and Higgs (2019) emphasized the need for interpersonal components in experimental vignettes to avoid potentially confounding structural and institutional stigma, which are less relevant in a social identity threat paradigm, and created a vignette focusing on the detrimental effects of "obesity" on dating and romantic relationships. Higher-weight research participants who endorsed high-levels of internalized weight bias consumed less calories after reading the stigmatizing article than the neutral article. In contrast, higher-weight women with lower IWB consumed more after reading the

stigmatizing article. Overall, it is clear that experimental vignettes are capable of inducing weight-based social identity threat and are useful tools for researching weight stigma.

When using experimental vignettes in weight stigma research, smoking is commonly used as the topic of the neutral vignette. All words pertaining to weight are replaced with words pertaining to smoking in this control condition. It is therefore essential to only include participants who do not identify as smokers, as they will not associate the social identity with themselves and experience social identity threat as a result.

Research involving weight-related stigmatizing vignettes has focused primarily on female undergraduate populations and caloric consumption. The weight-based social identity threat model (Hunger et al., 2015) suggests that weight stigma decreases self-regulatory capacity and increases caloric consumption as a result. The influence of a stigmatizing vignette on exercise intentions and behaviours has not been tested as thoroughly.

In a recent experimental study, Lambert et al (2019) had participants read a fictional news vignette on either weight stigma or smoking stigma, describing how employers are less inclined to employ higher-weight individuals/smokers. Participants who read the weight stigma article did not differ from participants who read the smoking stigma article in terms of intentions to avoid exercise or physical activity levels, both immediately after reading the article and at the one-month follow-up. However, the measurement of intentions to avoid exercise was limited. The 3-item measure was not a general measure of intentions to avoid exercise, but also focused on a specific domain of exercise avoidance (public) and endorsed specific barriers (mirrors, thin people) and emotions (embarrassment, uncomfortable). This specificity of these items could have reduced the impact of the vignette on intentions to avoid exercise. For example, the impact on at-home exercise would not be captured by this measurement. This study also did not include any potential mediators of these relationships, such as psychological stress.

2.2.3 Weight-Based Social Identity Threat and Stress

There is a large body of research showing the negative associations between weight stigma and psychological stress. Among a US sample of higher-weight individuals, weight stigma was significantly associated with perceived stress and psychiatric morbidity and comorbidity (Hatzenbuehler et al., 2009). Individuals who have experienced weight stigma report more psychological distress, lower well-being, and greater loneliness than individuals who have never experienced weight stigma (Lewis et al., 2011). Research participants who reported experiences of weight stigma were twice as likely to be diagnosed with mood and anxiety disorders, compared to participants who did not report stigma (Hatzenbuehler et al., 2009). Weight-related rejection has also been linked with a greater risk of depression (Hatzenbuehler et al., 2009). Interestingly, increased experiences of weight-based stigma and concerns about weight stigma have been found to mediate the indirect relationship between higher BMI and poorer psychological health (Hunger & Major, 2015). Several of the diseases thought to co-occur with body weight (e.g., hypertension, diabetes) are stress-related, and may partially develop from the stress of experiencing weight stigma (Muennig, 2008). Individuals who experience weight stigma may also be more vulnerable to experiences of daily stress, which may increase the risk of these health outcomes (Sutin et al., 2016). Therefore, the negative impact of weight stigma on psychological health also affects physiological health.

The relationship between weight stigma and psychological stress has been studied using lab-based experimental manipulations and the social identity threat framework. Overall, when research participants undergo laboratory exposures to weight stigma, they report increased stress (Major et al. 2012, Schvey et al. 2014). For example, after experiencing a weight-based social identity threat manipulation, higher-weight women showed higher stress reactivity and more cognitive depletion compared to higher-weight women who did not believe their weight was visible (Major et al., 2012). A similar experiment found that weight-based social identity threat was associated with increased stress, in addition to other negative psychological constructs, such as increased rejection expectations and decreased self-esteem (Blodorn et al., 2016).

Increased stress exposure from weight stigma has then been associated with physiological changes. Laboratory-based research suggests that exposure to weight stigma is psychologically and physiologically stressful, whereby exposure to stigmatizing content was correlated with an increase in cortisol reactivity, a marker of acute physiological stress (Schvey et al., 2014). Among higher-weight participants, higher frequency of experiencing weight stigma has been significantly related to measures of cortisol and higher levels of oxidative stress (Tomiyama et al., 2014). This suggests that weight stigma may contribute to greater perceived psychological stress, which then activates the psychobiological stress response (Dickerson & Kemeny, 2004).

Based on the extant experimental literature, experiencing weight stigma and weight-based social identity threat are clearly stressful. It has been suggested that the impact of weight-based social identity threat on motivation to avoid stigma (in domains such as exercise) occurs through the psychological stress response (Hunger et al., 2015). This tenet has not yet been tested but theoretical frameworks hypothesize that weight-based social identity threat may undermine resources needed to maintain regular exercise (Hunger et al., 2015).

2.2.4 Weight Based Social Identity Threat, Exercise Intentions, and Behaviours

Exercise is a domain in which weight is highly stigmatized, which is also critical in promoting physical health (Major et al., 2018). Appearance and physicality are a central aspect of exercise and physical activity, meaning that interactions in these contexts automatically increase an individual's awareness towards their body shape, size and weight. Simply engaging in an appearance-salient context can be sufficient to induce weight-based social identity threat in higher-weight individuals (Major et al., 2012: Blodorn et al., 2016).

The weight-based social identity threat model states that higher-weight individuals who experience weight stigma and discrimination may respond by avoiding areas where further weight stigma is likely to occur, such as exercise (Hunger et al., 2015; Major et al., 2018). Indeed, overt and subtle experiences of weight stigma, and fear

of weight stigma have been linked with withdrawal and avoidance of that exercise setting (Thedinga et al., 2021). Exercise contexts are highly exclusionary and pervasively stigmatizing to higher-weight individuals, which may in part explain why higher-weight individuals are less likely to exercise (Major et al., 2018). Strong anti-fat bias has been found in fitness professionals and regular exercisers, which likely promotes an unwelcoming environment at fitness centres and gyms (Robertson & Vohora, 2008).

There is a breadth of research focusing on the relationship between weight stigma and physical activity outcomes in adolescence. Among Canadian high school students, perceiving themselves as overweight was associated with lower engagement in sport and less vigorous physical activity (Patte et al., 2016). Weight stigma and weight-based teasing may account for these findings. Weight-based teasing is a commonly experienced form of weight stigma by higher-weight adolescents in settings such as gym class or sports practice (Puhl et al., 2013), and may continue into adulthood. As an adolescent, this teasing comes from a variety of sources including peers, physical education teachers and sports coaches. Weight-based teasing during physical activity may negatively impact exercise motivations and behaviours, and development of an exercise identity. Several studies have highlighted the relationship between weight-based teasing and lowered physical activity in adolescence (Greenleaf et al., 2014; Losekam et al., 2010; Slater & Tiggemann, 2011). Given that the majority of extant research is focused on adolescents, more research is needed exploring the relationship between weight stigma and exercise outcomes in older adult populations.

Among adults, qualitative research has shown that many higher-weight individuals are unwilling to participate in exercise because they expected to be laughed at, ridiculed, stared at, or abused (Lewis et al., 2011). Cross-sectional observational research has supported these results and demonstrated that individuals exposed to weight stigma are more motivated to avoid exercise, especially in public settings (Vartanian & Shapiro, 2008; Vartanian & Novak, 2011). A more recent 2-week ecological momentary assessment study found that the more participants reported experiencing stigma on a given day, the less motivations they reported to exercise at the end of that day (Vartanian et al., 2018). However, an experimental study investigating the effects of weight stigma

in a news media vignette on intentions to increase physical activity and changes in physical activity over one month found no significant effect of weight stigma on either outcome (Lambert et al., 2019). Their measurement of exercise avoidance was limited as it focused on avoidance of public exercise with three items ("I'm too embarrassed to participate in physical activity in public places", "I avoid going to the gym when I know there will be a lot of thin people there", and "I feel uncomfortable going to a gym with lots of mirrors") that endorsed specific barriers to exercise. More research is needed to study the relationship between a weight stigma induction and exercise intentions/intentions to avoid exercise using a more general measure of exercise intentions. Overall, weight stigma is suggested to be negatively associated with intention and motivation to exercise.

For middle aged and older adult women, physical inactivity can augment the physiological health decline associated with aging, whereas exercise and physical activity are linked with numerous health benefits and positive physiological changes (Kendall & Fairman, 2014). However, the majority of middle aged and older adults do not meet current physical activity guidelines, particularly middled aged and older adult women (Mynarski et al., 2014). Weight stigma and weight-based social identity threat may be important barriers to exercise in this population.

Research examining the association between weight stigma and exercise behaviours has been conflicting. Experiences of weight stigma have been associated with lower engagement in exercise (Jackson & Steptoe, 2017), and motivation to avoid exercise has been associated with lower levels of strenuous and moderate exercise (Vartanian & Shaprow, 2008). However, a recent cross-sectional study also found no significant relationship between weight stigma and leisure time physical activity behaviours (Lee et al., 2021), which includes sport, recreational walking, and exercise behaviours. The results of a week-long daily diary study found that reported experiences of weight stigma were unrelated to participants' self-reported exercise behaviours (Seacat et al., 2014). Weight stigma has shown both positive and negative associations, and no associations with exercise behaviours. These conflicting studies show significant methodological limitations which may impact their findings. For example, none of these

studies included measurements of self-perceived weight, focusing instead on BMI-assessed weight status to classify participants. Within a social identity threat framework, self-perceived weight may be more relevant in determining participants' responses to weight stigma (Blodorn et al., 2016). Studying weight-based social identity threat among a sample that identifies as higher-weight may reveal a clearer negative relationship between weight stigma and exercise behaviours.

Another potential factor in these conflicting findings may be the domain of exercise which is influenced by motivation to avoid stigma. Higher-weight individuals may be more motivated to avoid public and social exercise settings after encountering weight stigma in exercise-related contexts. Recent qualitative research suggests that negative experiences in exercise domains does not necessarily lessen higher-weight individuals' participation in exercise (Thiel et al., 2020). Rather, it is the individual's subjective perception of the stigma experience as a significant personal burden that may hinder participation. Higher-weight individuals report limiting their exposure to weight stigma in fitness domains by selectively avoiding specific exercise settings and exercising only in 'safe' settings, such as at-home, or strategically scheduling exercise at certain times (Thedinga et al., 2021). These higher-weight research participants also avoided weight stigma by managing their social relations. For example, these individuals would exercise individually and avoid any social exercise. Higher-weight individuals may be engaging in strategies to cope with weight stigma, that do not reduce their engagement in exercise.

Internalization of weight stigma, irrespective of BMI, has been associated with reduced willingness to engage in physical activity among higher-weight adults (Schmalz, 2010). In semi-structured interviews, higher-weight individuals endorsed common higher-weight stereotypes about themselves, such as describing themselves as being too lazy or lacking the willpower to engage in exercise activities (Thedinga et al., 2021). Self-stigmatization is a highly reported barrier to certain exercise activities. A study of 111 adults who perceived themselves as higher-weight found that participants high in anti-fat attitudes and high in internalization of societal standards of attractiveness showed higher motivation to avoid exercise, if they also reported a high degree of internal weight

stigma (Vartanian & Novak, 2011). Participants low in anti-fat attitudes and low in internalization did not show this relationship. In addition, higher-weight participants participating in an 18-week weight loss program with greater IWB self-reported greater caloric intake, and lower energy expenditure and exercise (Carels et al., 2009). It is thought that weight stigma increases higher-weight individuals' motivations to avoid exercise, especially for individuals with high internalized weight stigma.

More research is clearly needed to elucidate how internalized and experienced weight stigma influence exercise intention and behaviors among adults. Self-stigma has been proposed as an important moderator of the effects of weight-based social identity threat on health, but research testing this tenant is scarce (Major et al., 2018).

Researchers have also speculated that weight stigma may indirectly reduce physical activity levels through its direct impact on motivation to exercise (Vartanian & Shaprow, 2008; Vartanian & Novak, 2011). Sattler et al (2018) tested this theory and found gender differences in the relationship between weight stigma and motivation to exercise. Women reported more experiences of weight stigma than men and those experiences were associated with lower autonomous motivation to exercise, which was then associated with lower levels of walking, and moderate and vigorous physical activity (Sattler et al., 2018). Among men, a direct relationship between weight stigma and physical activity was observed whereby greater stigma experiences were associated with higher levels of walking and vigorous physical activity. Weight stigma did not show an impact on mens' autonomous motivation to exercise. More research including measures of motivation or ITE and exercise behaviours is needed to understand these associations.

2.2.5 Stress as a Mechanism linking Weight Stigma with Exercise Outcomes

Researchers have identified a series of potential mechanisms that may drive the association between experienced weight stigma and exercise outcomes. The activation of the stress response is one such mechanism, which has psychophysiological pathways of action, and may be particularly relevant in contributing to health outcomes. Stress has been previously shown to interrupt physical activity patterns, by decreasing engagement

in volitional exercise (Tomiyama, 2019). Higher perceived stress was related to less frequent exercise and leisure-time physical activity in cross-sectional and longitudinal research (Ng & Jeffrey, 2003; Mouchacca et al., 2013). Among a multinational sample of adults, participants who experienced weight stigma reported engaging in more gym avoidance as well as higher levels of stress (Lessard et al., 2021). These associations were documented over and above any demographic variables, including BMI, and were consistent across all the included countries.

More broadly, the literature on stress and coping responses shows that disengagement coping responses (such as exercise disengagement) are linked to increased psychological distress (Miller & Kaiser, 2001). Higher-weight women primed to think about negative weight-related stereotypes subsequently reported lower exercise-related intentions and self-efficacy than those not primed with the stereotype (Seacat & Mickelson., 2009). As such, weight stigma may function via social identity threat and psychological stress to decrease exercise intentions and engagement in exercise behaviours (Hunger et al., 2015).

2.3 Summary

A major pathway through which weight stigma negatively impacts health is likely through its effects on psychological stress, intentions to exercise (ITE) and exercise behaviours. However, weight stigma is often used as a motivational tool in exercise-related domains (Pickett & Cunningham, 2017). Middle aged and older adult women, who may be more likely to perceive themselves as higher-weight due to menopause and age-related changes in body composition (Douchi et al., 2002), may be particularly vulnerable to the pernicious effects of weight stigma. However, no experimental study has yet to establish the relationship between weight stigma and exercise outcomes in a population that identifies as higher-weight. Understanding the barriers to exercise among middle aged and older adult women is especially important, as the health benefits of exercise may lessen the negative health consequences associated with menopause.

2.4 Specific Research Objectives and Hypotheses

Drawing on theoretical and empirical evidence, the present research will test the relationship between weight stigma and exercise intentions and behaviour, and the potential mechanistic effects of psychological stress (Figure 1).

Specific research objectives and hypotheses are proposed:

Objective 1. To investigate if a weight-based social identity threat induction contributes to higher levels of psychological stress.

H_1. It is expected that women in the weight-based social identity threat condition will show higher psychological stress reactivity compared to women in the control condition.

Objective 2. To investigate if a weight-based social identity threat induction contributes to lower intentions to engage in exercise.

H_2. It is expected that women in the weight-based social identity threat condition will have lower intentions to engage in future exercise compared to women in the control condition.

Objective 3. To investigate if a weight-based social identity threat induction contributes to self-reported exercise behaviours in the following week.

H_3. It is expected that women in the weight-based social identity threat condition will have lower self-reported engagement in exercise in the following week compared to women in the control condition.

Objective 4. To determine if the association between weight-based social identity threat and exercise outcomes is mediated by psychological stress reactivity.

H_4. It is expected that weight-based social identity threat will be associated with lower intentions to engage in future exercise, and lower self-report exercise behaviours via the psychological stress response.

