

8-17-2023 11:00 AM

Effects of self-compassion on the psychobiological responses to weight stigma: A feasibility and proof-of-concept study

Karen K. Leung Miss, *Western University*

Supervisor: Pila, Eva, *The University of Western Ontario*

A thesis submitted in partial fulfillment of the requirements for the Master of Arts degree in Kinesiology

© Karen K. Leung Miss 2023

Follow this and additional works at: <https://ir.lib.uwo.ca/etd>



Part of the [Health Psychology Commons](#)

Recommended Citation

Leung, Karen K. Miss, "Effects of self-compassion on the psychobiological responses to weight stigma: A feasibility and proof-of-concept study" (2023). *Electronic Thesis and Dissertation Repository*. 9565.
<https://ir.lib.uwo.ca/etd/9565>

This Dissertation/Thesis is brought to you for free and open access by Scholarship@Western. It has been accepted for inclusion in Electronic Thesis and Dissertation Repository by an authorized administrator of Scholarship@Western. For more information, please contact wlsadmin@uwo.ca.

Abstract

Higher-weight individuals face pervasive weight-related stigma and discrimination in their daily lives. There is conceptual and empirical evidence to suggest that weight stigma contributes to worse physical and psychological health outcomes, mediated by the deleterious psychobiological responses to psychosocial stress. Activating self-soothing emotional states (such as self-compassion) may protect against this psychobiological cascade, conferring resilience to negative social evaluation (such as weight stigma). This proof-of-concept pilot study examined the feasibility and acceptability of an acute experimental protocol testing psychobiological responses to a weight-based social evaluative induction and self-compassion intervention. A secondary objective was to examine the efficacy of the acute self-compassion intervention to dampen the psychobiological stress response. Self-identifying cis-gender women ($N = 37$, $M_{\text{age}} = 21.93$) who also identified as “average weight”, or “higher weight” were randomized into an intervention or control condition and completed measures of psychobiological stress. Overall, the study demonstrated feasibility and acceptability evidence, however, it was not feasible to recruit the target sample size. Findings revealed that weight stigma induction elicited an increase in self-conscious emotions. While the intervention successfully induced self-compassion among participants in the intervention group, the efficacy of self-compassion to attenuate the psychobiological stress response was limited. The results from this study provide preliminary evidence of the feasibility and acceptability of a weight stigma induction and self-compassion intervention protocol but demonstrate limited efficacy, likely due to sample size restraints. Due to the important impact of weight stigma on health, future research is needed to elucidate the conditions in which weight-based social evaluation activates the psychobiological systems.

Keywords

weight stigma, weight based social identity threat, social self-preservation, psychosocial stress.

Summary for Lay Audience

Weight stigma stems from weight biases, which are stereotypes and negative attitudes towards individuals with higher-weight. These stereotypes and prejudicial attitudes lead to weight stigmatization, social exclusion, and marginalization of higher-weight individuals. Research shows that higher-weight individuals, particularly women, often face weight-based stigma and discrimination, consequently leading to mental and physical health impairments. Consequently, higher-weight individuals are likely to undergo a psychobiological stress response to weight-stigmatizing events. Continual activation of this stress response is associated with chronic diseases (e.g., hypertension, diabetes, heart disease, etc.), also commonly referred to as obesity diseases. Thus, weight stigmatization may be one factor that contributes to obesity-related diseases, which are often associated with weight-related issues. It is critical to identify intervention strategies to reduce the psychobiological stress effects induced by weight stigma. There is evidence to suggest that self-compassion may be effective, and therefore, the primary objective of this study is to examine whether a self-compassion intervention can be an effective method to buffer the psychobiological stress from the weight stigma induction. Also, to test the effectiveness of a weight stigma induction at eliciting psychobiological stress. This acute laboratory-based study is the first to our knowledge to examine psychobiological responses to a weight-based social-evaluative induction, thus, the feasibility of the experimental protocol and acceptability to participants will be established. N = 37 cis-gender women who identified as “average” or “higher weight” were randomized into the intervention (self-compassion) versus control (quiet rest) group. Results revealed that weight stigma induction was effective at inducing increased self-conscious emotions. The acute self-compassion intervention successfully induced

self-compassion within participants in the intervention group compared to the control group, however, the efficacy to buffer psychobiological stress was limited as the stress induction did not elicit a stress response. The study was acceptable to participants, and mostly feasible apart from the difficulty with recruitment due to limited allocated resources. Future research should replicate the study with improved efforts to explicate the relationship between weight stigma and psychobiological stress, and intervention strategies, such as self-compassion to buffer the stress response.

Co-Authorship Statement

I declare that this thesis incorporates research material that is the result of a collaboration among other researchers. The study was conceptualized by Eva Pila (Principal Investigator) and Madeline Wood, in collaboration with Lindsay Bodell (Co-Investigator). All other aspects of this work, including participant recruitment, data collection, analysis, interpretation of results and write-up were led by Karen Leung.

Acknowledgments

First and foremost, I'd like to express my deepest gratitude and appreciation to my supervisor, Dr. Eva Pila. Thank you for providing me with countless learning opportunities and for consistently pushing my boundaries for success. Your unwavering support and encouragement have played a pivotal role in shaping my growth as a student researcher and as a person. For your invaluable guidance, mentorship, and support, I am forever grateful.

Thank you to everyone in the Body Image and Health Research Lab and the Exercise and Health Psychology Lab. It has been an incredible experience working alongside an amazing team. Your social support has been instrumental in my research journey.

A sincere thank you to everyone involved in this research project, including volunteers and research assistants (IR, AO, JC, SB, SS, DT, IS, HC), your valuable contributions is what made this project possible. And of course, MW for initiating the efforts that brought this study into life.

A heartfelt thank you to all my amazing friendships (AA, AW, JW, KA, MA, SB, HC, JM). Thank you for all the laughter we've shared and wonderful memories. For the late-night discussions and spontaneous trips.

A big special thank you to my rock and pillar of support, WD. I cannot thank you enough for all the ways you have supported me throughout this experience and in life. Thank you for always pushing me beyond my limits to achieve my goals. For being the calm to my storm. For reminding me to believe in myself. Your boundless motivation and encouragements have been transformative on my path to personal growth.

Above all, I want to express my deepest gratitude and heartfelt appreciation to my mom for her unconditional love and support. Thank you, mom, for your unwavering belief in me and your continuous support of my passions and dreams, no matter how big. Thank you for being a role model of hard work and dedication. For reminding me the value of perseverance, determination, and compassion. I could not have been able to pursue my dreams without your sacrifices and for that, I am eternally grateful.

Table of Contents

Abstract	ii
Summary for Lay Audience	iii
Co-Authorship Statement	v
Acknowledgments	vi
Table of Contents	viii
List of Tables	xi
List of Figures	xii
List of Appendices	xiii
Chapter 1	1
1 Introduction	1
1.1 Overview of Research Aims	3
Chapter 2	4
2 Review of Literature	4
2.1. Weight Stigma	4
2.1.1. Prevalence of Weight Stigma	4
2.1.2. Weight Stigma and Physical and Psychological Health Outcomes	7
2.1.3. Experienced Weight Stigma	9
2.1.4. Internalized Weight Bias and Stigma	12
2.2. Weight-Based Social Identity Threat Model	13
2.2.1. Self-Preservation Theory	14
2.2.3. Psychobiological Stress Response	16
2.2.3.1. Cortisol Response	17
2.2.3.2. Uric Acid	19
2.2.3.3. Osteocalcin	20
2.2.3.4. Shame	22
2.2.3.5. Self-Conscious Emotions	23
2.2.3.6. Psychological Distress	25
2.2.3.7. Heart Rate Variability	25
2.3. Self-Compassion	27
2.3.1. The Polyvagal Theory and Compassionate Responding	29
2.3.2. Self-Compassion as a Buffer to the Psychobiological Stress Response	30
2.3.2.1. Self-Compassion and Cortisol	30
2.3.2.2. Self-Compassion and Uric Acid	31
2.3.2.3. Self-Compassion and Osteocalcin	32
2.3.2.4. Self-Compassion and Shame	33
2.3.2.5. Self-Compassion and Self-Conscious Emotions	34
2.3.2.6. Self-Compassion and Psychological Distress	35
2.3.2.6. Self-Compassion and Heart Rate Variability	36