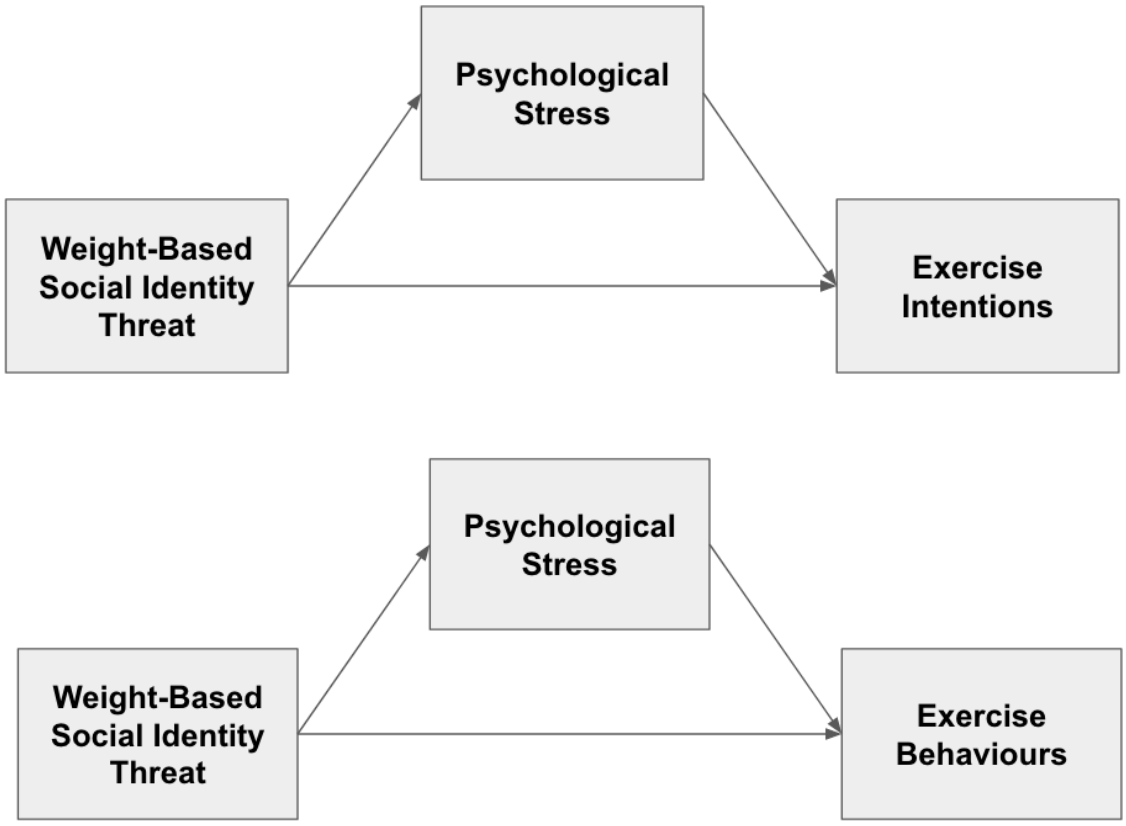

Figure 1: Conceptual mediation models to be tested.

Chapter 3

3 Method

3.1 Power Analysis

Power analysis for a Hotellings T^2 with two group mean vectors was conducted in G*Power to determine a sufficient sample size using an alpha of 0.05, a power of 0.80, and a medium effect size for the main outcome variable (Faul et al., 2009). The minimum sample size indicated by the power analysis was 158 (n = 79 per condition), and we aimed to recruit 190 to account for anticipated dropout at a rate of 20%. This sample size estimate also aligns with recommendations needed for 0.8 power using bias-corrected bootstrap mediation models with small-to-medium *a* and *b* paths (Fritz & MacKinnon, 2007).

3.2 Study Design

This online randomized experimental study assessed the influence of a weight-stigmatizing prime on exercise intentions and exercise behaviours. This study had two conditions: experimental (i.e., weight stigma induction) and control (i.e., neutral induction). Prior to data collection, the study protocol was pre-registered on *As Predicted* (Appendix B).

3.3 Recruitment

Study procedures were approved by Western University's Health Sciences Research Ethics Board in February 2021 (Appendix A). Participants were eligible to participate in this study if they were (1) phenotypically female and female-identifying, (2) between the ages of 50 to 69, (3) perceived themselves to be "heavier weight", (4) were located in Canada, the United Kingdom, or United States, and (5) were able to communicate in English. This sample was chosen because women who identify with a threatened social identity, such as higher weight, may face higher levels of weight-based stigma which may negatively contribute to exercise behaviours (Varnado-Sullivan et al., 2006; Himmelstein et al., 2015). In order to simulate weight-based social identity threat, participants must perceive themselves as part of the "heavy weight" category

(Himmelstein et al., 2015). We recruited women between the ages of 50 and 69 from Prolific's research participant pool since women in this age-range are more vulnerable to weight discrimination than men, face higher risks of weight discrimination at lower BMIs (Puhl et al., 2008), and report higher levels of physical inactivity than men in this age group (Mynarski et al., 2014). Prolific's participant pool is made up of individuals who create an account to participate in paid research.

Individuals were deemed ineligible to participate if they were (1) inactive, scored via the Godin Shephard Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985) as exercise outcomes were deemed to be more predictable in a physically active group, and (2) if they reported smoking a cigarette or e-cigarette, as we used vaping as the neutral prime. As per *Prolific* policies concerning compensation, all participants were paid a fixed fee per unit of average time subjects needed to complete each survey. Participants received the equivalent of £2.50 or 4.29 CAD for completing the experimental survey, and an additional £2.50 or 4.29 CAD for completing the follow-up survey. All participants who completed the pre-screen received £0.63 or 1.09 CAD regardless of their eligibility for the main study. The study ran in February and March 2021.

3.4 Materials

3.4.1 Screening Assessment

Demographics. At the time of screening, participants completed demographics to determine eligibility to participate in the main study. Participants were asked their current age in years using an open-ended response and were given four options to confirm their current country of residence a) Canada, b) United Kingdom, c) United States, or d) Other. To confirm their gender and sex, participants were asked to confirm they were phenotypically female and female-identifying ("Are you phenotypically female and female-identifying?"), with the binary response options of 'yes' or 'no'. Participants were eligible to participate if they responded 'yes'. *Prolific* provided additional demographic characteristics for participants including Country of Birth and Nationality.

Perceived Weight Status. Self-perceived weight was measured at the screening assessment by asking participants to select the descriptor they identified with: “very thin, moderately thin, slightly thin, average, slightly heavy, moderately heavy, very heavy.” (Himmelstein et al., 2015). Participants were eligible to participate if they responded: ‘slightly heavy’, ‘moderately heavy’, or ‘very heavy’. In comparison to an anthropometric measurement of weight, self-perceived weight is a more relevant measure when participants are exposed to weight stigma in private (Blodorn et al., 2016). For this experiment, self-perceived weight was measured due to the weight-based social identity threat model (Hunger et al., 2015) and the weight stigma induction likely occurring in private (online).

Smoking Behaviour. Cigarette and e-cigarette use was measured using the questions, “Have you ever smoked cigarettes” and “Have you ever smoked e-cigarettes/vaped?” with binary response options of ‘yes’ or ‘no’. Participants were eligible to participate if they responded ‘no’ to both questions.

*Godin-Shephard Leisure-Time Exercise Questionnaire**.*** To ensure participants were at least somewhat physically active, they were asked to complete the Godin-Shephard Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985). This is a short questionnaire that asks participants to report how many times in a typical week that they engage in strenuous, moderate and light exercise, with examples provided for each category. The number of bouts at each intensity are multiplied by 9, 5, and 3 metabolic equivalents (METs) and summed to create a Leisure Score Index, which includes all leisure-time physical activity. Participants with a Leisure Score Index lower than 14 units on this questionnaire were classified as “inactive” and were not invited to complete the main survey, because it was hypothesized that factors influencing starting exercise would vary from those influencing maintaining exercise. The Godin-Shephard Leisure-Time Exercise Questionnaire has demonstrated strong psychometric properties in adult populations (Amireault & Godin, 2015).

Internalized Weight Stigma. Internalized weight stigma was assessed at baseline (after screening; pre-experimental induction) as a potential moderator variable. This is an

exploratory variable that was beyond the pre-registered hypotheses on *AsPredicted*. This variable was measured using the modified version of the Weight Bias Internalization Scale (WBIS-M; Pearl & Puhl, 2014). This modified version replaces the original wording "because I am overweight," with "because of my weight,". Therefore, this modified version is suitable for participants who vary across the weight spectrum. Item responses are scored on a 7-point Likert scale from 'Strongly Disagree' to 'Strongly Agree'. A final score is calculated as a mean score for the full scale, with higher scores representing higher internalized weight stigma. This scale shows strong internal reliability in weight-diverse populations (Pearl & Puhl, 2014), and has similar psychometric properties among individuals classified as "overweight" or "normal" through both BMI criteria and self-classification (Lee & Dedrick, 2016). Higher scores on the WBIS-M have been strongly positively correlated with body dissatisfaction and shows moderate relationships with disordered eating and psychopathology with BMI as a controlled variable (Pearl & Puhl, 2014). The WBIS-M has previously been used in US, Australian and UK samples (Pearl & Puhl, 2014; O'Brien et al., 2016; Meadows & Higgs, 2019).

3.4.2 Experimental Assessment

Perceived State Stress. The visual analogue scale (VAS; 0-100%) was used to assess participants' perceived stress levels before and after reading the vignette. Scales ranged from 0 to 100 and participants were asked to drag a marker to indicate their current stress. The numerical difference between the VAS scores post-vignette and pre-vignette were used as the measure for perceived stress, such that a positive stress score indicates an increase in stress from pre-vignette to post-vignette. This type of scale is both recommended and widely used to assess perceived stress in research settings. A VAS has several subjective advantages over other questionnaires used to assess stress, such as the Perceived Stress Scale (PSS) (Cohen et al., 1983). It is a much quicker and simpler assessment tool that allows research participants to easily express stress with less possibility for literacy or language-based misunderstandings (Lesage et al., 2012). In addition, a VAS allows researchers to target acute stress rather than stress over a longer period of time. For example, the PSS measures participant stress over the last month

(Cohen et al., 1983). Concordance between the stress VAS and other stress measurement tools including the PSS have been demonstrated (Lesage & Berjot, 2011; Lesage et al., 2011). Previous research has highlighted the satisfactory inter-rater reliability (Lesage et al., 2011) of the VAS in stress assessment. Scores from this tool have shown good sensitivity in various experimental studies of the acute stress response (Scholey et al., 2009; Van Dulmen et al., 2007; Keitel et al., 2011).

Intention to Exercise (ITE). The measurement of ITE was derived from the Theory of Planned Behaviour (TPB), which has often been applied as a model of behaviour in the domain of exercise. A prominent tenet in this theory is that engagement in a behaviour is partially predicted by intention to engage in that behaviour (Ajzen, 1991). While participants in this research were classified as "active", daily life factors such as weight stigma could lead to fluctuations in participants' intentions to exercise. Behavioural intention to engage in exercise was measured using two bipolar (-3 to +3) scales. The items used were: 'How often do you intend to take part in regular physical activity?' (from never to frequently) and 'I want to exercise regularly.' (from 'definitely do not' to 'definitely do') (Armitage, 2005). The score for ITE was calculated as the mean of these items. Scores from this scale have previously shown good internal reliability and significantly predicted exercise behaviour in a UK sample (Armitage, 2005).

3.4.3 7-Day Follow-Up Assessment

*Exercise Behaviour***.** The International Physical Activity Questionnaire (IPAQ; Craig et al., 2003) long form was used to measure exercise behaviour at the follow-up survey 7-days after the experimental study. This is a widely-used 27-item scale that measures duration and frequency of physical activity in the previous 7 days in domains of: job-related, transportation, housework, house maintenance, caring for family, time spent sitting and recreation, sport and leisure time. The continuous variable sub-score for the leisure time physical activity domain was used as an indicator of exercise behaviours, reported in MET minutes a week. Scores from this scale have shown excellent test-retest reliability for physical activity (Craig et al., 2003) and adequate concurrent validity for leisure time physical activity, compared to logbook monitoring (Hagstromer, 2006).

3.5 Procedure

3.5.1 Vignette Development

The main *Qualtrics* survey was programmed to randomly allocate participants in either the neutral condition or weight stigma condition. Conditions consisted of vignettes that were written in the style of a newspaper article, describing the potential detrimental effects of either "vaping" or "obesity" in an exercise context. The vignettes were adapted from a protocol by Meadows and Higgs (2019). The experimental vignettes described findings from research studies suggesting that fitness professionals discriminate against "obese" exercisers. The language in this vignette (i.e., sloppy) was taken from previous research describing common weight-based stereotypes (Puhl & Brownell, 2001; Vartanian et al., 2013; Puhl & Heuer, 2012; Brewis, 2014). The study descriptions were adapted from research among health professionals that found biases in attitudes towards and the treatment of higher-weight patients (Wigton & McGaghie, 2001; Pantenburg et al., 2012). The vignette also incorporated data from qualitative research where higher-weight women report being excluded from classes by fitness instructors based on their size (Picket & Cunningham, 2017). The article ended with a fictional "quote" from a fictitious individual belonging to a genuine, well-known Canadian charity. This quote endorsed the common stereotype that weight is controllable for higher-weight individuals and that obesity is a sign of moral failing. The "vaping" and "obesity" vignettes were identical, except all words pertaining to weight were replaced with words pertaining to smoking/vaping (Appendix E).

3.5.2 Study Procedures

The study was conducted online using the research participant pool, Prolific. Compared to other online research platforms (e.g., MTurk), Prolific participants produce high data quality with more naivety and less dishonesty (Peer et al., 2017). Potential research participants were able to see the present study and choose whether they participated. To use the custom screening criteria, a pre-screening study was created. This study screened for cisgender women in the intended age-range and location range, then asked more specific screening questions, requiring participants to provide their Prolific

ID. After pre-screening, a list of participant IDs who met the above eligibility criteria was created for main study recruitment.

The main study had a custom pre-screen to only invite the Prolific IDs from the eligible pre-screening lists to the main experiment. Participants provided their Prolific IDs at each survey, allowing the responses for each questionnaire to be linked. The main study was advertised on Prolific for exactly 24 hours. Prolific redirected participants to *Qualtrics* for consent, the experimental induction, and survey assessment. Participants were informed that the purpose of the study was to examine psychological stress and personal lifestyle, and their relationships with common health behaviours. They were instructed to read an article about health and lifestyle, and answer questions from psychological surveys about their personal health behaviours and stress, and informed that they would be contacted in one week for a follow-up survey.

After reading the article, participants indicated if they found the vignette easy to understand, interesting, and relevant to themselves ("Did you find this article easy to understand?", "Did you find this article interesting?", "Did you find this article relevant to yourself?). All of these questions had the binary response options of 'yes' or 'no'. They were asked to briefly summarize the article. These questions ensure participants processed and recalled the details of the vignette and acted as an attention check. Participants would be excluded from analyses if unable to summarize the vignette. Specifically, participants would be excluded if they did not complete a summary, if they did not mention smoking/vaping or weight, or if they did not mention exercise. Participants were then asked to repeat the VAS and to complete questionnaires indicating their intentions to engage in exercise.

One week after the advertisement of the main study, all participants from the main study were recruited into the 7-day follow-up on Prolific. The advertisement for the follow-up study was listed for exactly 24 hours, meaning that participants were only able to respond during this 24-hour period. At this stage, participants were asked to report their leisure-time physical activity using the IPAQ (Craig et al., 2003) in the week following the main study. Participants were then asked what they believe the study

purpose to be, and whether they thought the newspaper article had influenced their exercise intentions and behaviours after this follow-up survey. Participants who indicated they believed the article influenced their exercise outcomes were labelled as “suspicious”. Analyses were completed with all participants, then sensitivity analyses were conducted excluding any “suspicious” participants and observing any changes in significance or patterns of results. This follow-up survey also included a prepared debriefing form, the purpose of the study was explained, and resources were provided to the participant.

3.6 Analytic Strategy

3.6.1 Preliminary Analysis

The analytic strategy for this randomized experimental study examined how a weight-stigmatizing prime influences subsequent psychological stress, ITE and self-reported exercise behaviour 7-days later. All analyses were conducted in SPSS and Jamovi. The analytic sample excludes cases who did not download the vignette and/or failed the post-vignette attention check (i.e., participant did not correctly or incompletely summarize the contents of the vignette). IPAQ data were cleaned as per recommendations, excluding unreasonably high values (i.e., walking, moderate, and vigorous time variables that are equal to or greater than 16 hours, days greater than 7). If participants reported engaging in an activity for less than 10 minutes, values were re-coded to ‘zero’. If a participant did not report the number of days or missed a time variable after reporting the number of days, in walking, moderate or vigorous, the case was excluded from the analytic sample. As recommended, any walking, moderate or vigorous time variables exceeding 240 minutes were truncated to be equal to 240 minutes. Participants who guessed the true purpose of the study or indicated they believed their physical activity levels were at least partially influenced by the article. were marked as "suspicious" to the deception, and sensitivity analyses were conducted with and without these participants. Data were screened to test for assumption of normality by inspecting the skewness, kurtosis, and boxplots for each dependent variable. Variables were deemed “non-normal” if they had skewness values exceeding +3 or -3, or

if they had kurtosis values exceeding +10 or -10 (Kline, 2011). Boxplots for dependent variables were inspected to determine potential outliers for removal (i.e., more than 1.5 or 3.0 interquartile ranges (IQR) that were below the lower quartile or above the upper quartile). To screen for assumptions of linearity, scatter plots were created showing the relationship between all dependent variables. These scatter plots were visually examined for linearity. Assumptions of homoscedasticity were evaluated by creating a scatter plot of the relationship between a dependent variable and the regression standardized residual. The scatter plot was visually examined for variance across the line of best fit.

After testing assumptions of normality, linearity, and homoscedasticity, data were then examined for missing values. The percentage of missingness was calculated for all dependent variables and each participant. Participants with >5% of values missing were then examined for patterns of missingness. Listwise deletion was used for cases where >5% of values were missing outside of the follow-up data (i.e., more than one value was missing from the main survey). For the main analysis, all missing values were handled either through listwise deletion or by calculating each participant's mean score while excluding the single missing item. Most missing data were due to attrition from the main survey to the 7-day follow-up. A series of independent samples t-tests were conducted to investigate if participants who responded to the follow-up survey differed from participants who did not in terms of age, IWB, perceived stress, and ITE.

This protocol was based on the intention to treat principle which requires that all participants be included in an analysis in the group they were randomized, regardless of dropout (Peace et al., 1989). This analysis aimed to follow a previously described framework for dealing with incomplete observations within this principle (White et al., 2011). In line with this framework, all randomized participants had been contacted to complete the follow-up survey.

Little's (1988) missing completely at random (MCAR) test was conducted to examine assumptions about the missing data in order to implement the main analysis. The results of Little's MCAR test were not significant ($X^2 = 302.166$, DF = 340, $p = .931$), meaning that the null hypothesis cannot be rejected. This suggests that the missing data

are MCAR, meaning that the cases of missing data occurred independently of the observed variables and multiple imputation techniques are suitable. All randomized participants were included in this test (White et al., 2011).

Because the data were MCAR and the majority of missingness was due to missing follow-up data, listwise deletion was used for participants missing the follow-up data. The main analyses (objectives ii and iii) were conducted using this listwise deletion sample. For sensitivity analyses, a separate data set was created using multiple imputation (MI) to estimate the missing follow-up data. This sensitivity analyses strategy accounts for all randomized participants. Results of the main analysis were compared with the MI data set, for example, noting if the significance of the main analyses were consistent with findings in the sensitivity analyses.

Imputation of missing data refers to procedures for replacing missing values with estimated scores. MI is a technique in which the estimated values replace the missing values such that parameter estimates may be unbiased and the uncertainty of parameter estimation in the missing data case can be reasonably estimated (Graham et al., 2007). MI estimates the missing values over *M* runs, with each run incorporating a random component which reflects the uncertainty of the missing value. Each run creates a separate dataset on which the desired analysis can be performed. By combining separate imputations, the uncertainty of each run is taken into account. Using the Automatic method in SPSS, the data were scanned for a monotone pattern of missing values and either the monotone or Markov chain Monte Carlo method was automatically applied.

Once the data were separated into two data sets (main analysis/listwise and sensitivity analysis/MI data set) and thoroughly inspected, the demographic characteristics of the sample were analyzed and summarized. Descriptive statistics, Pearson’s and Spearman’s correlations were then calculated for all study variables across the entire sample in both data sets.

3.6.2 Main Analysis

For the main analysis, objective (i) was intended to be tested using an independent samples t-tests to assess the effects of study condition (i.e., neutral vs stigmatizing article) on psychological stress reactivity. However, due to a high numbers of outliers, perceived stress was converted to a categorical variable (i.e., increase stress pre-post experiment, decrease or no change in stress pre-post experiment). Therefore, a chi-square test was performed to test the association between study condition and psychological stress group. Cramer's *V* is an index of association that is often used to report effect-size information for a chi-square test. It can be used for tables with any number of rows and columns (i.e., more than 2 x 2), and therefore was selected for this analysis.

Objectives (ii) and (iii) were tested using Hotelling's Trace to determine the effects of weight-based social identity threat on ITE and exercise behaviour. A one-way MANOVA was performed to compare mean ITE and IPAQ scores for participants across study conditions. The null hypothesis of this analysis corresponds to the assumption that when the scores on both exercise outcome variables are considered jointly, taking into account the intercorrelations between these variables, the means for this set of outcome variables do not differ across the study conditions. The factor used in this MANOVA is study condition, and there are $k = 2$ levels of this factor (experimental/stigmatizing article or control/neutral article). This test was employed to test if these two groups differ in the pattern of mean responses on the exercise variables (ITE and IPAQ score). Performing one MANOVA rather than a series of one-way ANOVAs reduces the risk of Type 1 error and considers the linear intercorrelations among the exercise outcome variables. A MANOVA can also detect a significant difference in response patterns on several variables across groups, even in situations where none of the single variables differ significantly across groups. However, since listwise deletion was used, a series of one-way ANOVAs was performed to confirm the results of the MANOVA, as the two variables had different sample sizes. Specifically, the measure of ITE was in the main survey which has a larger sample size and less missingness than the follow-up survey where the IPAQ was conducted. Sensitivity analyses were conducted for this analysis using the MI dataset, individually examining each run if pooled results are not available.

Using the Hayes Process v3.5 macro, bias-corrected bootstrap mediation models were created to test the indirect effect of psychological stress in the association between study condition and exercise outcomes (ITE and IPAQ score) (Figure 1). Bootstrapping is a nonparametric technique based on resampling a data set a large number of times and computing the indirect effect in each sample (Preacher & Hayes, 2004). Bootstrapping was used in order to overcome potential analytical issues such as the violation of the assumption of normality in the sampling distribution of the indirect effect (Hayes, 2009; Preacher & Hayes, 2008). Other advantages of bootstrapping include increased power and controlling for Type-1 error (Mackinnon et al., 2004). Mediation models with bootstrapping also do not require a significant direct association between variables to test the indirect effect (Mackinnon et al., 2004). The PROCESS macro does not allow for a dichotomous mediator, therefore the continuous difference in stress variable was used. Since the PROCESS macro is not compatible with imputed data, only the listwise data set was be tested for this objective. Significance of the indirect path was assessed using 95% confidence intervals with 5,000 bootstrap resamples.

3.6.3 Exploratory Analyses

Beyond the scope of the pre-registration, exploratory analyses were conducted to test IWB as a potential moderator. Also using the Hayes Process v3.5 macro, bias-corrected bootstrap moderated mediation models were created using the same parameters as the previous analysis, with IWB added as a moderator of the a-path and c-path. Once again, the significance of the indirect path was assessed using 95% confidence intervals with 5,000 bootstrap resamples.

Chapter 4

4 Results

4.1 Preliminary Data Processing

A total of 1200 potential participants were screened for eligibility, with 211 meeting eligibility criteria who were invited to complete the main study. Of this eligible sample, 30 participants did not respond to the invitation or chose to discontinue their participation by "returning" the study through *Prolific* or were "timed-out" automatically by *Prolific*, meaning that their response time was too slow. Overall, 181 participants were randomized to either the control group (n= 87) or the experimental group (n = 94). Four participants were excluded from further participation as they indicated they were unable to download the article at the main survey. The remaining participants' comprehension of the article was assessed, and the participants who were unable to summarize the downloaded article were removed from analysis (n = 3).

Next, 174 participants were invited to complete the follow-up survey. Of those 174, 17 participants did not respond to the invitation and 3 discontinued their participation by "returning" the study. The follow-up data were cleaned as per IPAQ recommendations, excluding unreasonably high values (i.e., walking, moderate, and vigorous time variables that are equal to or greater than 16 hours, days greater than 7). If any reported value for engaging in an activity was less than 10 minutes, it was re-coded to 'zero'. If a participant did not report the number of days or missed a time variable after reporting the number of days, in walking, moderate or vigorous, the case was excluded from the analytic sample. Sixteen participants who completed the follow-up and four participants without available follow-up data were excluded from analyses during data cleaning for issues such as large amounts of missingness and IPAQ requirements.

The final sample consisted of N = 170 participants for the main experiment, with 138 participants having follow-up data available (Figure 2). Seven of these participants were marked as suspicious to the manipulation (i.e., indicating they believed their physical activity levels were at least partially influenced by the article they read). These

participants remained in the final analytic sample, then were removed as a sensitivity analysis.

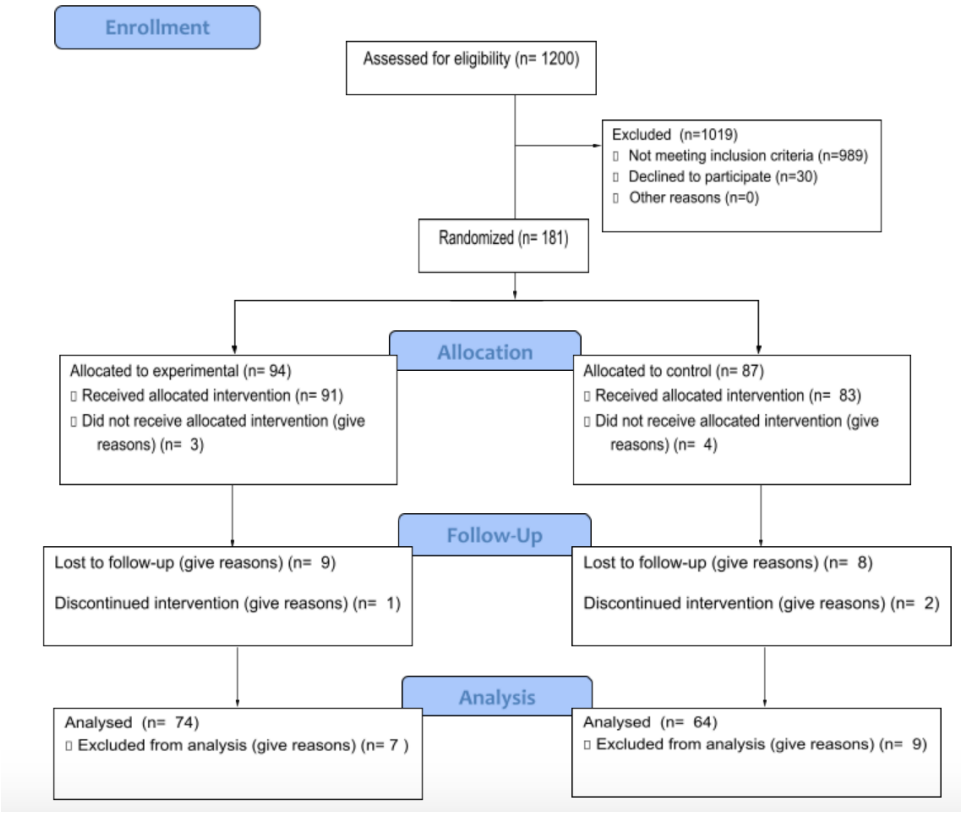

Figure 2: CONSORT 2010 Flow Diagram

Based on data screening and visualization, almost all skewness and kurtosis values were between the appropriate ranges of -3 to +3 and -10 to -10 respectively (Kline, 2011), to indicate a normal distribution (Table 2). The measure for Perceived Stress had a kurtosis value of 14.14. Descriptive statistics revealed that most participants endorsed little to no change in stress from pre to post article (M = 1.0, SD = 10.6). A high kurtosis value can be representative of outliers so the boxplot for perceived stress was analyzed visually. Twenty-two extreme outliers and 7 outliers were visually identified. Because of the large number of outliers and most participants reporting no change in stress, participants were separated into two groups of Perceived Stress: Decrease or No Change (dummy coded = 1) and Increase (dummy coded = 2).

Boxplots were also created to show potential outliers among the exercise outcome variables. Upon examination of the boxplot for leisure time physical activity, one extreme outlier and four outliers were identified. The extreme outlier was removed from analysis. No extreme outliers were visible in the boxplot of ITE. Nine outliers were identified. Given these outliers ranged from 1 to 7 on a 7-point scale, these outliers remained in the analysis.

Scatterplots were created to visually confirm the linear relationships between all continuous dependent variables (IWB, ITE and exercise behaviours). For each relationship, a second scatterplot was created to show the relationship between the dependent variable and the regression standardized residual. All scatterplots showed approximate homoscedasticity upon visual inspection.

4.1.1 Missingness

The initial percentages of missingness are as follows: IWB item 3 (0.60%), IWB item 9 (1.20%), perceived stress post-article (0.60%), perceived stress difference (0.60%), ITE item 1 (1.20%) and ITE item 2 (0.60%). After cleaning the follow-up data per IPAQ recommendations, missingness scores for walking (19.30%), moderate activity (18.70%), vigorous activity (18.70%), and leisure-time score (19.30%) were calculated. These percentages suggest that most data missingness are due to individuals responding to the main survey and not the follow-up.

The percentage of missing data were calculated for each individual participant. Examining missingness by case revealed 120 participants with a full data set, with no missingness. Among the remaining participants, 29 had a full data set, excluding the follow-up data. Any participant with larger than 5% missing data was examined. If a participant's missing data was largely due to missing the follow-up (i.e., no or only one missing item outside of the follow-up) then they remained in the analysis. One participant was removed who was missing overall 54.30% of data and a main outcome measure (perceived stress). If missing items were from a larger scale, the mean score for that participant was calculated excluding the missing items (i.e., IWB and ITE scores).

As the missing data pattern were MCAR, two datasets were created for analyses and compared – one using listwise deletion for any participants missing follow-up data and one where the missing follow-ups were estimated via MI to use in sensitivity analyses. To perform MI, the perceived stress group was included as an auxiliary variable. The core variables included follow-up scores for walking, vigorous physical activity, moderate physical activity, and overall leisure-time score. A multiple imputation based on 20 runs was performed based on previously described recommendations (Graham et al., 2007). SPSS automatically selected the appropriate imputation method (monotone vs. MCMC) after scanning the data for a monotone pattern of missing values.

4.1.2 Descriptive Statistics

The final analytic sample consisted of $N = 170$ participants for the main experiment, with original data available for the follow-up from 138 participants (Table 1). The main analyses were performed using listwise deletion, meaning sample size varied based on the included outcome measure (i.e., main survey or follow-up variable). The control group consisted of $n = 79$ participants and the experimental group consisted of $n = 91$ participants.

Participants in the control group and experimental group did not significantly differ in terms of age: $t(167) = 1.26$, $p = .21$, or stress pre-article: $t(167) = -1.97$, $p = .051$. However, participants in the experimental group did have significantly higher baseline IWB ($M = 4.29$, $SD = 1.46$) than participants in the control group ($M = 3.68$, $SD = 1.46$): $t(167) = -2.75$, $p = .007$.

In terms of perceived stress, 47 participants reported decreased stress after reading the vignette (27.60%, 29 in control group, 18 in experimental group), 68 participants reported no change in their stress after reading the vignette (40.00%, 36 in control group, 32 in experimental group), and 55 participants reported increased stress after reading the vignette (32.40%, 14 participants in control group, 41 in experimental group). Participants with decreased stress and no change in stress were added into one group regardless of condition for the main analyses. As most participants overall showed no change in stress, there were a large number of outliers in the continuous variable.

Converting psychological stress into a binary variable allowed analyses to be conducted without removing outliers. Across both conditions, 115 participants reported decreases or no change in their stress levels after reading the article (67.60%) and 55 reported an increase in stress (32.40%).