2.4. Research Objectives	37
2.4.1 Hypotheses and Feasibility Criteria	40
Chapter 3	42
3 Methodology	42
3.1 Sample	42
3.1.2. Recruitment	43
3.2 Design	43
3.2.1. Telephone Pre-screening Interview	44
3.2.2. Initial In-Lab Baseline Assessments	45
3.2.3. Experimental Manipulation	47
3.2.3.1. Randomization	47
3.2.3.2. Baseline Data Collection and Pre-Lab Protocol Confirmation	47
3.2.3.3. Acute Intervention	48
3.2.3.4. Self-Compassion Induction	49
3.2.3.5. Weight Stigma induction	50
3.2.3.6. Recovery	52
3.2.3.7. Saliva Collection	52
3.2.3.8. Debriefing	53
3.3. Measures	55
3.3.1. Initial In-lab Demographic & Baseline Psychological Measures	55
3.3.2. Experimental In-Lab Psychological Measures	55
3.4. Data Analysis	57
3.4.1. Process Criteria	57
3.4.2. Resources Criteria	58
3.4.3. Management Criteria	59
3.4.4. Secondary Objectives	59
Chapter 4	62
4 Results	62
4.1. Feasibility and Acceptability	62
4.1.1. Process Criteria	63
4.1.2. Resources Criteria	66
4.1.3. Management Criteria	68
4.2. Secondary Objective: Preliminary Efficacy Results	69
4.2.1. Data Processing Results	69
4.2.2. Baseline Condition Differences	73
4.3. Main Efficacy Results	75
4.3.1. State Self-Compassion	76
4.3.2. Self-Conscious Emotions	76
4.3.3. Shame	77
4.3.4. Guilt	78
4.3.5. Subjective Distress	79
4.3.6. Weight Bias Internalization	80
4.3.7. Cortisol	81

4.3.8. Heart Rate Variability	84
4.4. Exploratory Analyses.....	86
4.4.1. Uric Acid.....	86
4.4.2. Osteocalcin.....	89
Chapter 5	96
5 Discussion	96
5.1. Primary Objective	97
5.2. Objective 2: Preliminary Efficacy	102
5.2.1. Weight Stigma Induction and Psychobiological Stress	102
5.2.3. Acute Self-Compassion Intervention	109
5.6. Limitations and Future Directions	111
5.6. Study Implications	114
5.6.1. Methodological Implications	115
5.7. Conclusion	116
References	118
Appendices.....	139

List of Tables

Table 1. Summary of Process Criteria	63
Table 2. Summary of Resources Criteria	66
Table 3. Summary of Management Criteria	68
Table 4. Salivary Assay Reliability and Validity	69
Table 5. Composite scale reliability analyses	69
Table 6. Sociodemographic Characteristics and Perceived Weight Variable	71
Table 7. Descriptive Statistics for Baseline and Main Study Variables	74
Table 8. Means and Standard Deviations of Time-Aggregated Psychological Outcome Variables by Condition	75
Table 9. Effectiveness Indicator Scores and Means and Standard Deviations Across Time	91
Table 10. Bivariate Pearson Correlation Between All Main Outcome Variables	93
Table 11. Independent Samples T-Tests for Salivary Biomarkers	95

List of Figures

Figure 1. Experimental Design Flow Chart	54
Figure 2. Mean self-conscious emotions across time	77
Figure 3. Mean shame across time.....	78
Figure 4. Mean guilt across time.....	79
Figure 5. Mean subjective distress across time	80
Figure 6. Mean internalized weight stigma across time	81
Figure 7. Mean cortisol across time	82
Figure 8. Individual participant data points for cortisol across time	83
Figure 9. Mean HRV during intervention or quiet rest.....	84
Figure 10. Mean HRV during weight stigma induction	85
Figure 11. Mean HRV during recovery	86
Figure 12. Mean uric acid across time	87
Figure 13. Individual participant data points for uric acid levels across time	88
Figure 14. Mean osteocalcin across time	89
Figure 15. Individual participant data points for osteocalcin levels across time	90

List of Appendices

Appendix A: Study Approval from Western Health Science Research Ethics Board....	139
Appendix B: Pre-Registration.....	140
Appendix C: Recruitment Email / Online Community Group Post	142
Appendix D: Recruitment Poster	143
Appendix E: Pre-Screen Letter of Information and Consent.....	144
Appendix F: Telephone Pre-Screening Interview – Researcher Script	150
Appendix G: Experimental Session Letter of Information and Consent	158
Appendix H: Participant Pre-Study Preparation Checklist.....	168
Appendix I: Psychological Baseline & Demographic Survey Measures.....	169
Appendix J: In-Lab Baseline Assessment Session – Researcher Script	178
Appendix K: Experimental Lab Session – Procedures & Researcher Script.....	183
Appendix L: In-Lab Baseline Data Collection/Eligibility Confirmation – Verbal Survey (Researcher Facing)	192
Appendix M: Self-Compassion Presentation Script	195
Appendix N: Self-Compassion Writing Activity Script	198
Appendix O: Debriefing Open Funnel Questions.....	201
Appendix P: Debriefing Letter.....	202
Appendix Q: Survey Outcome Measures	206

Chapter 1

1 Introduction

Weight stigma can be broadly defined as weight-related experiences of labeling, stereotyping, separation, status loss, and discrimination at the individual (e.g., unequal treatment of individuals based on weight) and the structural level (e.g., societal structures that create barriers to opportunities, resources, and well-being of higher-weight individuals)¹ (Hatzenbuehler et al., 2013). The stigma associated with weight is ubiquitous and widely acknowledged as a fundamental factor contributing to health inequities among higher weight individuals¹ (Hatzenbuehler et al., 2013; Puhl & Heuer, 2009). Despite the growing widespread recognition and awareness of weight stigma, it still remains a socially acceptable form of prejudice and discrimination that is reinforced through sociocultural norms, with far reaching implications across various domains of life (Puhl & Brownell, 2001; Puhl & Heuer, 2009). Research finds weight stigma to be a psychosocial factor to various negative health outcomes (e.g., commonly referred to as “weight-related diseases”; Puhl et al., 2020).

Ample empirical research has linked weight stigma with a range of negative health outcomes, such as binge eating (Brauhardt et al., 2014; Vartanian & Porter, 2016), body dissatisfaction (Puhl et al., 2017; Stevens et al., 2017; Wu & Berry, 2018), psychological distress (Cheng et al., 2018; Curll & Brown, 2020; Wu & Berry, 2018), and negative affect (Lucibello et al., 2021, 2022, 2023), poorer mental health (Emmer et al., 2020; Major et al., 2012; Tomiyama et al., 2018; Warnick et al., 2022), above and

¹ Weight inclusive terminology is used throughout this thesis to purposefully avoid the medicalization of obesity (Meadows & Danielsdóttir, 2016).

beyond the effects of weight status alone. Weight stigma predicts increased mortality risk independent of body mass index (BMI; Sutin et al., 2015) and has been identified as an underlying cause of health disorders that are commonly attributed to excess adiposity (Rubino et al., 2020; Wu & Berry, 2018). Researchers have proposed that weight stigmatizing experiences that are disproportionately experienced by higher-weight individuals indirectly contribute to negative health outcomes via a coordinated psychobiological stress response (Hunger et al., 2015), invoking specific neuroendocrine, autonomic, and immunological parameters (e.g., cortisol release, sympathetic activation; Dickerson, 2008; Hunger et al., 2015) and affective states (i.e., self-evaluative emotions such as shame and guilt; Dickerson et al., 2004) that together signal social threat and mobilize the self to engage in social self-preservation efforts (Dickerson et al., 2004). Although adaptive in acute contexts, chronic activation of this stress response results in cumulative physiological wear and tear (i.e., allostatic load; McEwen, 1998) and dysregulation of these physiological systems (Dickerson et al., 2011), causing adverse physical and psychological health outcomes in higher-weight individuals who are repeatedly subjected to stigmatizing and socially threatening experiences based on their weight (Hunger et al., 2015).