Participants who completed the follow-up (N = 138) did not significantly differ from participants who did not (N = 32) in terms of age: $t(167) = 0.99$, $p = .47$, IWB: $t(168) = -1.48$, $p = .34$, stress group: $t(168) = -1.10$, $p = .274$, or ITE: $t(168) = 0.12$, $p = .927$.

Means, standard deviations, and bivariate correlations were calculated for the variables in the study (Table 2, Table 3). The mean age of the sample was 57.2 years (SD = 5.5). The sample reported an average IWB score of 4.0 (SD = 1.5*)*. A score of 4 on the WBIS-M corresponds to "Neither agree nor disagree" and is the exact middle of the scale. The average ITE score was 3.74 (SD = 1.0) among all participants**.** This score falls slightly lower than the middle of potential ITE scores, which ranged from 1-7. Participants in the control condition reported an average score of 3.9 (SD = 1.0) for ITE. Overall, participants in the control condition had higher ITE than the experimental group. Participants in the experimental condition averaged a score of 3.6 (SD = 1.0). In the listwise deletion data set, among participants who completed the follow-up, the average physical activity leisure time score was 995.2 MET minutes/week (SD = 1047.2). Participants in the control condition had an average of 1088.19 MET minutes/week (SD = 1000.9). Participants in the experimental condition averaged 912.4 MET minutes/week (SD = 1086.9). In the imputed data set, the pooled mean of the physical activity leisure time score was 986.2 MET minutes/week. Significant correlations were found between IWB and IPAQ score ($r = .18$, $p = .033$), and ITE and IPAQ score ($r = .24$, $p = .004$) in the listwise data set. In the pooled MI data, there was a significant correlation between IPAQ score and ITE ($r = .23$, $p = .002$), and a significant association between IWB and stress group ($r = .21$, $p = .007$). As expected, the continuous stress variable and stress group variables were also significantly correlated in the listwise ($r = .81$, $p = .00$) and pooled ($r = .83$, $p = .00$) data sets.

Table 1. *Frequency, Percentage and Descriptives of Demographic and Perceived Stress Variables*

Descriptive Measure	Frequency	Percentage
Country of Nationality		
United Kingdom	105	61.80%
United States	55	32.40%
Canada	10	5.90%
Self-Perceived Weight		
Slightly Heavy	89	52.40%
Moderately Heavy	52	30.60%
Very Heavy	29	17.10%
Employment		
Due to start a new job within the next month	1	0.60%
Full-Time	54	31.80%
Part-Time	47	27.60%
Unemployed (and job seeking)	11	5.70%
Not in paid work (e.g. homemaker, retired, disabled, etc.)	46	27.10%
Other	8	4.70%
N/A	3	1.80%

Table 2. *Descriptive Statistics for Main Study and Follow-Up Variables*

Variable	M(*SD*)	Skewness	Kurtosis
Age (years)	57.2 (5.5)	0.63	-0.58
Psychological Stress	1.0 (10.5)	1.17	14.14
ITE	3.7 (1.0)	0.12	1.48
IPAQ score (listwise)	995.2 (1047.2)	1.33	1.53
IWB	4.0 (1.5)	0.09	-0.93

Note: M = Mean. *SD* = Standard deviation. *IPAQ*= Physical Activity Questionnaire, MET minutes/week

Table 3. *Bivariate Pearson and Spearman Correlations using listwise data*

	1	2	3	4	5
1. ITE	-				
2. IPAQ	.24**	-			
3. Stress Group	.08[a]	.004[a]	-		
4. IWB	-.10	.18*	.10[a]	-	
5. Stress Score (Continuous)	.006	-.02	.81[a]**	.02	-

*p<.05. **p<.01. [a]Corresponds to Spearman correlations. *IPAQ*= Physical Activity Questionnaire, MET minutes/week

Table 4. *Bivariate Pearson and Spearman Correlations using imputed data*

	1	2	3	4	5
1. ITE	-				
2. IPAQ	.236**	-			
3. Stress Group	.043[a]	.007[a]	-		
4. IWB	-.141	.148	.206[a]**	-	
5. Stress Score (Continuous)	-.016	-.02	.83[a]**	.05	-

Notes. Stress Score refers to the difference in stress after reading the vignette. *p<.05. **p<.01. [a]Corresponds to Spearman correlations. *IPAQ*= Physical Activity Questionnaire, MET minutes/week

4.2 Objective (i): Study Condition and Psychological Stress

To examine if a weight-based social identity threat induction contributed to a psychological stress response, a chi-square test of independence was performed to test the association between study condition and psychological stress group. The relation between these variables was significant, $X^2(1, N = 170) = 14.44$, $p < .001$. Notably, 0 cells had an expected count of less than 5. Effect size was calculated using Cramer's V = .29, $p < .001$. As hypothesized, more participants in the experimental condition had increased stress after reading the article than participants in the control condition. The effect size estimate indicated a medium sized effect of the weight-based induction and psychological stress.

4.3 Objectives (ii) and (iii): Study Condition and Exercise Outcomes

A MANOVA was conducted to test the effect of a weight-based social identity threat induction on ITE, and on exercise behaviours in the following week. Box's *M* test

was performed in the listwise data which suggested that the assumption of homogeneity of variance was not violated. The Box's M value of -0.51 was associated with a *p* value .920. The main effect for study condition was not statistically significant: Hotelling's Trace = 0.03, $F(2, 135) = 1.74$, $p = .18$, partial $\eta^2 = .25$. This indicates that there were no differences in scores on the dependent variables based on study condition. To verify these findings, two separate one-way ANOVAs were run to test the effect of condition on ITE and IPAQ scores. Due to listwise deletion of missing data, each ANOVA had a different sample size. There was a statistically significant difference between group ITE means between study condition (Experimental Group: $M = 3.59$, SD = 1.00; Control Group: $M = 3.91$, SD = 0.98), when including all participants (with and without follow-up data): $F(1, 136) = 4.208$, $p = .04$, partial $\eta^2 = .02$.

As a sensitivity analysis, the MANOVA was performed again using the MI data set. A pooled analysis was unavailable in SPSS, but none of the 20 individual analyses were significant. A one-way ANOVA was then performed to investigate the effect of condition on IPAQ scores. Since a single pooled analysis was unavailable, the 20 individual runs were inspected. Similar to the listwise dataset, there was no statistical significance between IPAQ means based on study condition in any of the runs. The ITE ANOVA was the same, as both included the full sample. The MANOVAs and ANOVAs were also performed with potentially suspicious participants removed and all patterns of significance remained consistent, therefore the full sample was retained.

For a final series of sensitivity analyses, a MANOVA was conducted testing the effect of stress group on ITE and IPAQ scores in the listwise data set. The Box's M value of 6.78 was associated with a *p* value .084. The main effect of stress group was not statistically significant: Hotelling's Trace = .01, $F(2, 135) = 0.64$, $p = .53$, partial $\eta^2 = .01$. A series of one-way ANOVAs were also performed to separately investigate the influence of stress reactivity group on ITE and IPAQ score, with neither showing statistical significance.

4.4 Objective (iv): Psychological Stress as a Mediator

Using the Preacher & Hayes (2004) method, a bias-corrected bootstrap mediation analysis was performed to test the continuous psychological stress reactivity score as a potential mediator in the relationship between condition and exercise outcomes (Figure 3). The *a* path (direct effect) from study condition onto psychological stress response was positive and statistically significant (*a* = 4.32, SE = 1.60, *p* = .008), indicating that participants in the experimental condition showed larger psychological stress reactivity to the article than participants in the control condition. The *b* path (direct effect) of psychological stress on ITE was non-significant (b = 0.00, SE = 0.01, *p* = .837). The *c*' path (direct effect) from study condition to ITE is significant (*c*' = -0.31, SE = 0.16, *p* = 0.04). The total effect size on ITE was nonsignificant (R^2 = 0.16, *p* = .12).

The indirect effect is tested using non-parametric bootstrapping. If the null of zero falls between the lower and upper bound of the 95% confidence interval, then the inference is that the population indirect effect is zero. If zero falls outside the confidence interval, then the indirect effect is inferred to be non-zero. In this case, the bootstrapped unstandardized indirect effect (ab = .01) is nonsignificant at 95%CI [-0.06, 0.08], indicating that psychological stress reactivity did not mediate this relationship.

Testing to see if psychological stress reactivity mediated the relationship between study condition and IPAQ score revealed non-significant results in the listwise data (*N* = 138). The path (direct effect) from study condition to stress was non-significant (*b* = 3.09, SE = 1.73, *p* = .076). The path from stress to IPAQ score was nonsignificant (*b* = -.65, *SE* = 8.88, *p* = .941). The direct effect of study condition on IPAQ score was also non-significant (*b* = -172.72, SE = 181.36, *p* = .34). The total effect on IPAQ score was not significant (R^2 = 0.08, *p* = .61). The indirect effect (ab = -2.02), is not statistically significant at 95%CI [-56.24, 40.00].

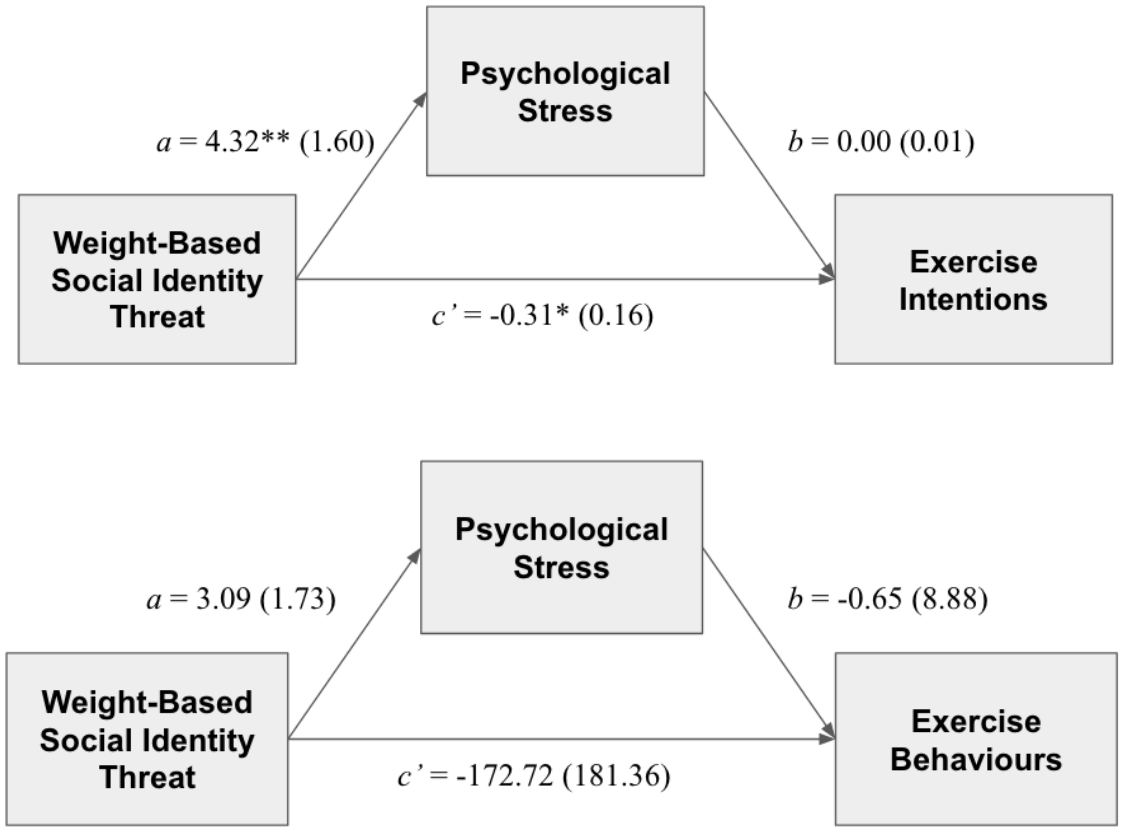

Figure 3: Tested mediation models: a, b, and c' are path coefficients with standard errors in parentheses. *p<0.05, **p<0.01

4.5 Exploratory Analyses: Testing IWB as a Moderator – Mediation model

In an exploratory analysis, IWB was examined as a moderator in a moderated mediation model testing perceived stress as a mediator in the relationship between study condition and exercise outcome. IWB was tested as a moderator of both the a-path and c-path in a single model for each outcome. The path models are listed below:

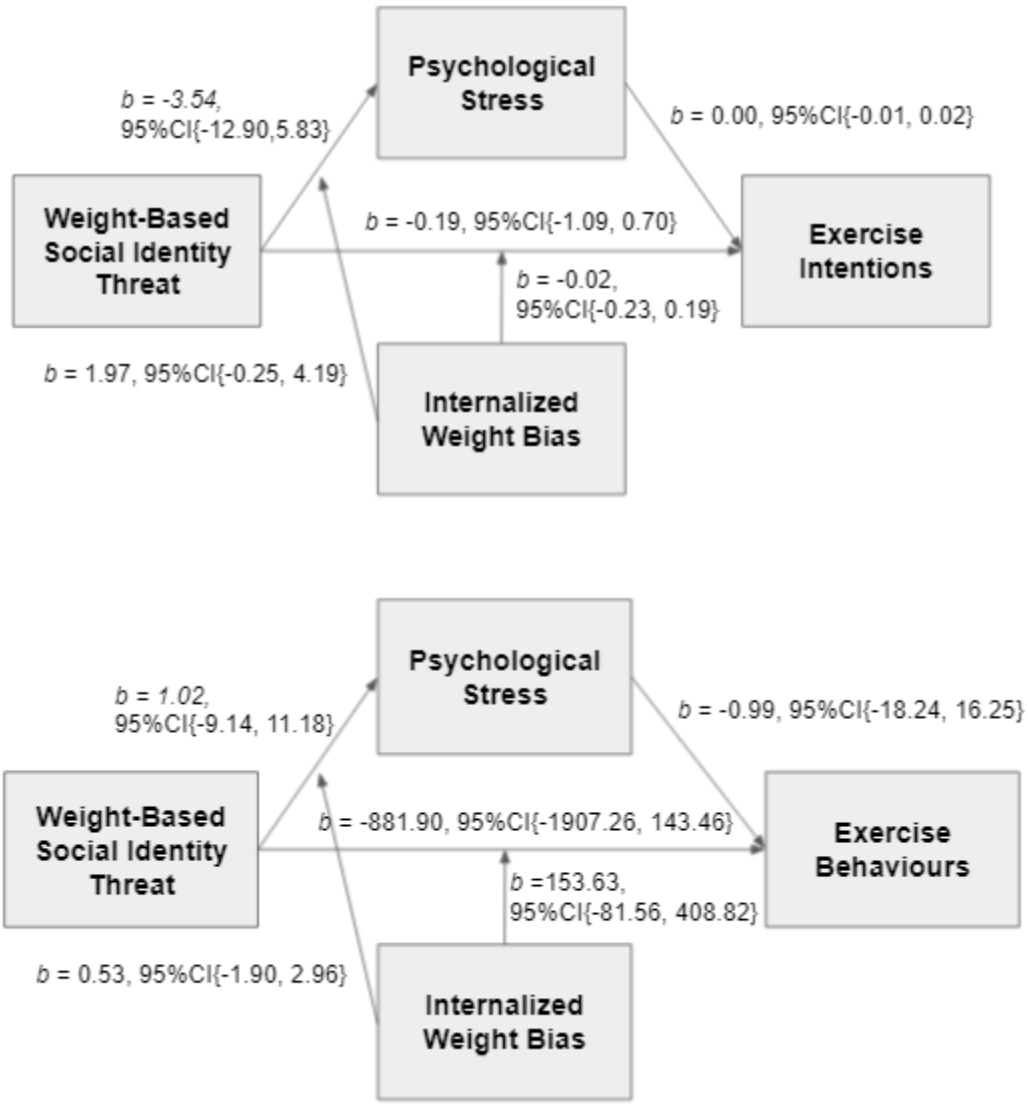

Figure 4: Tested moderated mediation models: standard errors in parentheses.

First, with ITE as the outcome variable, the total effect on ITE was: $R^2 = 0.04$, $p = .18$. The index of moderated mediation suggested that the 95% CI contained zero: [-.03, 0.50]. Therefore, there is no significant index of a moderated mediation model. Similar nonsignificant results were found with IPAQ score as the outcome variable: 95%CI [-21.00, 15.01]. The total effect of this model on IPAQ score was: $R^2 = 0.24$, $p = .09$.

Chapter 5

5 Discussion

The aim of this thesis was to explore the impact of a weight-related stigma induction on psychological stress, ITE and exercise behaviours. As hypothesized, more participants who were exposed to a weight stigmatizing prime showed an increase in psychological stress than participants who read the neutral article. Similar to previous research, participants endorsed lower ITE after the weight stigma induction than participants in the neutral article condition. However, there was no difference between groups in exercise behaviours in the following week. Neither of the relationships between study condition and exercise outcomes were mediated by the psychological stress response. The exploratory moderated mediation model examining IWB as a potential moderator was also nonsignificant. Overall, these findings suggest that exposure to weight stigmatizing content is psychologically stressful and may contribute to lower intentions to engage in exercise, but not to exercise behaviour in higher-weight adult women. These findings are important because higher-weight individuals experience pervasive weight bias, stigma, and discrimination in Western society, particularly women (Puhl & Suh, 2015), and weight is particularly stigmatized in the domain of exercise (Major et al., 2018). Given that weight stigma is often used as a tool for "health promotion" with the intention of increasing higher-weight individuals' motivation to exercise, the present study did not support this assertion. This research will contribute and extend the growing evidence that weight stigma has negative psychological consequences for higher-weight individuals (Hunger et al., 2015).

5.1 Weight Stigma Induction and Psychological Stress

Weight-based social identity threat is psychological state whereby individuals who perceive themselves to be higher weight are concerned they have or will experience discrimination, rejection or stereotyping associated with higher-weight individuals (Hunger et al., 2015). This state can be triggered by enacted experiences of weight-based discrimination, as well as situations where weight stigma is anticipated. A large body of research demonstrates that weight-based social identity threat is both physiologically and

psychologically stressful. The findings from this study indicate that a weight stigma induction has the potential to induce weight-based social identity threat in higher-weight women. Specifically, almost half of the participants showed increased stress after reading the stigmatizing article, compared to the control condition where a significantly larger number of participants had lower stress or no change in stress after reading the neutral article.

While the weight stigma induction is stressful, it is clear there is individual level variability that needs to be accounted for in these responses. There may be factors influencing individual participants' stress response to experiencing weight stigma and weight-based social identity threat. Previous research has suggested that higher-weight individuals cope with experiences of weight stigma with a wide variety of strategies (Puhl & Brownell, 2006). Coping strategies also vary in their effectiveness and associations with psychological functioning. For example, coping with weight stigma by obtaining social support has shown a positive association with self-esteem, and positive self-talks was related to lower levels of depression in cross-sectional research (Puhl & Brownell, 2006). Negative responses to weight stigma may be a maladaptive coping strategy that negatively impacts psychological functioning among women (Puhl & Brownell, 2006). For example, coping responses involving self-blame or disengagement have been associated with poor psychological functioning (Fettich & Chen, 2012; Myers & Rosen, 1999; Puhl & Brownell, 2006). Other factors may influence an individual's psychological stress response to weight stigma, such as lifetime experiences of stigma, which was not measured in this thesis. Higher-weight research participants who report more frequent exposures to weight stigma typically express greater psychological distress and endorse more coping strategies (Myers & Rosen, 1999; Puhl & Brownell, 2006). It has also been suggested that the duration of time that individuals identify as higher-weight may be a risk factor which increases their vulnerability to stigma (Puhl & Brownell, 2006). There may also be differences in coping with weight stigma across ethnic groups (Himmelstein et al., 2017).

However, it is important to note that around half of the participants in the experimental group showed no change or a decrease in stress from pre- to post- article.

This could be due to the exposure occurring in private, meaning that no other individuals were present who would categorize them as higher-weight. Inducing weight-based social identity threat in this study depends entirely on participants identifying with the social identity of higher-weight in private. Therefore, only participants who identified as higher-weight were recruited for this study. However, the strength of this social identity was not measured. For example, though participants all identified themselves as higher-weight it may be a more prominent social identity for certain participants. It is possible that participants with no change in their stress levels did not strongly identify as higher-weight. Indeed, over half of the participants identified their weight as "Slightly Heavy" rather than "Moderately Heavy" or "Very Heavy". It is likely that a sample with higher perceived weight would have more participants with psychological stress reactivity in response to the weight stigma induction.

Overall, the findings suggest that reading a stigmatizing vignette is sufficient to induce social identity threat and increase psychological stress in higher-weight women. Among middle-aged to older adult women, this is an important finding as they have likely encountered more overall experiences of weight stigma in their lifetime than younger adults (Puhl & Heuer, 2012; Thiel et al., 2020) – though this was not assessed and therefore speculative. Despite more encounters with weight stigma and more time to develop coping strategies (Himmelstein et al., 2020), women who identify as higher-weight in this age group still experience weight stigma as psychologically stressful. It is also important to consider that health concerns addressed in the vignette may be more salient and therefore stressful for middle aged to older adult women. As such, women in these age groups may experience health-related weight stigma, such as in the domain of exercise, as more stressful than younger adult women. Future research should consider how age acts as a protective factor or perhaps increases the vulnerability to the stress of weight stigma in health-related domains such as exercise.

Weight stigma has been linked with perceived stress (Hatzenbuehler et al., 2009), loneliness and psychological distress (Lewis et al., 2011), and may play an important role in the development of negative health outcomes, such as hypertension (Muennig, 2008). Lab-based manipulations have consistently shown that anticipating weight stigma (Major

et al., 2012; Blodorn et al., 2016) or experiencing weight stigma (Schvey et al., 2014; Himmelstein et al., 2015) increases psychological stress and cognitive depletion among higher-weight women. Taken together, these findings support the weight-based social identity threat model (Hunger et al., 2015). Experiencing weight-based social identity threat is psychologically stressful for higher-weight individuals. However, how the psychological stress response to weight stigma impacts self-regulatory behaviours was an aspect of the model not explored in this research. Hunger et al (2015) suggest that coping with the psychological stress of weight stigma reduces the cognitive resources necessary to engage in healthy behaviours, such as exercise. These results could be extended in future research by studying the relationship between weight stigma, psychological stress, and self-regulation. For example, laboratory research could involve asking participants to complete a measure of executive functioning such as the Stroop Test after reading either a stigmatizing or neutral vignette, as well as a measure of psychological stress. Researchers could then analyze if the effect of the weight-stigmatizing vignette on executive functioning occurs through the psychological stress response.

5.2 Weight Stigma Induction and Exercise Intentions

It is suggested that weight-based social identity threat may increase higher-weight individuals' motivations to avoid domains where they anticipate encountering weight stigma, such as exercise (Hunger et al., 2015). Intentions to engage in a behaviour are separate but related to motivations to avoid a behaviour. This thesis uses intentions to engage in exercise as a proxy for avoidance motivation, rather than a direct assessment of motivation to avoid exercise. The theory of planned behaviour (TPB; Ajzen, 1991) defines intentions as a measure of the motivational factors that influence a behaviour. According to the TPB, an individual's physical activity behaviours are highly influenced by that individual's intentions to be physically active. Physical activity intentions are in turn influenced by an individual's explicit attitudes, subjective norms, and perceptions of behavioural control of physical activity. These domains also directly affect physical activity behaviours, but in theory are more stable than intentions. It is well-known in research that there is an intention-behaviour gap, which particularly affects physical activity behaviours (Sheeran et al., 2002). Fluctuations in individual's ITE, caused by

daily life factors such as changing constraints, goals, and interests, may help to explain the intention-behaviour gap in physical activity. Weight stigma and weight-based social identity threat are daily life factors that could contribute to negatively impact a higher-weight individual's momentary ITE. Indeed, the results of this thesis suggest that experiencing a weight stigma induction lowers higher-weight participants' ITE, but has no impact on their subsequent exercise behaviour. These findings are supported by cross-sectional research which found that individuals who are exposed to weight stigma are more motivated to avoid exercise, particularly in public settings (Vartanian & Shaprow, 2008; Vartanian & Novak, 2011). Previous research suggests that the more frequent that participants report experiencing weight stigma, the greater their motivation to avoid exercise and exercise-related situations (Vartanian & Novak, 2011). The findings from this thesis are distinct as they focus specifically on ITE, rather than motivation to avoid exercise, among a sample of active women. The vignette focused on weight stigma in an exercise-related domain, which active women may have experienced more than inactive women due to their likely higher engagement in exercise domains. It is particularly impactful that active women have less ITE in response to weight stigma, especially weight stigma that occurs related to exercise. However, their usual exercise habits may limit the impact of fluctuations in exercise intentions on their actual exercise behaviours.

Similar patterns of effects on exercise intentions are also observed in participants' daily lives, with motivations to engage in exercise. Ecological momentary assessment research found that on days where participants reported experiencing more stigma than their average, they also reported lowered motivations to exercise at the end of that day (Vartanian et al., 2018). Taken together with the present findings, there is support for the theory that weight-based social identity threat increases higher-weight individuals' motivations to avoid stigma.

Contrary to the present findings, a recent study by Lambert et al (2019) asked participants to read a fictional news vignette describing either weight stigma or smoking stigma in the domain of employment. Participants (M_{age} = 41.0) who read the weight-related vignette did not differ from participants who read the smoking vignette in terms of intentions to avoid exercise or physical activity, after reading the article and at the one-

month follow-up. However, the measurement of intentions to avoid exercise posed methodological limitations. The 3-item measure included: “I feel uncomfortable going to a gym with lots of mirrors”, “I avoid going to the gym when I know there will be a lot of thin people there”, and “I’m too embarrassed to participate in physical activity in public spaces”. These items focus on a specific features in the environment (e.g., mirrors, thin people) and emotions (e.g., embarrassment) that are associated with exercise avoidance and consider only public spaces (e.g., gyms). Unlike the present experimental paradigm which focused on broad intentions to engage in exercise, the Lambert et al. (2019) study focused on characteristics that may be associated with avoidance motivation. Further, the Lambert et al. (2019) study vignette elicited stigma in the context of employment – which may not have been context-specific to elicit an effect of exercise intentions.

It is important to note that while the relationship between the stigmatizing article condition and ITE was significant in the present study, it was significant at a value close to the cutoff for significance ($p<.05$), and the difference between group means was only 0.4 on a scale scored from 1-7. An explanation may be due to the selection of active women who likely already engage in exercise. As such, variability in their exercise intentions may be limited, particularly in response to exercise-related weight stigma, which they may have already developed resilience against.

It is possible that weight-based social identity threat impacts exercise motivations rather than ITE. While related, ITE and motivation to exercise are distinct psychological predictors of exercise behavious. The weight-based social identity theory framework suggests that weight stigma and psychological stress impacts a higher-weight individual’s motivation to *avoid* stigma, in contexts such as exercise – however avoidance of exercise was not directly assessed in the present study. Within self-determination theory (SDT), motivation for a behaviour such as exercise has different types, including intrinsic motivation (i.e., I exercise for enjoyment), integrated regulation (i.e., I exercise because I identify as an exerciser) and identified regulation (i.e., I exercise because I value the benefits). An individual may also be amotivated and performing exercise without feeling any motivation (Ryan & Deci, 2000). More research will be needed to investigate if weight-based social identity threat primarily affects intentions or motivations to exercise,

and the extent to which each are related to exercise behaviour. Future research could include an instrument such as the Behavioural Regulation in Exercise Questionnaire-3 (BREQ-3) which was designed to measure behavioural regulation according to SDT in the domain of exercise (Mullan et al., 1997).

Investigating barriers to exercise and physical activity among middle aged to older adult women is particularly important. There are gender differences in terms of aging, whereby menopause can augment physiological declines associated with aging and physical activity (Karinkanta et al., 2009). A recent meta-analysis suggests that physically active middle-aged and older adults are more likely to age successfully in terms of disease, maintenance of physical and cognitive function, and active engagement with life (Lin et al., 2020). Among this age group, a dose-response relationship has been found between physical activity and a decrease in mortality risk (Gebel et al., 2015). Despite these benefits, a significantly larger portion of middle-aged to older adult men meet physical activity recommendations than women (Mynarski et al., 2014). The results of the present study suggest that experiencing weight stigma may decrease higher-weight women's exercise intentions in this age group and act as a barrier to participation in exercise.

5.3 Weight Stigma Induction and Exercise Behaviours

There was no statistically significant relationship observed between weight stigma and exercise behaviours in the following week. While it has been suggested that weight-based social identity threat reduces higher-weight individuals' exercise behaviours, the research has been conflicting. Recent cross-sectional and daily diary studies have found weight stigma to be unrelated to self-reported physical activity and exercise behaviours (Lee et al., 2020; Seacat et al., 2016). However, these studies were not conducted within a social identity threat framework. For example, Lee et al. (2020) recruited weight-diverse participants and controlled for BMI in their analyses, while Seacat et al (2016) recruited participants classified as obese based on BMI criteria. Weight stigma may be particularly impactful among individuals who perceive themselves as overweight, as it leads them to experience the psychological stress of weight-based social identity threat.

These results are do not consider perceptions of weight status, which are more relevant to social identity threat compared to BMI-assessed weight status (Hunger et al., 2015).

Contrasting with other research, a large population-based study found that individuals who perceive weight stigma are less physically active than individuals who do not report perceiving discrimination (Jackson & Steptoe, 2017). The sample from this research consisted of diverse-weight participants aged 50 years of age and older, and likely represents the true impact of weight stigma in this population. Unlike this thesis, Jackson and Steptoe (2017) did not exclude inactive participants, meaning their sample likely has more variability in their exercise behaviours. They also included measures of stigma in five daily life situations that were not exercise-related. By including measures of stigma in multiple domains, they may have captured the broader impacts of weight stigma than the domain-specific effects of exercise-related weight stigma.

Interestingly, experiences of weight stigma have also been associated with increased exercise behaviours in higher-weight individuals (Pearl et al., 2015). In accordance with Jackson & Steptoe (2017), it was found that participants who had experienced weight stigma were less likely to endorse that weight was controllable. Both studies also reported that weight bias internalization was associated with lower levels of physical activity. However, the mean age of their higher-weight sample was 35.48 years and these findings may be less relevant to middle aged and older adult populations. Age and perceived weight status could be key factors that influence the effects of weight stigma. More ecological momentary and experimental research is needed to provide insights in the relationship between experienced weight stigma, internalized weight stigma and exercise behaviours among higher-weight middle and older adult women.

There are several potential explanations for the present finding. First, it is possible that weight stigmatizing content impacts specific types of exercise engagement, such as private versus public exercise. In qualitative research, higher-weight individuals report engaging in strategies to avoid weight stigma, such as exercising at home, exercising individually, or scheduling exercise at specific times (Thedinga et al., 2021). Rather than reducing their overall participation in exercise, weight stigma may reduce higher-weight

individuals' participation in social and public exercise. Indeed, cross-sectional research demonstrates that research participants who have been exposed to weight stigma are more motivated to avoid exercising in public settings (Vartanian & Shaprow, 2008; Vartanian & Novak, 2011). As such, future research studying the relationship between weight stigma and exercise behaviours may need to separately consider individual and private exercise behaviours, and social and public exercise behaviours.

It is also possible that the present findings are due to the eligibility criteria that included only participants that were currently physically active. It is likely that if women are regularly participating in exercise, they may have had more opportunities to develop coping strategies or resilience to weight stigma in exercise domains, and their exercise behaviour may be less vulnerable to acute weight-based inductions. As such, activation of weight-based social identity threat may not impact their future exercise behaviours. Indeed, the average exercise score for the sample of women was 995.2 MET minutes/week, which amounts to approximately 42 minutes of moderate activity per day. As this sample is already "active", there is likely less variability in their physical activity behaviours than might be observed in a sample that consisted of both active and inactive participants. Given that individual's previous engagement in exercise predicts their future engagement in exercise (Van Stralen et al., 2008), the present sample may have been biased towards participants with established exercise habits.