While research has indicated that the psychobiological responses provoked by social threats mediate harmful health outcomes of stigma (Hunger et al., 2015), there has been comparatively limited exploration of the protective factors that foster resilience against these negative effects. As such, it is critical to increase awareness and understanding of weight stigma and to develop effective evidence-based strategies to combat it.

Drawing upon the polyvagal theory (Porges, 2007), affiliative processing (i.e., cognitive, and emotional processing to promote prosocial behaviour social connectedness, and social bonding) may be one approach the body uses to adapt the fight or flight response when facing stress. Specifically, self-compassion is one method of affiliative processing that facilitates adaptive responding to social evaluative stressors (Neff & Vonk, 2009). Self-compassion may also be effective in buffering the negative effects of psychosocial stress induced by weight stigmatization and dampening the cortisol response. There is evidence that self-compassion attenuated the psychobiological response to acute social stress through the activation of self-soothing systems via the parasympathetic nervous system (PNS; Breines et al., 2015; Breines, Thoma, Freeman, et al., 2014; Breines, Thoma, Gianferante, et al., 2014; Luo et al., 2018). Self-compassion opposes stigma-related states, such as shame and self-criticism, acting as an antidote to social threat (Gilbert & Procter, 2006). Preliminary evidence shows that self-compassion buffers the negative psychological effects of self-stigma among higher weight individuals (Hilbert et al., 2015). Specifically, self-compassion mediated the associations between self-stigma and depressive symptoms (Hilbert et al., 2015). Also, evidence suggests that when acutely induced, self-compassion may protect against adversity, such as psychosocial stress (Chan et al., 2020). However, currently, there is a gap in experimental research that has evaluated the effects of an acute self-compassion intervention on psychobiological responses to experienced weight stigma.

1.1 Overview of Research Aims

Based on the theoretical tenants of the weight based social identity model (Hunger et al., 2015) and social self-preservation theory (Dickerson & Kemeny, 2004), the overarching goal of the proposed research paper is to elucidate the psychobiological

mechanisms (i.e., affect regulation, HPA axis reactivity) that underlie the relationship between self-evaluative emotions (i.e., shame, guilt, internalized stigma) and affiliative processing (i.e., self-compassion).

Chapter 2

2 Review of Literature

2.1. Weight Stigma

Social devaluation of individuals due to their weight and/or size stems from weight biases, which are stereotypes and prejudicial attitudes towards those who are higher-weight (e.g., higher weight people are lazy, lacking in self-discipline and willpower, etc.) (Pearl, 2018; Puhl & Heuer, 2009). These negative attitudes and beliefs held by society ultimately lead to stigma, social exclusion, and marginalization, which consequently evolve into weight-based discriminatory behaviours (e.g., hiring decisions, salary, promotion opportunities, etc.) (Pearl, 2018; Puhl & Brownell, 2001; Puhl & Heuer, 2010). Weight bias, in particular, is widely tolerated and considered an acceptable form of prejudice and stigmatization (Puhl & Brownell, 2001; Puhl & Heuer, 2009). Indeed, the detrimental perceptions and stereotypes about people with higher body weight have significant implications across multiple areas of daily living (e.g., employment, health care, education, interpersonal relationships, etc.; Puhl & Brownell, 2001; Puhl & Heuer, 2009).

2.1.1. Prevalence of Weight Stigma

A multi-national systematic comparison of the prevalence of weight stigma in adult participants who formerly enrolled in Weight Watchers found that over 55.6-61.3%

experienced some form of weight stigma in their lifetime (Puhl et al., 2021). Across the included countries (i.e., Germany, Canada, Australia, France, United Kingdom, and the United States), weight stigma was commonly experienced from family members (76.0-87.8%), classmates (72.0-80.9%), doctors (62.6-73.5%), coworkers (54.1-61.7%), and friends (48.8-66.2%; Puhl et al., 2021). Interestingly, rates of weight stigma were most disproportionate and the highest in Canada compared to the other countries surveyed (61.3%; Puhl et al., 2021). It is important to note that the prevalence of weight stigma in the weight loss seeking group is likely different compared to prevalence rates from the general population. Interestingly, recent study among 3821 adults across any weight classes, found prevalence for weight stigma to be 57%, to which weight-based discrimination were highest for higher-weight adults (Prunty et al., 2020).

Studies have also shown that weight stigma frequently begins during childhood and adolescence, and its effects often persist into adulthood (Puhl et al., 2017, 2021). Children and adolescents who are higher-weight are especially vulnerable to weight stigma, with consistent research indicating they are more likely to be the target of weight-based teasing and bullying than their thinner peers (Hayden-Wade et al., 2005; Janssen et al., 2004; Pearce et al., 2002). In fact, weight-based teasing, bullying, and victimization are among the most prevalent forms of weight stigma experienced by higher weight youths during childhood and adolescence (Haines et al., 2008; Hooper et al., 2021; Puhl & Lessard, 2020; Puhl et al., 2011; Puhl, Lessard, Pearl, et al., 2021; Puhl & King, 2013).

During childhood and adolescence, weight stigmatization can have significant negative consequences, if it hinders the formation of fundamental aspects of development, such as social relationships, eating habits, and academic progress (Puhl & Latner, 2007). Weight-based discriminating behaviours can manifest in various ways in

youth, including overt forms such as verbal harassment, name-calling, physical assault, to more covert forms like relational aggression and social exclusion (Puhl & King, 2013). Longitudinal studies have found that experiences of weight stigmatization in early adolescence (i.e., weight-based teasing) predicted higher BMI, binge eating, unhealthy weight control, eating to cope, poor body image, recent dieting in women, and obesity 15 years later (Puhl et al., 2017). Likewise, studies that utilized cross sectional designs have yielded comparable findings, showing that 64.5% of young adults who reported experiencing weight teasing exhibited disordered eating behaviours, and this was especially salient among youths from marginalized groups, such as those of lower socioeconomic status and Black, Indigenous, and People of Colour (Hooper et al., 2021).

Research has consistently shown that higher weight women experience more negative attitudes and discrimination compared to men with similar body weight, and this is largely attributed to societal pressures to conform to narrow beauty standards (e.g., thinness for women, larger body size for men; Puhl et al., 2008). Further, robust literature have also consistently demonstrated that individuals with higher BMI tend to experience greater weight stigma compared to those with lower BMI across various studies, and this is especially true for higher weight women (Dutton et al., 2014; Hatzenbuehler et al., 2009; Prunty et al., 2020; Puhl & Brownell, 2001; Puhl et al., 2008; Puhl, Lessard, Pearl, et al., 2021; Roehling et al., 2007; Spahlholz et al., 2016; Wang et al., 2021).

Research indicates that weight bias is a pervasive issue among health care providers (i.e., primary care providers, medical trainees, nurses, dietitians, exercise therapists, psychologists, etc.) (Puhl & Brownell, 2006; Sabin et al., 2012; Schwartz et al., 2003; Teachman & Brownell, 2001). Thus, the health care environment may present as a potential risk for weight stigmatization to occur for higher weight individuals.