Another explanation may be that the relationship between weight stigma and reduced exercise engagement follows a time course that was not captured in the design of this study. For example, it is possible that the 7-day follow-up period research participants experienced a lower than usual amount of weight stigma. Higher-weight individuals in Western society face prevalent indirect and direct weight stigma, in a variety of life domains across their lifespan (Puhl et al., 2008). These experiences may have a negative cumulative effect on exercise behaviour. Investigating the daily life influence of many experiences of weight stigma over a longer period, rather than a single acute experience, may reveal that weight stigma negatively impacts the exercise behaviours of higher-weight individuals. Relatedly, it is also possible that participants' lifetime experiences of weight stigma could influence their response to a weight stigma

induction. Higher experiences of weight stigma could give participants more experience developing coping strategies to mitigate its negative impacts. Encountering less experiences of weight stigma could also mean a lowered cumulative impact of stigmatizing experiences. Future research may need to control for participants' history of experienced weight stigma in analyses. Weight-based social identity threat may also influence self-regulatory processes more acutely, meaning that the research participants showed reduced exercise behaviours for a shorter time period than could be captured by the IPAQ. Participants may also have had difficulty recalling their exercise activities over the period of a week. An objective measure of physical activity would be better suited to reveal the impact of the weight-stigma induction on exercise behaviours.

5.4 Psychological Stress as a Mediator/Mechanisms

Based on social identity threat theory (Hunger et al., 2015), it has been proposed that weight stigma may undermine the cognitive and self-regulatory resources needed to engage in exercise. In the tested mediation model, there was a significant path was from study condition to psychological stress and participants reported lower ITE after reading the stigmatizing article than the neutral article. However, there was no significant path linking the psychological stress response and ITE. The psychological stress response also did not mediate the relationship between study condition and ITE. There were no significant paths in the mediation model with exercise behaviours as the outcome variable. The indirect effect of psychological stress was not significant, as well as the total effect of the model on exercise behaviours.

Overall, the results of this analysis do not support a major component of the weight-based social identity threat model (Hunger et al., 2015). Weight-based social identity threat may not impact motivation to avoid stigma and subsequent health behaviours through the psychological stress response. While previous research has found associations between higher levels of perceived stress and lower exercise engagement (Ng & Jeffrey, 2003; Mouchacca et al., 2013) and exercise intentions (Seacat & Mickelson., 2009), there may be more relevant mechanisms that need to be explored in future weight stigma research. The majority of weight stigma research has been conducted in younger adult women. As such, theoretical frameworks developed on

current research, such as the weight-based social identity threat model, may not be relevant to older populations who have more time to develop coping strategies that limit the impact of stress on their motivations, intentions, and behaviours. Moreover, these outcomes are likely more stable in middle aged to older adult populations. It was also found in this thesis that there was no relationship between weight-based social identity threat and exercise behaviours. It is not surprising that adding psychological stress as a mediator to this relationship did not affect the significance and the total effect of the model was also not significant.

There are also methodological features of the present study that may have impacted these findings. For example, there was variability of participants' stress responses in the stigmatizing condition, whereby participants displayed no change in stress, increased stress and decreased stress in response to the weight-related article. Most participants in both conditions showed no change in stress after reading the article. The continuous psychological stress variable used to test mediation therefore contained a large number of outliers. A more intense weight stigma inducted may have resulted entirely in increased stress and been better suited to study psychological stress as a mediator. As previously discussed, there were significant limitations in recruiting an entirely active population, which may have less variability to measure in their exercise behaviours, as well as using a self-report measure of exercise such as the IPAQ. Another issue includes the inability to perform sensitivity analyses with the MI data set using the statistical software. This was an issue impacting the model with exercise behaviours, as there was a large portion of missing data due to participant dropout from the main survey to the 1-week follow-up.

There may be other mediators, rather than psychological stress, which influence the impact of weight stigma on higher-weight individuals' exercise intentions and outcomes. Meadows & Bombak (2019) proposed that experiences of weight stigma and societal anti-fat attitudes both directly and indirectly impair the development of exercise self-efficacy and active identities for higher-weight individuals. Perceived self-efficacy is an individual's belief that they can accomplish an outcome or behaviour of interest, such as exercise, and influences factors such as what behaviours an individual engages in, and

the effort invested in these behaviours (Bandura, 1997). Exercise self-efficacy robustly predicts both adoption and maintenance of physical activity (McAuley & Blissmer, 2000). Meadows & Bombak (2019) suggest that experiences of weight stigma in exercise and physical activity concepts teach higher-weight individuals from a young age that their body excludes them from enjoyable and rewarding engagement in exercise. As such, higher-weight individuals display reduced exercise self-efficacy and engage less frequently in exercise (Rice, 2007). There is also a lack of positive representation of higher-weight exercisers in the media, which reinforces an idea that higher-weight bodies are less suited to exercise than slim bodies (Tiggemann & Zaccardo, 2015). This lack of representation increases the salience of higher-weight bodies in an exercise or fitness context (Dunlop & Schmader, 2014), and serves to impede the development of active identities and exercise self-efficacy among higher-weight individuals. Future research should consider other potential mediators underlying the relationship between weight stigma and exercise outcomes, such as exercise self-efficacy.

5.5 Weight Stigma Induction and Internalized Weight Bias

IWB has been found to moderate the impact of a stigmatizing article on higher-weight participants' calorie intake compared to higher-weight participants exposed to a neutral prime (Meadows & Higgs, 2019). Since it has also been proposed that IWB may moderate the relationship between weight-based social identity threat and health (Major et al., 2018), exploratory analyses were conducted to investigate IWB as a moderator in a moderated mediation model with psychological stress as a mediator in the relationships between study condition and exercise outcomes. However, IWB did not moderate the relationship between weight-based social identity threat condition and exercise intention or exercise behaviours. The total effects of both models were also not significant. Interestingly, there were no significant paths in either model, including the relationship between weight-based social identity threat and psychological stress. Researchers have also suggested other moderators that may impact the perception of weight stigma and its influence on health, such as age of onset of stigma and ethnicity, which were not explored in this research.

As the recruited sample was entirely active, it is likely that their exercise intentions and behaviours are more stable and less vulnerable to daily fluctuations than the general population, regardless of internalized weight stigma. They also may have more opportunities to develop coping responses to experiencing weight stigma in exercise domains that limit its influence on exercise outcomes. In fact, in the tested dataset, exercise behaviours and IWB were significantly and positively correlated. This is in contrast with previous research that suggests weight bias internalization is negatively associated with exercise self-efficacy and exercise behaviours (Pearl et al., 2014), as well as motivation to avoid exercise (Carels et al., 2019) among higher-weight participants. In this sample, participants with more self-stigma engaged in more exercise, which likely prevents a moderated effect on either exercise outcome. It is also possible that participants with high self-stigma are engaging in exercise for weight management purposes, which may be a response to pervasive weight stigma. A single experience of weight stigma may not be sufficient to contribute to this pattern. However, a key limitation of this research was that the control group did have significantly lower IWB than the experimental group, which limits any conclusions that can be drawn from this analysis.

5.6 Limitations

The present research has several limitations worth considering. Using an online recruitment software, such as Prolific, is associated with inherent limitations. Recruitment for the study was completed on a first-come, first-serve basis. Therefore, the sample may have been biased towards rapid responders who were online at the time of recruitment. Each round of pre-screening was launched at a different time to try and recruit a more diverse sample, however there may be some remaining bias. Potential research participants can also choose which surveys they wish to complete – viewing study descriptions, hourly reward rates and average completion time. Participants who selected this study may differ systematically from a wider population: they may be specifically interested in the advertised study topic or were attracted by the completion reward. Individuals who use paid recruitment tools may do so primarily to make money, and thus do not consider the quality of their responses. There were attention checks

developed to combat this phenomenon, but some low-quality data may remain in the sample. For example, participants may have retained enough information from the vignette to complete a basic summary but did not meaningfully think about and engage with the topic. Now that these associations have been initially established with an online recruitment tool, future research should take steps to recruit community-based populations who reflect the diversity of middle aged and older adult women and who do not complete research studies primarily for the rewards.

Related to characteristics of the Prolific platform, most participants were born and resided in the United Kingdom and Prolific's research pool is also biased towards a more highly educated population. Relatedly, many of the demographic measures of the sample were limited to the demographics collected by Prolific. As such, a large limitation of this work is that it includes no measurement of race or ethnicity. Country of birth may be used as a proxy but does not capture the same information. Research suggests that body size ideals and weight stigmatization differ between ethnic groups (Gluck & Geliebter, 2002; Hebl et al., 2009). Notably for social identity threat research, Black and Hispanic individuals are less likely to perceive themselves as higher-weight than members of other ethnic groups (Paeratakul et al., 2002). Thus, it is necessary to explore how weight-based social identity threat may be more or less influential for women belonging to different ethnic groups. Additionally, broad criteria was used to determine higher-weight perceptions, and most of the sample identified as 'Slightly Heavy', rather than 'Moderately Heavy' or 'Very Heavy'. This diversity in higher-weight perceptions could have reduced the impact of weight-based social identity threat, which is more salient at higher levels of weight perception. Future research studying the effects of weight-based social identity threat may benefit by focusing on a sample that more strongly identifies as higher-weight.

Potential limitations associated with the written vignettes also need to be considered. While only participants who had never smoked or vaped were recruited, vaping is still a behaviour known to be highly relevant to health, regardless of personal relevance. There may have been some effects driven by control group participants' own health concerns becoming salient in response to the neutral/vaping article. Such an effect

may have influenced control participants' psychological stress, ITE, or exercise behaviours. Future research could explore the influence of stigmatizing vignettes in a variety of domains. It may also be useful to include a third vignette that is completely unrelated to health.

Methodological features of the study design may inadvertently pose as a study limitation. Since participants in this study were physically active at recruitment, and the sample consisted of active women, it may have impacted the variability observed in the main study outcomes (e.g., future exercise intentions and behaviours). This eligibility criteria was chosen so that study participants would have a baseline level of physical activity that could be impacted by the weight stigma induction. However, this criteria limits the conclusions that can be drawn from this research, as participants could have stronger exercise habits or coping strategies that limit the impact of weight stigma on their exercise intentions and behaviours. Another limiting feature of this research is that only psychological stress was measured before and after reading the article – ITE and exercise behaviour was only measured after the article. It is possible that, for example, participants in the control group had lower baseline ITE. Future research should include these measurements before and after the manipulation in order to draw stronger conclusions about its impact.

5.7 Theoretical Implications

This research has important theoretical implications. Firstly, these findings support central aspects of the weight-based social identity threat model (Hunger et al., 2015). Individuals who perceive themselves as higher-weight are aware of the pervasive negative stereotypes associated with higher-weight individuals and are therefore vulnerable to weight-based social identity threat. Experiencing weight stigma, such as reading a stigmatizing article, can trigger weight-based social identity threat. This psychological state is stressful and increases negative emotions (Hunger et al., 2015; Major et al., 2018). The results of the current research also support that weight-based social identity threat reduces exercise intentions. In response to weight stigma, higher-weight individuals may display increased intentions to avoid health behaviour domains where weight is highly stigmatized, such as exercise and fitness (Major et al., 2018). To

our knowledge this is the first study to explicitly test the weight-based social identity threat model using exercise outcomes.

The weight-based social identity threat model (Hunger et al., 2015) suggests that weight stigma negatively impacts health outcomes through its effects on higher-weight individuals' exercise behaviours. However, the findings of this research suggest that a stressful experience of weight stigma does not impact exercise behaviour 1-week later. More research is needed to understand if and how acute experiences of weight stigma influence exercise behaviours.

Weight-based social identity threat theory also extends to other health-related behaviours, such as attending healthcare appointments (Hunger et al., 2015). The mechanisms studied in the present research, the psychological stress response, are also proposed to reduce engagement in healthcare behaviours. There are other mediators suggested in this theory that were not explored in this thesis, such as self-regulatory capacity and motivation to escape stigma, that may also impact health behaviours. As these mechanisms are established for exercise behaviours, future research should start to target the effects of weight stigma on other health behaviours.

5.8 Methodological Implications

Surveys incorporating experimental vignettes are popular research tools. One advantage of using an experimental vignette is the associated flexibility – they can easily be used in different formats to explore a variety of topics. Meadows & Higgs (2019) first explored the use of an experimental vignette within a weight-based social identity threat framework in a lab environment. They found that higher-weight participants with high levels of IWB consumed less calories after reading a stigmatizing vignette, compared to a neutral vignette, whereas participants with low internalized stigma consumed more calories in the stigmatizing condition. The present study adds to this research by extending the use of an experimental vignette to online research and with self-reported health behaviour outcomes. Overall, from these two experimental procedures, it is clear that a vignette is both capable of and sufficient to induce weight-based social identity threat in higher-weight participants both in-person and in private.

Participants in the neutral condition for Meadows and Higgs (2019) read about the detrimental effects of smoking. As such, only participants who had never smoked were recruited to their study. However, smoking is known to be strongly related to health, and may lead to health-related stress becoming salient in the control condition. Vaping was chosen to be the neutral article topic in the current thesis, as its longitudinal effects on health are less well-known. Vaping may also be less relevant to middle-aged and older adult women, which is more prevalent among younger adults (Iftekhar Uddin et al., 2020)

Another key finding of the current research is that reading a short vignette is capable of inducing a psychological stress response. Future stigma studies using a psychological stress induction may be able to use a vignette in their research design. However, while this vignette did result in mean differences between the control and experimental groups, it did not consistently produce the same results across the groups. Researchers using experimental vignettes will need to consider how to reliably induce a stigmatizing response in all participants. The vignette in the current study was designed to be a fictional news article, and therefore was hypothetical and not personalized. Future research may need to explore methodologies such as asking participants to recall a negative stigma experience with stigma to induce the stress response or simulating a direct experience of stigma.

5.9 Practical Implications

Weight stigma is often used as a fear and shame-based motivational tool to inspire weight loss and health behaviours in exercise-related domains, such as gyms and fitness centre classes (Thiel et al., 2020; Pickett & Cunningham, 2017). A growing area of research now suggests that the opposite effect may be occurring: weight stigmatizing content is associated with negative motivational and behavioural consequences. Weight stigma may induce weight-based social identity threat which decreases intentions to engage in healthy behaviours such as exercise. A key factor which underlies the social acceptability of weight stigma, is the widespread belief that weight is controllable and that higher-weight individuals are not exerting enough effort to reduce their weight (Crandall, 1994; Blaine & Williams, 2004; Silkorski et al., 2012; Tanneberger & Ciupitu-Plath, 2017). Higher-weight individuals who are viewed as attempting to lose weight are

stereotyped less negatively and evoke less disgust than higher-weight individuals who are viewed as not attempting to lose weight (Black et al., 2014). This personal responsibility for weight justifies the shaming and ridiculing of higher-weight individuals, and underlies many weight loss programs and media campaigns (Major et al., 2018). However, this research suggests that outside influences including weight stigma may cause higher-weight individuals to disengage from healthy behaviours such as exercise. Health policy should begin to tackle the institutional factors in exercise and fitness contexts that exclude higher-weight exercisers from participation, such as stigmatizing gym advertisements, language in fitness classes, and purposeful exclusion by fitness instructors (Meadows & Bombak, 2019; Pickett & Cunningham, 2017).

Higher-weight individuals face weight stigma in exercise and physical activity contexts across their lifetime. Qualitative research reveals that higher-weight adolescents in physical education (PE) classes face frequent weight-related teasing and bullying, being mocked for their perceived lack of ability, and being laughed at if they are injured, with teachers often overtly or directly supporting these stigmatizing behaviours (Li & Rukavina, 2012; Trout & Graber, 2009). Experiencing weight stigma in PE classes is associated with lowered perceived physical activity in higher-weight adolescents, who then report greater fear of being further stigmatized and reduced engagement in physical activity outside of PE classes (Maïano et al., 2018). Results from the current study suggest that these experiences are psychologically stressful and may reduce intentions to engage in exercise. PE teachers themselves often endorse negative stereotypes about higher-weight students, expecting them to be less fit and healthy than lower-weight students (Greenleaf & Weiller, 2005), particularly for female students (Puhl et al., 2012). These stigmatizing experiences continue into adulthood. Fitness center professionals often hold negative implicit and anti-fat attitudes, even when they believe themselves to be unbiased (Dimmock et al., 2009), and other gym members also exhibit high levels of anti-fat attitudes (Flint & Reale, 2015). Higher-weight exercisers report experiencing bullying and verbal abuse in exercise domains (Bombak 2015).

Middle aged and older adult women who identify as higher-weight therefore have likely experienced or witnessed weight stigma in fitness contexts throughout their

lifetimes. Promoting engagement in exercise among this group may be accomplished by addressing the stigmatizing environments of gyms and fitness centers. It is particularly important to address barriers to exercise among middle aged and older adult women, as the benefits of exercise may help reduce the negative health consequences associated with menopause.

5.10 Conclusion

Weight stigma is highly prevalent in Western society. However, its causal effects and mechanistic influence on exercise intentions and behaviours has not been well established in research. This study highlights the negative influence of weight-based social identity threat on psychological stress and ITE among higher-weight women. Women are particularly vulnerable to the effects of weight stigma as they report more experiences in a variety of life domains than men (Puhl et al., 2008). The influence of weight-based social identity threat is especially important to study in middle aged and older adult women, who are more likely to identify as higher-weight due to menopause and age-related changes in body composition (Douchu et al., 2002). Contrary to the hypotheses, the findings demonstrated no significant effect of weight-based social identity threat on exercise behaviours in the following week, and psychological stress did not mediate any relationship. It is often theorized that weight stigma has use as a tool for health-promotion by way of increasing higher-weight individuals' motivation to exercise, however there is no empirical evidence to support this strategy (Major et al., 2018). This experimental study contributes to and extends the growing evidence that weight stigma has negative psychological consequences that are known to contribute to health behaviour disengagement (Hunger et al., 2015).

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Appendices

Appendix A: Study Approval from Western Health Science Research Ethics Board

Western Research

Date: 9 February 2021

To: Dr Eva Pila

Project ID: 118171

Study Title: Lifestyle, Stress and Health Behaviours

Application Type: HSREB Initial Application

Review Type: Delegated

Full Board Reporting Date: 23/Feb/2021

Date Approval Issued: 09/Feb/2021

REB Approval Expiry Date: 09/Feb/2022

Dear Dr Eva Pila

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above mentioned study as described in the WREM application form, as of the HSREB Initial Approval Date noted above. This research study is to be conducted by the investigator noted above. All other required institutional approvals must also be obtained prior to the conduct of the study.

Documents Approved:

Document Name	Document Type	Document Date
Pre-Screen Questionnaires	Online Survey	Received February 5, 2020
Experiment Questionnaire - Exercise	Online Survey	Received February 5, 2020
Follow up questionnaire - exercise	Online Survey	Received February 5, 2020
Exercise & weight stigma protocol	Protocol	01/Feb/2021
Prolific Advertising Content	Recruitment Materials	01/Feb/2021
LOI Pre-Screen 2	Written Consent/Assent	01/Feb/2021
Exercise - LOI Experimental Exposure	Written Consent/Assent	01/Feb/2021
Exercise debrief letter 3	End of Study Letter	05/Feb/2021

No deviations from, or changes to, the protocol or WREM application should be initiated without prior written approval of an appropriate amendment from Western HSREB , except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Karen Gopaul , Ethics Officer on behalf of Dr. Joseph Gilbert, HSREB Vice-Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Appendix B: Pre-Registration on As Predicted

As Predicted: *"Weight Stigma, Psychological Stress and Health Behaviour Outcomes"* (#59624)

Created: 03/01/2021 07:41 AM (PT)

Author(s)
Isabella Randall (University of Western Ontario) - [redacted]
Eva Pila (University of Western Ontario) - [redacted]

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
The present studies seek to explore the impact of a weight-related stigma induction on psychological stress, intentions to exercise and exercise behaviours. We are separately measuring intentions to exercise and self-report exercise behaviours
i. Does a weight-based social identity threat induction contribute to psychological stress? It is expected that women in the weight-based social identity threat condition will show higher psychological stress reactivity compared to women in the control condition.
ii. Does a weight-based social identity threat induction contribute to lower intentions to engage in exercise? It is expected that women in the weight-based social identity threat condition will have lower intentions to engage in future exercise compared to women in the control condition.
iii. Does a weight-based social identity threat induction contribute to self-reported exercise behaviours in the following week? It is expected that women in the weight-based social identity threat condition will have lower self-reported engagement in exercise in the following week compared to women in the control condition.
iv. Is the association between weight-based social identity threat and exercise outcomes mediated by psychological stress reactivity? It is expected that weight-based social identity threat will be associated with lower intentions to engage in future exercise, and lower self-report exercise behaviours via the psychological stress response.

3) Describe the key dependent variable(s) specifying how they will be measured.
• Intention to exercise: Theory of Planned Behaviour (TPB) measure of intention to engage in exercise (Armitage, 2005) "How often do you intend to take part in regular physical activity?" (7-point scale: never to frequently), "I want to exercise regularly" (7-point scale: Definitely do to definitely don't).
• Perceived stress levels: assessed using the visual analogue scale (VAS; 0-100%). Scales will range from 0 to 100. Participants will be asked to drag a marker to indicate their current stress (0 = lowest rating of perceived stress, 100 = highest measure of perceived stress)
• Exercise behaviours: International Physical Activity Questionnaire (IPAQ) long version – leisure time physical activity domain. The IPAQ is a self-report questionnaire where participants provide information on the duration (minutes) and frequency (days) of moderate and vigorous physical activity in the last 7 days in specific domains. We will be using the leisure time physical activity domain sub score (in MET minutes/week)

4) How many and which conditions will participants be assigned to?
Participants will be randomly assigned to one of two conditions: experimental (i.e., reading a weight stigmatizing article) and control (i.e., reading a neutral article). 95 participants will be in each group.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
This is a randomized experimental study designed to examine how a weight-stigmatizing prime influences subsequent intentions to exercise and exercise behaviours. Analyses will be conducted in SPSS and Jamovi. After testing assumptions of normality, linearity, and homoscedasticity, data will be examined for missing values, and listwise deletion will be used for cases where >5% of values are missing. Descriptive statistics and Pearson's and Spearman's correlations will be calculated for all study variables.

Objective (i) will be tested using independent samples t-tests to assess the effects of weight-based social identity threat on psychological stress. Objectives (ii, iii) will be tested using Hotelling's T2 to determine the effects of weight-based social identity threat on exercise intention and behaviour. Objective (iv) will use bias-corrected bootstrap mediation models to test the indirect effect of psychological stress in the association between weight stigma condition and exercise outcomes

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
After reading the article participants will indicate if they found the vignettes easy to understand, interesting, and relevant to themselves. They will be asked to briefly summarize the article. These questions will ensure participants processed and recalled the details of the vignette, and will act as an attention check. Participants will be excluded from analyses if they fail this attention check, meaning they are unable to summarize the vignette. We will develop a coding system to verify their processing/recollection of the article

At the end of the follow-up survey, participants will be asked whether they thought the newspaper article influenced their exercise behaviours or intentions. They will also be asked what they believe to be the purpose of the study and to describe how they felt while participating in the study. We will develop a coding system to mark participants as "suspicious" to the deception or "non-suspicious". The research team will remove data labelled as "suspicious"

As recommended by Prolific, we will reject any participants who complete any survey "exceptionally fast" (who are three standard deviations below the mean). For the IPAQ, data will be excluded that is unreasonably high. Any walking, moderate, and vigorous time variables that are equal to or greater than 16 hours will be excluded. Any 'day' variables that are greater than 9 will be excluded (IPAQ, 2005).

7) How many observations will be collected or what will determine sample size?
No need to justify decision, but be precise about exactly how the number will be determined.
We propose to recruit n = 190 cisgender women (95 in each group) who perceive themselves to be "heavier-weight". Power analysis for a Hotellings T2 with two group mean vectors was conducted in G*Power to determine a sufficient sample size using an alpha of 0.05, and a medium effect size (Faul et al., 2013). The minimum sample size indicated by the power analysis was 158 (n = 79 per condition), and we will be recruiting 190 to account for anticipated dropout. We increased this sample size based on a dropout rate of 20%. This sample size estimate also aligns with recommendations needed for 0.8 power using bias-corrected bootstrap mediation models with small-to-medium a and b paths (Fritz & MacKinnon, 2007).

8) Anything else you would like to pre-register?
(e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

Appendix C: Online Prolific Recruitment Advertisement

LIFESTYLE, STRESS AND HEALTH BEHAVIOURS

Prolific Advertising Content

Title: Pre-Screening Survey for Study: Lifestyle, Stress and Health Behaviours

Description: This women's study consists of 3 online surveys. The first will be a 5-minute pre-screening survey to assess your eligibility for the study. If you are eligible, you will be invited to complete the second online survey which should take approximately 20 minutes, and a third follow-up survey, which should take approximately 20 minutes.

You will be compensated for completing the pre-screen regardless of whether you are eligible or not.

Pre-Screening Survey for Study: Lifestyle, Stress and Health Behaviours

Hosted by *Isabella Randall*

£0.63 • 5 minutes • £7.56/hr • 158 places remaining

This women's study in the psychological basis of kinesiology consists of 3 online surveys. The first will be a 5-minute pre-screening survey to assess your eligibility for the study. If you are eligible, you will be invited to complete the second online survey which should take approximately 20 minutes, and a third follow-up survey, which should take approximately 20 minutes.

You will be compensated for completing the pre-screen regardless of whether you are eligible or not.

Open study link in a new window

Version Date: 2/1/2021

Title: Lifestyle, Stress and Health Behaviours
Description: You are being invited to participate in this study because you completed the pre-screening survey and have met the eligibility requirements.

If you choose to participate in this study, you will read a health-related article and answer questions about your lifestyle within an online survey. The survey should take approximately 20 minutes. You will be contacted in one-week for a follow-up survey that should also take approximately 20 minutes.

You will be compensated for your time through Prolific.

Lifestyle, Stress and Health Behaviours

Hosted by *Isabella Randall*

£2.50 • 20 minutes • £7.50/hr • 79 places remaining

You are being invited to participate in this study because you completed the pre-screening survey and have met the eligibility requirements.

If you choose to participate in this study, you will read a health-related article and answer questions about your lifestyle within an online survey. The survey should take approximately 20 minutes. You will be contacted in one-week for a follow-up survey that should also take approximately 20 minutes.

You will be compensated for your time through Prolific.

Open study link in a new window

Version Date: 2/1/2021

Title: Follow-Up: Lifestyle, Stress and Health Behaviours

Description: You are being invited to participate in this study because you completed the main experiment survey where you read a health-related article.

If you choose to participate in this study, you will answer questions about your lifestyle within an online survey. The survey should take approximately 20 minutes.

You will be compensated for your time through Prolific.

Follow-Up: Lifestyle, Stress and Health Behaviours

Hosted by *Isabella Randall*

£2.50 • 20 minutes • £7.50/hr • 158 places remaining

You are being invited to participate in this study because you completed the main experiment survey where you read a health-related article.

If you choose to participate in this study, you will answer questions about your lifestyle within an online survey. The survey should take approximately 20 minutes.

You will be compensated for your time through Prolific.

Open study link in a new window

Version Date: 2/1/2021

Appendix D: Letter of Informed Consent (Pre-Screen)

Letter of Information and Consent

Project Title: Pre-Screening Survey for Study: Lifestyle, Stress and Health Behaviours

Principal Investigator: Dr. Eva Pila

Research Coordinator: Isabella Randall, MA Student

Address: [redacted]

Telephone Number: [redacted]

Email: [redacted]

1. Invitation to Participate

We invite you to take part in the pre-screening process for an online research study because you have met the initial eligibility requirements. The requirements are that you are a Prolific user, you are a cisgender woman who identifies as female, you currently reside in Canada, the United Kingdom or United States, and you are between the ages of 50 and 69 years old.

2. Why is this study being done?

The purpose of this voluntary pre-screening survey is to identify potential participants for a research study that will examine stress and common health behaviours.

3. How long will you be in this study?

This pre-screening survey will take approximately 5 minutes.

4. What are the study procedures?

This study is a Master's student project conducted under the direction of Dr. Eva Pila. The study procedures will be executed by the student investigator, Isabella Randall. We are asking your permission to participate in a pre-screening survey for a study about psychological stress and health behaviours. This survey will assess whether you meet the eligibility requirements to participate in the second part of the study.

Through an online survey, you will provide your Prolific ID. You will be asked questions about your age, gender identity, country of residence, weight and lifestyle factors that could affect your health behaviours. The survey should take no longer than 5 minutes.

If you meet the eligibility requirements, you will be invited to participate in the second part of this study through Prolific. You have no obligation to participate in this secondary study.

If you meet the eligibility requirements and choose to complete the second part of the study, we will use your data from both surveys for research purposes.

5. What is the inclusion criteria?

Participants will need to be a cisgender woman who identifies as female, be between 50-69 years old, reside in Canada, United Kingdom, or the United States, can fluently read, write, and understand English, and agree to participate in the study.

6. What are the risks and harms of participating in this study?

There are no known risks and harms of participating in this pre-screening survey.

Participants are free to discontinue participation in the study by simply closing the survey at any time and for any reason.

7. What are the benefits of participating in this study?

There are no direct benefits for participation in this study.

8. Can participants choose to leave the study?

Yes. Participation in this research is completely voluntary. You can decide to participate or not participate at any point throughout the study. You may discontinue participation at any time by simply closing the survey. If you would like your data to be withdrawn from the study before it is approved by the researcher, you may "return" the study through Prolific:

1. Before the study begins by selecting "cancel reservation."
2. During the study by selecting "stop without completing."
3. After the study has been completed and before it has been reviewed by the researcher by selecting "return and cancel reward."

You may learn more about how to return your study through Prolific by clicking this link: https://participant-help.prolific.co/hc/en-gb/articles/360022342094-How-do-I-withdraw-my-participation-in-a-study

If you would like to withdraw your data after your submission has been approved by the researcher on Prolific, you may contact the researchers to request this withdrawal by sending the researchers a message on Prolific. You should provide your Prolific ID so researchers can identify your data and discard it. If you would like to withdraw your data after your submission is approved, you will keep the compensation you have already been awarded through Prolific and your data will be discarded. If the study has already been submitted for publication, we will not be able to remove your data.

9. How will participants' information be kept confidential?

Because this study is being conducted through Prolific, researchers will not have access to and are unable to request any identifying information of participants. Participant data will be collected under a unique alphanumeric code called a Prolific ID that does not indicate any participant identifying information. If you wish to send a message to the research team to ask questions or request that your data be removed, submit a message through Prolific and provide your Prolific ID. Prolific offers an anonymized messaging service so researchers and participants may contact each other without revealing any personal information.

The confidentiality of the data that is collected will be protected. Only the investigators will have access to the data collected during the study, which will be stored securely on password-protected devices and documents. The data that is collected by researchers will not be able to be linked to any participant identities. The researchers do not intend to make the research data available on an open platform (the data will not be made publicly available or provided in open access format) or on request. Delegated institutional representatives of Western University and its Health Sciences Research Ethics Board may require access to your study-related records to monitor the conduct of the research in accordance with regulatory requirements. Research data will be stored for 7 years per UWO policy. Electronic data will be then permanently purged according to institutional guidelines at the time of data destruction.

Your survey responses will be collected through a secure online survey platform called Qualtrics. Qualtrics uses encryption technology and restricted access authorizations to protect all data collected. In addition, Western's Qualtrics server is in Ireland, where privacy standards are maintained under the European Union safe harbour framework. The data will then be exported from Qualtrics and securely stored on Western University's server

All data presented to the public will be presented in aggregated format. This means that the data collected from any single participant will not be included in any public presentations or published works.

10. Are participants compensated to be in this study?

Participants will be compensated the equivalent of $1.09 CAD through Prolific for their participation in this study.

11. What are the rights of participants?

Taking part in this research study is voluntary:

- You do not have to be in this research.
- If you choose to be in this research, you have the right to stop at any time.
- If you decide not to be in this research or if you decide to stop later, there will be no penalty and you can still receive partial or full compensation.

You do not waive any legal rights by consenting to this study. Withdrawing from this study will not have any impact on your Prolific score or ability to participate in future studies. If you wish to withdraw your data, please contact the researchers by sending an anonymous message through Prolific.