Empirical research has demonstrated that health care providers' implicit anti-fat bias attitudes can impact their care provision abilities by influencing their judgements, decision making, interpersonal behaviours, and people perception, thus potentially impacting the quality-of-care higher weight individuals receive (Phelan et al., 2015). Studies have demonstrated that individuals may be more likely to avoid medical appointments/medical care, delays health screenings (such as for cancer or pelvic exams), decreased health prioritization, and have reduced adherence to health treatment if they feel stigmatized (Amy et al., 2006; Phelan et al., 2015; Puhl et al., 2013),

2.1.2. Weight Stigma and Physical and Psychological Health Outcomes

The negative psycho-physical health consequences of weight stigma have been extensively studied (Emmer et al., 2020; Himmelstein et al., 2019; Puhl & Lessard, 2020; Puhl et al., 2020; Puhl & Suh, 2015; Wu & Berry, 2018). Weight stigma can have a range of negative health outcomes including psychological distress, disordered eating, body image concerns, physiological stress, avoidance of physical activity and exercise, and delayed health care seeking (Emmer et al., 2020; Latner et al., 2014; Phelan et al., 2015; Puhl & Suh, 2015; Tomiyama, 2014; Vartanian et al., 2018; Wu & Berry, 2018).

There has been an abundance of consistent evidence synthesis studies (i.e., systematic reviews and meta-analyses) showing experiences of weight stigma can lead to various psychological distress (Alimoradi et al., 2020; Emmer et al., 2020; Papadopoulos & Brennan, 2015; Pearl & Puhl, 2018; Puhl & Lessard, 2020; Wu & Berry, 2018). Specifically, more frequent perceived experiences of weight stigma were associated with greater depressive symptoms (Fettich & Chen, 2012; Friedman et al., 2008; Hatzenbuehler et al., 2009; Magallares et al., 2017; Pearl & Puhl, 2018; Savoy et al., 2012; Wang et al., 2021). As well, there is evidence that BMI may be a significant

moderator of this relationship, where the higher the BMI, the stronger the association between weight stigma and mental health concerns (Emmer et al., 2020). Moreover, certain studies suggest that the association between internalized weight bias and depressive symptoms remained significant, even after adjusting for BMI (Hilbert et al., 2014; O'Brien et al., 2016), hence indicating a distinctive relationship between the two variables (Emmer et al., 2020).

Similarly, more frequent experiences of weight stigma or internalized weight stigma are also positively correlated with higher anxiety levels (Friedman et al., 2008; Hatzenbuehler et al., 2009; Magallares et al., 2017; Savoy et al., 2012), lower self-esteem (Durso et al., 2016; Friedman et al., 2008; Wu & Berry, 2018), and higher body image concerns (e.g., body dissatisfaction, body shape concerns) (Durso et al., 2016; Durso & Latner, 2008). Lastly, experiences of weight stigma are correlated with a range of other psychological distress (e.g., antisocial behaviours, hostility, manic/hypomanic episodes, post-traumatic stress disorder, drug dependence, etc.) (see Wu & Berry, 2018).

In addition, consistent studies have also documented the association between experiences of weight stigma and eating psychopathology (Papadopoulos & Brennan, 2015; Vartanian & Porter, 2016; Wu & Berry, 2018). One study found that within a community population, internalized weight stigma was positively associated with binge eating, even after adjusting for BMI (Durso & Latner, 2008). More frequent perceived experiences of weight stigma was also positively correlated with binge eating and/or emotional eating behaviours (Ashmore et al., 2008; Friedman et al., 2008; Wu & Liu, 2015). Moreover, Vartanian and Porter found that more frequent experiences of weight stigma is associated with less healthy eating behaviours, which can potentially lead to negative health and well-being (Vartanian & Porter, 2016).

In regards to exercise behaviours, research shows that more frequent experiences of weight stigma are positively associated with avoidance to exercise and reduced motivation to exercise in higher weight adults (Papadopoulos & Brennan, 2015; Vartanian & Novak, 2011; Vartanian & Shaprow, 2008; Vartanian & Smyth, 2013). Another study revealed that internalized weight bias was negatively associated with all exercise-related variables (i.e., exercise behaviour, exercise motivation, and exercise self-efficacy) (Pearl et al., 2015).

Furthermore, a study revealed that an individual's risk for all-cause mortality is predicted by weight stigma (60%), even when controlling for BMI, thus highlighting the detrimental impact of weight discrimination as it is not only linked to various physical and psychological health concerns but also on life expectancy (Sutin et al., 2015b).

2.1.3. Experienced Weight Stigma

Higher weight individuals directly experience stigma and discrimination due to their weight (Puhl & Brownell, 2001). Experienced weight stigma is characterized by overt discriminatory attitudes and behaviours directed towards individuals or groups due to their weight status (e.g., verbal teasing, hiring prejudice, social exclusion, social rejection, size discrimination in transportation, etc.). Experienced weight stigma has been well-documented in employment, health care, and education (Puhl & Brownell, 2001; Puhl & King, 2013).

Puhl and colleagues (2008) found that lifetime experiences of weight-based discrimination predominantly occurred within employment settings, and included hiring prejudice, promotion prejudice, and wrongful termination (Puhl et al., 2008). These trends parallel evidence from empirical studies. For instance, in an experimental study, average weight hypothetical managers were found to be more desirable than higher-

weight managers (Decker, 1987). Similarly, Klassen and colleagues (1993) found that participants expressed a preference for working with thin employees compared to higher-weight employees (Klassen et al., 1993). In a more recent study, it was reported that employees with higher BMI experienced more weight-based stereotype threat, which consequently led to less perceived work ability (Zacher & von Hippel, 2022).

Weight stigma has been extensively observed in health care settings, including anti-fat bias attitudes exhibited from health care providers (e.g., clinicians, doctors, nurses, medical students, etc.), and weight-biased experiences encountered by patients (Hebl & Xu, 2001; Puhl & Heuer, 2009; Schwartz et al., 2003; Teachman & Brownell, 2001). For example, a recent study found that Canadian physicians held negative attitudes towards treating patients with obesity, which is consistent with cross-sectional evidence from the U.S. (Alberga et al., 2019; Jay et al., 2009). A range of weight-based stereotypes have been documented from health care providers, including beliefs that higher weight patients are lazy, lacking in self-discipline, unintelligent, dishonest, annoying, and non-compliant with treatment (Klein et al., 1982; Puhl & Brownell, 2001; Puhl & Heuer, 2009; Schwartz et al., 2003; Teachman & Brownell, 2001). In addition, current health care practices generally adopt a weight-centric approach to health, thus often equating health with body weight (Mauldin et al., 2022; Tylka et al., 2014). In recent years, the weight-centric approach has come under scrutiny for its lack of effectiveness and tendency to perpetuate negative attitudes towards higher weight individuals (Bacon & Aphramor, 2011; Tylka et al., 2014). Consequently, people with larger body sizes often report feeling disregarded, invalidated, and held responsible for their health problems due to their weight in health care settings (Amy et al., 2006; Guthrie & Wyke, 2006).

Despite receiving less scholarly attention than weight stigma in employment and health care, a growing body of literature highlights the prevalence of experienced weight bias and stigma towards higher weight students in the educational setting (Puhl & Heuer, 2009). A recent systematic review revealed that weight bias is pervasive in educational settings, which has the potential to significantly impact student well-being (Nutter et al., 2019). The study also revealed negative attitudes from teachers towards higher-weight students negatively influenced their perception of student ability (i.e., belief that higher weight children were perceived to be more likely to have academic challenges; Nutter et al., 2019). The experiences of weight-based teasing, which is the most common form of weight-based victimization among youths (Hayden-Wade et al., 2005), resulted in students feeling self-conscious, angry, unappreciated by their peers, low self-esteem, and increased symptoms of depression (Lampard et al., 2014; Li & Rukavina, 2012; Puhl et al., 2011).