12. Whom do participants contact for questions?

Please contact the researchers by sending a message through Prolific with your Prolific ID if you:

- Have questions about the research
- Believe you may have been harmed by being in the research study
- Would like to withdraw from the study

You may also contact the Office of Research Ethics at Western University at (519)-661-3036, 1-844-720-9816 or ethics@uwo.ca if you:

- Have questions regarding your rights as a person in a research study.
- Have concerns, complaints, or general questions about the research.

This letter is yours to keep for future reference.

Submitting the survey is indication of your consent to participate.

- o I agree to participate.
- o I do not agree to participate. I will exit the survey now.

Appendix E: Letter of Informed Consent (Main Survey)

Letter of Information and Consent

Project Title: Study: Lifestyle, Stress and Health Behaviours

Principal Investigator: Dr. Eva Pila

Research Coordinator: Isabella Randall, MA Student

Address: [redacted]

Telephone Number: [redacted]

Email: [redacted]

1. Invitation to Participate

We invite you to take part in an online research study because you have completed the pre-screening survey for this study and have met the study eligibility requirements. The requirements are that you are a Prolific user, you are a cisgender woman who identifies as female, you currently reside in Canada, the United States, or the United Kingdom, and you are between the ages of 50 and 69 years old.

2. Why is this study being done?

The purpose of this voluntary pre-screening survey is to examine psychological stress and personal lifestyle, and their relationships with common health behaviours.

3. How long will you be in this study?

This survey will take approximately 20 minutes. You will be contacted in a week to participate in a follow-up survey that will also take approximately 20 minutes.

4. What are the study procedures?

This study is a Master's student project conducted under the direction of Dr. Eva Pila. The study procedures will be executed by the student investigator, Isabella Randall. We are asking your permission to participate in a study about psychological stress and health behaviours. Through an online survey, you will provide your Prolific ID. You will be asked to read an article about health and lifestyle, and answer questions from validated psychological surveys about your health behaviours and stress. The entire study should take no longer than 20 minutes. In one week you will be contacted for a follow-up survey asking about your health behaviours.

We are asking your permission to use your data from the surveys for research purposes.

5. What is the inclusion criteria?

Participants will need to be a cisgender woman who identifies as female,, be between 50-69 years old, reside in Canada, can fluently read, write, and understand English, and agree to participate in the study.

6. What are the risks and harms of participating in this study?

There may be some slight emotional distress associated with the protocol procedures. Responding to multiple survey questions takes time, effort and may cause some discomfort. For example, since survey questions assess health behaviours, some people may experience negative feelings or anxiety when answering these questions. Many questions in this study have been used in research studies all over the world with no reports of adverse effects on participants.

If a participant experiences distress from a question and/or does not wish to answer it, they may leave it blank. Following the completion of the study, if a participant is still experiencing distress, they may access a variety of community-level resources that will be provided in the debriefing form at the end of the study.

Participants are free to withdraw from the study by simply closing the survey at any time and for any reason.

7. What are the benefits of participating in this study?

There are no direct benefits for participation in this study. However, the results from this research may help scientists better understand the relationships between stress, lifestyle and health behaviours.

8. Can participants choose to leave the study?

Yes. Participation in this research is completely voluntary. You can decide to participate or not participate at any point throughout the study. You may discontinue participation at any time by simply closing the survey. If you would like your data to be withdrawn from the study before it is approved by the researcher, you may "return" the study through Prolific:

4. Before the study begins by selecting "cancel reservation."
5. During the study by selecting "stop without completing."
6. After the study has been completed and before it has been reviewed by the researcher by selecting "return and cancel reward."

You may learn more about how to return your study through Prolific by clicking this link: https://participant-help.prolific.co/hc/en-gb/articles/360022342094-How-do-I-withdraw-my-participation-in-a-study

If you would like to withdraw your data after your submission has been approved by the researcher on Prolific, you may contact the researchers to request this withdrawal by sending the researchers a message on Prolific. You should provide your Prolific ID so researchers can identify your data and discard it. If you would like to withdraw your data after your submission is approved, you will keep the compensation you have already been awarded through Prolific and your data will be discarded. If the study has already been submitted for publication, we will not be able to remove your data.

9. How will participants' information be kept confidential?

Because this study is being conducted through Prolific, researchers will not have access to and are unable to request any identifying information of participants. Participant data will be collected under a unique alphanumeric code called a Prolific ID that does not indicate any participant identifying information. If you wish to send a message to the research team to ask questions or request that your data be removed, submit a message

through Prolific and provide your Prolific ID. Prolific offers an anonymized messaging service so researchers and participants may contact each other without revealing any personal information if needed.

The confidentiality of the data that is collected will be protected. Only the investigators will have access to the data collected during the study, which will be stored securely on password-protected devices and documents. The data that is collected by researchers will not be able to be linked to any participant identities. The researchers do not intend to make the research data available on an open platform (the data will not be made publicly available or provided in open access format) or on request. Delegated institutional representatives of Western University and its Health Sciences Research Ethics Board may require access to your study-related records to monitor the conduct of the research in accordance with regulatory requirements. Research data will be stored for 7 years per UWO policy. Electronic data will be then permanently purged according to institutional guidelines at the time of data destruction.

Your survey responses will be collected through a secure online survey platform called Qualtrics. Qualtrics uses encryption technology and restricted access authorizations to protect all data collected. In addition, Western's Qualtrics server is in Ireland, where privacy standards are maintained under the European Union safe harbour framework. The data will then be exported from Qualtrics and securely stored on Western University's server. All data presented to the public will be presented in aggregated format. This means that the data collected from any single participant will not be included in any public presentations or published works.

10. Are participants compensated to be in this study?

Participants will be compensated the equivalent of $4.29CAD through Prolific for their participation in this survey. The follow-up survey will be an additional $4.29CAD through Prolific.

11. What are the rights of participants?

Taking part in this research study is voluntary:

- You do not have to be in this research.
- If you choose to be in this research, you have the right to stop at any time.
- If you decide not to be in this research or if you decide to stop later, there will be no penalty and you can still receive partial or full compensation.

You do not waive any legal rights by consenting to this study. Withdrawing from this study will not have any impact on your Prolific score or ability to participate in future studies. If you wish to withdraw your data, please contact the researchers by sending an anonymous message through Prolific.

12. Whom do participants contact for questions?

Please contact the researchers by sending a message through Prolific with your Prolific ID if you:

- Have questions about the research
- Believe you may have been harmed by being in the research study
- Would like to withdraw from the study

You may also contact the Office of Research Ethics at Western University at (519)-661-3036, 1-844-720-9816 or ethics@uwo.ca if you:

- Have questions regarding your rights as a person in a research study.
- Have concerns, complaints, or general questions about the research.

This letter is yours to keep for future reference.

Submitting the survey is indication of your consent to participate.

- o I agree to participate.
- o I do not agree to participate. I will exit the survey now.

Appendix F: Survey Measures

What is your current age in years?

What country do you currently reside in?

- Canada
- United Kingdom
- United States
- Other

Are you phenotypically female and female-identifying? Yes/No

Godin Leisure-Time Exercise Questionnaire

During a typical 7-Day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time (write on each line the appropriate number).

Weekly leisure activity score (9 x Strenuous) + (5 x Moderate) + (3 x Light)

Modified Weight Bias Internalization Scale (WBIS-M)

(Pearl & Puhl, 2014)

7-point rating scale from 1 (strongly disagree) to 7 (strongly agree)

Each of the statements below refer to your perceptions of your weight. Please indicate to what extent you agree or disagree with each of the statements using the scales provided.

Please be assured that your answers will remain anonymous and confidential. There are no right or wrong answers.

1. Because of my weight, I feel that I am just as competent as anyone.*
2. I am less attractive than most other people because of my weight.
3. I feel anxious about my weight because of what people might think of me.
4. I wish I could drastically change my weight.
5. Whenever I think a lot about my weight, I feel depressed.

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

***Reverse coded**

Higher scores reflect greater weight bias internalization.

Visual Analogue Scale:

Indicate how stressed you feel on the scale below (0= None, 100= As bad as it could be) (Lesage & Deschamps, 2012).

Article:

Please read the following article about the detrimental effects of (obesity/vaping) on exercise. You will be asked questions about the article when you are finished.

"It is common knowledge that [obese people/people who vape] are less fit than than [people of average weight/non-vapers]. [Vaping/excess weight] has been linked to less endurance, poorer physical performance and increased rates of injury during exercise.

New research suggests that these risks may be influenced by a reluctance of fitness professionals to work with [people who vape/obese people].

A recent study found that personal trainers rated ["people of size"/ people who vape] as ugly, lazy, sloppy and more depressed compared to normal exercisers. These fitness professionals identified that [obese patients/patients who vape] are a main target of derogatory humour among gym employees. They are thought to be responsible for their lack of fitness and cause extra work for gym staff.

Research has also shown that personal trainers spend less time with [obese exercisers/exercisers who vape], view them more negatively, have less respect for them and are reluctant to take them on as clients.

For fitness classes, such as a high-intensity interval training (HIIT), some fitness instructors may even refuse to allow [obese people/people who vape] to join the class until they [lose weight/quit vaping]. [Excess weight/Vaping] makes these classes higher-risk, which instructors may not be comfortable allowing in their class.

Andrea Cahill of The Heart and Stroke Foundation Canada says that the current prevalence of [obesity/vaping] may be frustrating to fitness professionals. “[People of size/People who vape] are more difficult to work with than normal people. A lot of their health problems could be treated by simply [eating better/quitting vaping].”

Attention Check:

“Did you find this article easy to understand?” {yes/no}

“Did you find this article interesting?” {yes/no}

“Did you find this article relevant to yourself? {yes/no}

“Summarize the article you just read. Provide any details you remember.” {Text box provided}

Visual Analogue Scale:

Indicate how stressed you feel on the scale below (0= None, 100= As bad as it could be) (Lesage & Deschamps, 2012).

Exercise Intention:

"How often do you intend to take part in regular physical activity?" (7-point scale: never to frequently) "I want to exercise regularly" (7-point scale: Definitely do to definitely don't).

Thank you for participating!

1-week follow up:

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

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 **last 7 days**. 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, 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** and **moderate** 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. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

   ☐ Yes

   ☐ No → ***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

   _____ **days per week**

   ☐ No vigorous job-related physical activity → ***Skip to question 4***

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

   _____ **hours per day**
   _____ **minutes per day**

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

   _____ **days per week**

   ☐ No moderate job-related physical activity → ***Skip to question 6***

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**

☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

7. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**
_____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**

☐ No traveling in a motor vehicle → ***Skip to question 10***

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**
_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**
_____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days **walking** from place to place?

_____ **hours per day**
_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**
_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

_____ **days per week**

☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**
_____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

_____ **days per week**

☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**
_____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

_____ **days per week**

☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?
_____ **hours per day**
_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while 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. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ **hours per day**
_____ **minutes per day**

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

_____ **hours per day**
_____ **minutes per day**

This is the end of the questionnaire, thank you for participating.

Debriefing Questions:

"What do you believe is the purpose of this study?" "How did you feel when participating in the study?" "Do you believe your answers to the questionnaires were influenced by the article you read 1-week ago?"

Appendix G: Debriefing Form

Debriefing

Lifestyle, Stress and Health Behaviours

Thank you for participating!

This form will explain to you in more detail the purpose of the study. The general purpose of this study is to understand how different individuals respond to weight stigma and discrimination, specifically in an exercise context. Although you were told that the purpose of the study was to examine the effects of stress on lifestyle, the main purpose of the study was to examine the impact of weight stigma on stress and exercise intentions/behaviours.

Research suggests that weight stigma leads to psychological stress for individuals belonging to a stigmatized group. Some individuals may respond to stigma by avoiding domains where they believe further stigma will occur, such as exercise. We know that individuals who are exposed to weight stigma are motivated to avoid exercise, especially in public settings, and that weight discrimination is associated with lower engagement in physical activity. After reading a stigmatizing or control article, participants completed a series of questionnaires assessing their intentions to engage in exercise/exercise behaviours.

You were invited to take part in this study because you had indicated during the screening assessment that you self-identified as "heavier-weight". In the study, we asked you to read a fictional article that was designed to be stigmatizing. The article was either written about a neutral subject (vaping) or about weight. We ran each of the article conditions as separate and sequential studies on Prolific. We first ran the neutral article as its own study to completion, then created a second study for the weight-related article. Participants who completed the neutral article study were excluded from participating in the weight-related article condition. We used a random computer generator to assign Prolific IDs from the Pre-Screen to each condition. We expect that some participants in the weight stigma condition will show lower intentions to engage in exercise and lower exercise behaviours 1-week later, and will report elevated levels of psychological stress.

The 'weight stigma' articles were developed for experimental purposes from similar studies, to replicate the sometimes negative everyday treatment or assumptions about higher-weight individuals engaging in exercise. In reality, we do not endorse the belief that higher-weight individuals are necessarily unhealthier or less capable of performing exercise than are slimmer individuals. We are doing this research to help understand why weight stigma is harmful, which will help scientists find strategies to reduce the negative effects of stigma on women's health.

Now that you have been made aware of the true purpose of the study, I would like to remind you that you are able to withdraw your data and samples from the study at this point, at no penalty. If you would like to do so, please contact the researchers by sending an anonymized message through Prolific and request to have your data removed. You can also contact us to withdraw in the future, up until this work has been published.

Your results are fully anonymized, and all data we recorded from your participation in this survey will remain confidential to the investigators. If you wish to send a message to the research team to ask questions or request that your data be removed, submit a message through Prolific and provide your Prolific ID. Prolific offers an anonymized messaging service so researchers and participants may contact each other without revealing any personal information if needed. Any data that is published from this study will appear in aggregate form and will not detail specific results from any individual participant.

Please feel free to ask the student investigator any questions you may have about the study protocol, and/or use the following contact information for questions that arise later. If participating in this study has caused you any distress or discomfort, please be aware that the researchers are available to discuss the purposes of the research further either through an email or through an anonymized message on Prolific:

Principal Investigator: Eva Pila 

Student Investigator: Isabella Randall 

If you feel that you are struggling with your body image or self-esteem, or that this study has caused you harm in any way, and you feel you need help, please consider accessing the following resources.

- List of global mental health resources
  https://checkpointorg.com/global/
- Canada Crisis Services
  https://www.crisisservicescanada.ca/en/
  1-833-456-4566
- CAMH Crisis Resources (Toronto and area)
  https://www.camh.ca/en/health-info/crisis-resources
- National Eating Disorder Information Centre

  https://nedic.ca/

  NEDIC HELPLINE: 1-866-633-4220 (toll-free); 416-340-4156 (Toronto)

If you have questions about your rights as a research participant, you should contact the Director of the Office of Human Research Ethics at ethics@uwo.ca or 519-661-3036.

Thank you again for your time and participation – it is greatly appreciated! If you are experiencing any negative thoughts or feelings about the study, we encourage you to send us an anonymized message through Prolific.

Eva Pila

Isabella Randall

Western University

Curriculum Vitae

Name:	Isabella Randall
Post-secondary Education and Degrees:	McGill University Montreal, Quebec, Canada 2015-2019 B.Sc. in Cell Biology and Anatomy The University of Western Ontario London, Ontario, Canada 2019-Present M.A. in Psychological Basis of Kinesiology
Honours and Awards:	FHS Graduate Conference Travel Award 2020
Related Work Experience	Teaching Assistant The University of Western Ontario 2019-2021 Research Assistant The University of Western Ontario 2019-2020
Related Volunteer Experience	Research Assistant McGill University – Allan Memorial Institute 2018-2019 Active Listener and Volunteer McGill Student's Nightline 2018

Academic Conferences and Presentations:

Eastern Canadian Sport and Exercise Psychology Symposium
Oral Presentation: *Weight Stigma, Psychological Stress and Health Behaviour Outcomes*
Online – 2021

Eastern Canadian Sport and Exercise Psychology Symposium
Cancelled Presentation: *Psychophysiological Responses to Weight Stigma: Applications to Exercise Behaviour*
St. Catharines, ON – 2020

Canadian Society for Psychomotor Learning and Sport Psychology
Poster Presentation: *Exercising for appearance versus health reasons: Associations with latent classes of mental health*
Vancouver, BC - 2019