Some forms of experienced weight stigmatization may not be experienced directly, but indirectly through a sentiment of anti-fat portrayals in the sociocultural context. The media, including news and entertainment industries, often perpetuate negative stereotypes and biases against people with higher body weight, contributing to the normalization of weight stigma in society (Ata & Thompson, 2010; Brown et al., 2022; Heuer et al., 2011; Puhl et al., 2013; Saguy & Gruys, 2010). For example, Heuer et al., (2011) conducted a content analysis of images associated with online news stories about “obesity” and discovered that most photographic content with higher weight people were portrayed in a negative and stigmatizing manner. Compared to images featuring non-higher-weight individuals, images of higher weight individuals often excluded their head and face, focusing instead on their abdomen and/or lower body, and these images

tended to portray higher weight individuals consuming food and/or beverages, and were less likely to be shown exercising or wearing clothing (Heuer et al., 2011).

Another study conducted by Puhl, Pterson, and Luedicke (2013), investigated the effect of visual media portrayals of “obesity” on weight stigma, and found that majority of participants rated stereotypical images of higher-weight individuals more negatively (e.g., social distance, attitudes, and opinion), and held more negative stereotypes (e.g., lazy, unattractive) compared to non-stereotypical images of higher-weight individuals, which induced more positive attitudes. Overall, experienced weight stigma and anti-fat attitudes are harmful forms of prejudice and discrimination, and collectively, the experiences of weight stigma in daily life result in an array of adverse negative physical and mental health consequences for higher-weight individuals.

2.1.4. Internalized Weight Bias and Stigma

Cumulative experiences of weight stigma are theorized to lead to internalized weight stigma (also called self-stigma; Durso et al., 2012; Pearl et al., 2019; Puhl et al., 2018; Puhl, Lessard, Himmelstein, et al., 2021). Internalized weight stigma (or bias) is a phenomenon in which individuals internalize societal stereotypes and negative attitudes towards higher weight individuals, leading to self-directed anti-fat attitudes and negative self-evaluations (Durso & Latner, 2008). Studies have shown that higher levels of internalized weight bias are associated with a multitude of negative health outcomes, including but not limited to, body image concerns, depression, anxiety, stress, and lower self-esteem (Durso & Latner, 2008; Pearl & Puhl, 2018). While experiencing weight bias/stigma is thought to directly influence the internalization of weight bias and stigma, weight bias internalization can occur through exposure to anti-fat attitudes, in lieu of experienced weight stigma (Pearl & Puhl, 2016). Further, there is a growing body of

literature that suggests internalized weight bias may be a more important predictor of negative health outcomes compared to experienced weight stigma (Latner et al., 2014; Pearl & Puhl, 2016).

A study on the prevalence of internalized weight stigma ($N = 3504$) found a significant portion of U.S. adults (44%) endorse internalized weight bias across the weight spectrum, with a significant positive correlation between internalized weight bias and BMI (Puhl et al., 2018). In a study examining internalized weight bias in a Weight Watchers sample ($N = 18,769$), it was reported that 58.3% of individuals endorsed internalized weight bias (Pearl et al., 2019). Studies have consistently found that higher BMI is positively associated with higher levels of internalized weight bias, indicating that higher-weight individuals are at disproportionate risk of internalizing weight bias and stigma (Pearl et al., 2019; Pearl & Puhl, 2018). In addition, there is also preliminary evidence supporting internalized weight stigma as a mediator between experienced and perceived weight stigma and biopsychosocial adverse health outcomes, such as body shame, body dissatisfaction, disordered eating, etc., (Bidstrup et al., 2022).

2.2. Weight-Based Social Identity Threat Model

Related to the concept of internalized weight stigma, scholars have identified the concept of weight-based social identity threat. This concept describes how individuals who belong to a stigmatized social group may face social identity threat in situations where they sense the possibility of being negatively stereotyped and devalued due to a perceived self-attribute or identity (Steele et al., 2002). Unlike internalized weight stigma, social identity threat occurs based on the knowledge that *others* may endorse this ideology, without necessarily internalizing these negative stereotypes to the self (Major & Schmader, 2018; Steele, 1997). While most research to date has focused on

understanding social identity threat as it relates to race, gender, social class, and sexual orientation, a growing body of research is focusing on weight-based social identity threat (Major & Schmader, 2018).

Weight based social identity threat is a psychological phenomenon that involves individuals fearing the possibility they may be subject to being socially devalued, stereotyped, judged, stigmatized by others due to their weight (Major et al., 2012). The cumulative impact of stigmatizing experiences, whether they are perceived or directly encountered, can have negative effects on the psychological and physical health of individuals who identify with the stigmatized identity (Hunger et al., 2015; Lick et al., 2013; Major et al., 2012; Major & Schmader, 2018; Panza et al., 2019). Grounded in the weight based social identity model, social identity threat contributes to poor health via a series of mechanisms (see Hunger et al., 2015 for review). Specifically, weight based social identity threat elicits physiological stress, which directly influences health behaviours and indirectly impacts mental and physical health. Additionally, it induces psychological stress, motivating individuals to avoid/escape stigma, and also impacting one's capacity for self-regulation, thereby directly influencing health behaviours and indirectly impacting mental and physical health.

2.2.1. Self-Preservation Theory

Related to the weight based social identity threat model (Hunger et al., 2015), the Social Self-Preservation Theory (Dickerson & Kemeny, 2004) proposes that people naturally have an innate motive to maintain and protect their social self against negative evaluations. This theory is supported by adaptive bio-psycho-behavioural processes (e.g., elevated cortisol, alterations in affective responses such as shame, etc.) that respond to social stressors in order to help the individual preserve their social identity (Dickerson &

Kemeny, 2004). In other words, this theory emphasizes that people's sense of self-worth and value is closely connected to social connections and how they are perceived and evaluated by others (Dickerson & Kemeny, 2004). Accordingly, there is a robust body of literature that has documented the effects of social evaluation in eliciting changes in self-esteem, self-conscious emotions, and stress (Dickerson, 2008; Dickerson & Kemeny, 2004; Rohleder et al., 2007; Van den Bos et al., 2014). In relation to weight stigma, individuals who perceive and/or experience weight stigmatization from others, may be motivated to protect their social identity from negative evaluations and prejudice from others to preserve their sense of social self and self-worth. Similar to propositions of the weight-based social identity threat model, it is possible that higher weight individuals who are often subject to weight-based discrimination and negative evaluation may experience certain psychobiological stress responses (Hunger et al., 2015).

Though both frameworks are similar, such that both theories are grounded in the evolutionary need for sense of belongingness, it is important to note its distinction. Weight based social identity threat asserts that an individual's sense of belonging to a specific social group hold significance to their self-concept (Hunger et al., 2015). In the context of body image and weight, individuals who perceives themselves to be higher-weight may be susceptible to weight-based identity threat in which one's social identity may be devalued and discriminated against due to stereotypes and cultural attitudes surrounding higher women individuals (Hunger et al., 2015). When weight-based identity threat is triggered, a certain mechanistic process occurs, which may lead to negative physical/mental health outcomes (see Hunger et al., 2015 for review). While social self-preservation theory hinges on a fundamental evolutionary need to maintain social relationships, preserve social status, and attain acceptance by others (Dickerson et al.,

2009). In the context of body image/weight, social evaluative threats are permeating and negative evaluations of the body by others and the self can result in deleterious social consequences (Lamarche et al., 2012). Social preservation entails a set of psychobiological responses that are elicited when individuals are at risk for negative evaluation from others, in attempt to preserve social self (Lamarche et al., 2012). These response systems are systematic (e.g., self-conscious emotions are selectively elicited) and aims to prevent additional loss of social status (Dickerson et al., 2004; Lamarche et al., 2012).

2.2.3. Psychobiological Stress Response

A growing body of research has examined the psychobiological effects (i.e., cortisol and shame) of weight stigma (e.g., experimental studies, body image threat inductions; Himmelstein et al., 2015; Jung et al., 2020; Schvey et al., 2014; Tomiyama et al., 2018; Wu & Berry, 2018). There is evidence to suggest that the negative health outcomes associated with weight stigma may be mediated by the psychobiological responses elicited by social threats (Hunger et al., 2015). Although adaptive in acute contexts, chronic activation of the psychobiological stress response causes physiological wear and tear, which then impacts overall health and well-being (McEwen, 1998). Thus, many scholars have proposed that the biopsychosocial stress response elicited by uncontrollable evaluative threats, such as weight stigma, may be an underlying factor contributing to health disorders (i.e., “obesity” related diseases) that are commonly attributed to excess adiposity and weight (Dickerson & Kemeny, 2004; Himmelstein et al., 2015; Rubino et al., 2020; Wu & Berry, 2018). Existing experimental stress studies typically examine cortisol and affective state of shame as markers of stress (Cloudt et al., 2014; Lamarche et al., 2014, 2016, 2017; Smyth et al., 2020). In this study, in addition to

cortisol and shame, physiological biomarkers for stress included heart rate variability and two novel biomarkers for stress (salivary uric acid and osteocalcin), along with other psychological measures for stress (i.e., subjective distress and self-conscious emotions).

2.2.3.1. Cortisol Response

A common biomarker for stress is cortisol, which is the body's primary stress hormone. Cortisol is a neuroendocrine stress hormone that is produced by the adrenal glands, specifically the adrenal cortex, and released in response to physical and/or psychological stress (Smyth et al., 2013). Cortisol is released to adapt to stress and maintain homeostasis (McEwen et al., 2007; Smyth et al., 2013). The specific physiological pathway that is activated in response to stress is through hypothalamus-pituitary-adrenal (HPA) axis reactivity. In response to external stressors, the hypothalamus triggers the release of corticotropin-releasing hormone (CRH) into the blood stream (via hypothalamic-pituitary portal blood vessels), which signals the pituitary gland to release adrenocorticotrophic hormone (ACTH), which then stimulates the adrenal glands to produce and release cortisol (Smyth et al., 2013). This process is regulated by a negative feedback loop; thus, the release of cortisol inhibits the hypothalamus and pituitary gland to release their respective hormones to ultimately stimulate cortisol release (Smyth et al., 2013).

There are some studies finding that a dysregulation of the HPA axis (e.g., blunted cortisol response, hyperactive HPA axis, altered feedback inhibition etc.), can be seen in individuals suffering from chronic stress, psychiatric disorders, or traumatic experiences (De Bellis et al., 1994; Harkness et al., 2011; Karin et al., 2020; McEwen et al., 2007). Consequently, a dysregulation of cortisol and other stress mediators contributing to allostatic load (i.e., physiological wear and tear), may be a factor in both psychiatric

disorders as well as systemic disorders, such as diabetes, which may have an underlying psychiatric component (McEwen et al., 2007; Rasgon & Kenna, 2005). There is some research evidence that has shown that uncontrollable contexts, such as social evaluative environments can elicit the largest cortisol reactivity (Dickerson & Kemeny, 2004), thus may present as a “central experience among those who are stigmatized or possesses a devalued social identity” (Dickerson, 2008, p. 1373).

Given that direct and perceived experiences of psychosocial threats are associated with a range of psychobiological markers of stress, thus implicating various physical and psychological health outcomes, a growing body of research has investigated the acute psychobiological stress reactivity to social evaluation and body image threat inductions. For instance, several studies investigating experimental body image threat inductions have reported that the skin-calliper body composition assessment can trigger a cortisol response (Brown et al., 2023; Lamarche et al., 2012, 2016, 2017; Smyth et al., 2020). Further, a study that subjected participants to watch a weight stigmatizing video versus neutral video revealed those in the stigmatizing condition exhibited greater cortisol reactivity than those in the neutral condition, irrespective of participants’ weight status (Schvey et al., 2014). Therefore, the finding suggests that mere exposure to weight stigmatizing stereotypes can trigger a cortisol response, even in individuals who have not personally experienced weight stigma.

Similarly, another study showed that increases in frequency of experiencing weight stigma is associated with increased salivary cortisol and oxidative stress (Tomiyaama et al., 2014). This stress response has been observed in participants who were subjected to anticipatory threats, even in the absence of actual threats (Cloudt et al., 2014). Interestingly, cortisol reactivity was also observed only in self-identified higher

weight participants who were subjected to an acute weight based social rejection paradigm (Himmelstein et al., 2015). Therefore, indicating that self-reported weight status may be an important factor to consider in experimental weight-based social threat inductions. Overall, these studies collectively show that experiences, and even perceived experiences of social evaluation and body image threats, can elicit a cortisol stress response.

2.2.3.2. Uric Acid

In addition to cortisol, uric acid (UA) is another potential biomarker for stress that has begun to receive some research attention in stress studies. UA is a natural waste product formed from the breakdown of purines through the liver, which are compounds found in foods and human cells (El Ridi & Tallima, 2017). UA is linked to both positive (e.g., inflammation regulation) and negative health outcomes (e.g., hyperuricemia; (Lucas et al., 2020).

There are some recent experimental studies examining UA and social evaluative stress that provide evidence for UA's role in stress reactivity. When participants were subjected to an experimentally induced social evaluative stress activity (Trier Social Stress Test; TSST), it was observed that salivary uric acid (sUA) was able to predict cardiac reactivity (i.e., increased systolic and diastolic blood pressure) and also demonstrate direct reactivity to psychosocial stress itself (i.e., elevated sUA; Lucas et al., 2020; Woerner et al., 2019). Further, sUA was able demonstrate direct reactivity and recovery to psychosocial stress before, during, and after the TSST administration (Lucas et al., 2020). There is also evidence to suggest that UA reactivity may be associated to HPA axis activity and ANS activity and may also function as a stress alarm by activating the limbic system in response to stress (Fleshner, 2013; Lucas et al., 2020; Maslanik et

al., 2013; Ulrich-Lai & Herman, 2009). In response to physical stress (e.g., cold pressor task), increased UA was observed 32 minutes after stressor onset, and participants with higher sUA at baseline displayed greater cortisol concentrations after stressor task (Acevedo et al., 2022).

Elevated UA levels have been linked to stress-related diseases, such as cardiovascular diseases and hypertension, which are disproportionately experienced by individuals facing weight stigma (El Ridi & Tallima, 2017; Myers, 2009). As emphasized in Myers (2009), experiences of stigmatization are also most prevalent among marginalized communities (Myers, 2009). Given that the dysregulation of acute stress responses (e.g., increased stress responsiveness, poor recovery, etc.) has been implicated in the pathogenesis of these stress related diseases (Chida & Steptoe, 2010; Panaite et al., 2015) investigating the potential role of UA in the psychosocial stress reactivity of those facing stigma (e.g., weight stigma) is particularly important (Lucas et al., 2020). Furthermore, because most of the existing research on stress-physiology focuses on HPA axis, SNS, and PNS reactivity, the potential impact of UA on stress remains understudied. As such, there is a need for increased research to investigate the potential role of UA in response to stress (Acevedo et al., 2022; Lucas et al., 2020).

2.2.3.3. Osteocalcin

Osteocalcin is another novel biomarker for stress that has received some research attention in stress studies and may be responsive to weight-based social evaluation. Osteocalcin (OCN) is a bone-derived protein hormone produced by osteoblasts and is traditionally thought to be important in bone regulation/mineralization (Komori, 2020; Zoch et al., 2016). Chronic stress is consistently shown to be negatively associated with bone health and positively associated with a higher risk of bone fractures and

inflammation (Forsén et al., 1999; Kiecolt-Glaser et al., 2003; Wu et al., 2009). Chronic stress and inflammation may impact bone health through bone metabolism imbalance, where the activity of osteoclasts (i.e., bone resorption) exceeds osteoblasts (i.e., bone formation), thus resulting in loss of bone density and risk of fractures (Ng & Chin, 2021). There is evidence that experiences of chronic stress are associated with decreased osteocalcin production (Napal et al., 1993). Further, chronic stress is also associated with prolonged activation of the HPA axis, thus impacting sustained hypercortisolemia (Stefanaki et al., 2018), which is important in bone mass regulation (Guo et al., 2018; Lawson et al., 2009).

Some cross-sectional observational studies demonstrated that serum osteocalcin is negatively associated with systemic inflammatory markers, such as IL-6 (Millar et al., 2020; Pittas et al., 2009; Sarkar et al., 2013; Schett et al., 2006). Hence, this suggests that osteocalcin may have an anti-inflammatory effect, as reflected by the inverse relationship between osteocalcin and inflammatory biomarkers, such as IL-6 and c-reactive protein (CRP) levels. This can be supported by Napal et al., (1993), which found that serum osteocalcin level decreases with increased stress.

Further, recent evidence also shows that increases in circulating osteocalcin is present in response to acute stress (i.e., public speaking task) within minutes, and that it may play a role in inhibiting parasympathetic tone during the onset of an acute stressor (Berger et al., 2019). Another study also observed that increased osteocalcin levels are positively correlated with perceived subjective stress (Nguyen et al., 2020). Hence, similar to UA, osteocalcin may play a role in the dysregulation of stress responses that are thought to contribute to metabolic and psychiatric diseases (Nguyen et al., 2020).

Although, there is some evidence suggesting an inverse relationship between serum osteocalcin levels and inflammation (i.e., IL-6; (Millar et al., 2020; Pittas et al., 2009; Sarkar et al., 2013; Schett et al., 2006) and that experiences of chronic stress are associated with decreased osteocalcin production (Napal et al., 1993) which may suggest that osteocalcin may have an anti-inflammatory protective function in response to stress. Alternative evidence suggests higher osteocalcin levels is associated with higher subjective stress (Nguyen et al., 2020), which contributes to conflicting evidence on the role of osteocalcin in acute stress reactivity. Thus, further research is needed to elucidate the specific role of OCN in the regulation of stress. As previous studies primarily focused on analyzing serum osteocalcin levels in relation to acute stress, the emergence of new testing methods for assessing salivary osteocalcin provides an opportunity to explore a new avenue of research involving stress reactivity. Since, there is some preliminary evidence supporting osteocalcin's reactivity and associations to chronic stress and inflammation, it can be proposed that osteocalcin may be a relevant biomarker to examine in response to an induction of stress and social evaluation, and thus future research is warranted to understand the nature of these relationships.

2.2.3.4. Shame

Shame is a self-conscious emotion, and it is experienced when an individual's social self is negatively judged by others, leading to self-directed negative beliefs and evaluation of the self (Dickerson et al., 2004; Gilbert, 1997). Dickerson and colleagues (2004) proposed that "shame results when perceptions of negative *social* evaluation are transformed into negative *self*-evaluation" (p. 1195). Social evaluation can occur in multiple different contexts, including stigmatizing conditions where an individual or

group is made to feel inferior due to a characteristic that is both uncontrollable and non-dominant (e.g., weight) (Dickerson et al., 2004).

Experiences of weight stigmatization and discrimination elicit a certain psychobiological response, including some evidence for the affective state of shame (Dickerson et al., 2004). Social evaluation induction studies have found that affective states of shame are elicited when participants are subjected to social evaluative body image threat (Cloudt et al., 2014; Lamarche et al., 2017; Smyth et al., 2020), and the findings were similar even when participants were subjected to anticipatory social evaluative body-related threat (Lamarche et al., 2014).

Studies have also shown that greater levels of internalized weight stigma are associated with greater levels of body-related shame (Lucibello et al., 2021; Mensinger et al., 2018). In particular, higher-weight individuals (i.e., higher BMI), and individuals who perceive themselves as higher weight tend to experience greater body-related shame, which was related to higher internalized weight stigma (Lucibello et al., 2021). Thus, experiences of shame play a foundational role in the experience of internalized weight stigma and are fundamental to the devaluation of the self. Given that shame, as a primary emotional response to low social status (Gilbert, 2000) and as an affective state that closely resembles stigma (Skinta et al., 2014), some have proposed that shame and the cortisol response are highly interrelated, and both are considered essential factors to the psychobiological stress response to social threats (Dickerson, 2008).

2.2.3.5. Self-Conscious Emotions

Self-conscious (i.e., shame, guilt, embarrassment, and envy) may be other psychological indicators that may respond to an acute weight stigma induction. Distinct from basic emotions, self-conscious emotions entail emotional experiences that are the

result of thinking and evaluating the self (Tangney & Tracy, 2012). Self-conscious emotions are foundational to one's self-concept, specifically the physical self (Harter, 2012; Sabiston et al., 2020). The physical self is one of the multi-dimensional selves that encompasses the body, and this can be in regard to one's appearance (e.g., body, weight, and size), or functionality (e.g., physical competence, fitness, agility, etc.; (Sabiston et al., 2020). Body-specific self-conscious emotions can be elicited in the context of a weight stigma as the body is always present and on display for observation and potential evaluation by others and the self (Harter, 2012). These self-conscious affective experiences are most salient among environments where the body are put on display for potential judgement, such as exercise and sport contexts (Sabiston et al., 2014). This can be extended to health-care contexts as body assessments are a standard medical practice (e.g., anthropometric assessments).

A recent body of research investigating the links between self-conscious emotions and weight stigma has reported positive associations between internalized weight stigma and body-specific self-conscious emotions (Lucibello et al., 2021, 2022, 2023). Moreover, an experimental research study manipulating weight stigma through a weight based social rejection paradigm found increased self-conscious emotions among higher weight (as assessed by BMI) women who gave a dating speech with their weight/body visible and anticipated greater rejection compared to women with lower BMI (Blodorn et al., 2016). Therefore, it can be proposed that feelings of body-related self-conscious emotions may be elicited during a weight stigma induction, where one may anticipate an evaluation of their body.

2.2.3.6. Psychological Distress

Weight stigma is one factor that contributes to lower psychological health among higher weight individuals (Wu & Berry, 2018). It has been well documented that individuals with higher perceived/overt weight stigma experiences display higher levels of psychological distress (including anxiety and depression; Alimoradi et al., 2020; Ashmore et al., 2008; Cheng et al., 2018; Curll & Brown, 2020; Friedman et al., 2008; O'Brien et al., 2016; Papadopoulos & Brennan, 2015; Puhl & Heuer, 2010; Wu & Berry, 2018). Fear of social evaluation can serve as a trigger for the psychological distress arising from weight stigma. A multitude of social evaluation studies typically through the TSST, have reliably found that social evaluation elicits psychosocial stress (e.g., anxiety, psychological stress, etc.; Allen et al., 2014; Buske-Kirschbaum et al., 2002; Jezova et al., 2004; Rimmel et al., 2009; Rohrmann et al., 1999; Sugaya et al., 2012; von Dawans et al., 2011). As such, psychological distress may be one component of psychological effects that may be elicited when subjected to a social evaluative weight stigma induction.

2.2.3.7. Heart Rate Variability

Heart rate variability is one physiological marker for stress and may respond to an acute weight-based stigma induction. The parasympathetic nervous system (PNS), commonly referred to as the “rest and digest” system is a branch of the autonomic nervous system (ANS), which plays a large role on the body’s organ systems, such as cardiovascular (e.g., heart), gastrointestinal (e.g., stomach and digestion), respiratory (e.g., lungs), and immune systems (Chapleau, 2011). The vagus nerve is the primary channel for PNS activity in the heart (Chapleau, 2011), thus PNS activity can be also referred to as vagal tone (Larborde 2017). Vagal tone activity can be indexed by heart

rate variability (HRV), which is a measure of time intervals between the beat-to-beat successive changes in heartbeat (Chapleau & Sabharwal, 2011; Laborde et al., 2017). There are many physiological influences on heartbeat, but the ANS plays the most predominant role (Thayer & Lane, 2007). HRV is a dynamic balance of the ANS (i.e., Sympathetic nervous system (SNS) and PNS), more specifically, greater PNS input decreases heart rate and increases HRV, and greater SNS input increases heart rate and decreases HRV (Porges, 2007).

In recent decades, there has been a growing trend in psychobiological research, particularly stress research, to incorporate measures of HRV, and this is due, in part, to the ease of administering and measuring HRV, as well as its non-invasive nature, which makes it a more practical alternative compared to other measures of PNS activity (Chapleau & Sabharwal, 2011; Laborde et al., 2017). Numerous research studies have linked decreased vagal function (lowered HRV) as an independent risk factor for all-cause mortality, and also a risk factor for all cardiovascular-related diseases including both modifiable (i.e., hypertension, diabetes, abnormal cholesterol, smoking, exercise) and non-modifiable factors (i.e., family history of early heart disease or stroke; see Thayer & Lane, 2007). Vagal function is also related to increased levels of inflammation and negative affect (i.e., negative affect processing and regulation), which is proposed to be a factor contributing to health and diseases, such as cardiovascular diseases (Thayer & Lane, 2007).

Jordan and Smith (2014) reported that social evaluative threats such as threats to social acceptance (i.e., acceptance, inclusion, connection) and social status (i.e., status, achievement, influence) can lead to a sympathetic-mediated cardiac activity response (Jordan & Smith, 2023). Likewise, a systematic review revealed that both cross-sectional

and experimentally induced measures of racial discrimination are linked to reduced HRV (Panza et al., 2019). Other studies examining physiological stress in response to social evaluation have found that induced weight stigma can lead to changes in cardiac reactivity (Hunger et al., 2015; Major et al., 2012).

On the other hand, elevated HRV is an indicator of robust physiological function, self-regulating capacity, and resilience to stress, and has been linked to various positive health outcomes, including, cardiovascular, autonomic, psychological, and social wellbeing (Laborde et al., 2017; McCraty & Shaffer, 2015). Greater HRV has been shown to be positively associated with social functioning and self-soothing capabilities in response to stress (Porges, 2007). Similar to HRV, respiratory sinus arrhythmia (RSA) is a natural variation in heart rate that occurs when breathing as a result of a physiologic interaction between respiration and circulation, whereby inhalation shortens, and exhalation lengthens the R-R interval on an electrocardiogram (ECG) (Yasuma, 2004).

2.3. Self-Compassion

Since a growing body of research has found that experiences of acute social stress, such as weight stigmatization, can lead to various psychobiological health outcomes, and that these experiences are most prevalent and pervasive among marginalized identities, it is pertinent to identify evidenced based strategies to mitigate the deleterious consequences of such experiences. Recent research proposes self-compassion as a modifiable factor that may foster resiliency against negative experiences through adaptive responding, affiliative processing, and self-soothing abilities via PNS activity (Arch et al., 2014). Self-compassion is grounded in Buddhist philosophy and (Neff, 2003a) involves taking a non-judgemental perspective towards one's pain by

recognizing that feelings of pain, personal inadequacy, and failure are a shared universal human experience (Neff, 2003a).

The adoption of a Westernized iteration of self-compassion originally rooted in Eastern Buddhist philosophies raise several ethical implications that warrant careful contemplation. It is important to acknowledge the origins of self-compassion as this thesis study takes a Westernized perspective of self-compassion. Equally vital is the cautious avoidance of any misinterpretations or distortions of the fundamental tenants of self-compassion during the process of adaptation.

Greater levels of self-compassion have been linked to a range of positive health outcomes, including lower mental health issues (i.e., depression, anxiety, and stress (MacBeth & Gumley, 2012) and increased overall well-being (Zessin et al., 2015). Compassion-focused therapy (CFT) is largely shaped through an evolutionary perspective for social and affiliative processing (Gilbert, 2014), and inducing self-compassion in individuals has been shown to yield physiological and psychological benefits (Desbordes et al., 2012; Gilbert, 2014; Weng et al., 2013), as well as therapeutic benefits (Hofmann et al., 2011). There are a multitude of different modalities used to induce self-compassion, such as self-compassion guided meditations and self-compassion guided writing exercises, both of which are used in therapeutic contexts of CFT and mindfulness-based therapies (MBT).

Since compassionate responding may facilitate an adaptive response to stress, recent research has examined self-compassion (e.g., trait and acutely induced state self-compassion) and the psychobiological response to stress through various experimental modalities. Collectively, these studies suggest that self-compassion may be effective in buffering the negative psychobiological stress of social stress.

2.3.1. The Polyvagal Theory and Compassionate Responding

Understanding the psychobiological mechanisms of self-compassion is critical to understanding how responding compassionately can mitigate psychobiological stress. From an evolutionary perspective and based on Porges' (2007) polyvagal theory, the myelinated vagus is a part of the parasympathetic branch of the ANS within mammals and is evolved to facilitate prosocial behaviour (see Porges, 2001, 2007 for an analysis of the phylogenetic development of the ANS). The vagus nerve is responsible for regulating the ANS through PNS activation (i.e., rest and digest) and SNS inhibition (i.e., fight or flight; (Porges, 2007). It innervates the muscles of the head and face, and also multiple internal organs (e.g., heart, stomach, lungs, intestines), and functions to promote relaxation, facilitate calmness, and self-soothing affective states, and fostering affiliative and prosocial behaviour (Kirby et al., 2017; Porges, 2001; Siegel & Germer, 2012). This nerve acts as a vagal brake, which actively inhibits or disinhibits the vagal tone of the heart to either immobilize or mobilize the heart respectively (Porges, 2001).

The vagal brake is an adaptive responding of cardiac output to visceral state by speeding or slowing down (i.e., calming) heart rate (Porges, 2001). Vagal tone, which is degree of vagus nerve's activation on the ANS can be indexed by HRV and RSA and some scholars have proposed that high vagal tone (i.e., higher HRV and RSA) is associated with the ability for affect regulation, self-regulation, and prosocial behaviours (Porges, 1991; Thayer & Lane, 2000, 2007).

Taken together, the vagal brake is a neurophysiological mechanism that facilitates the cardiac requirements for mobilization, self-soothing and affiliative processing (Porges, 2001). The vagus nerve's neural pathways are intricately linked neuro-physiologically and behaviourally to the body's adaptive stress response and coping

abilities (Porges, 2001). Thus, “the polyvagal theory links the evolution of the ANS to affective experience, emotional expression, facial gestures, vocal communication, and social behaviour, and provides an explanation of stress-related responses” (p. 127; Porges, 2001).

Self-compassion is proposed as a method to activate the adaptive response and affiliative processing that may be useful when facing social evaluative stressors (Arch et al., 2014; Leary et al., 2007; Neff & Vonk, 2009b), by activating the PNS activity, therefore inhibiting the SNS cardiac output, and inhibiting HPA axis activity (Porges, 2007). Similar to vagal activity within the ANS, compassionate responding functions to promote prosocial behaviour (e.g., social connections), caretaking and self-soothing abilities, and disengagement with negative affective emotions, such as distress (Batson et al., 1987; Eisenberg et al., 1989; Goetz et al., 2010; Stellar et al., 2015). Likewise, increased vagal tone (i.e., parasympathetic activity) within the body is associated with a calming effect and affect regulation, to which both effects are similar to the outcomes of compassionate responding (Rockliff et al., 2008). Hence, self-compassionate responding may be analogous to vagal tone activity within the ANS, to facilitate resiliency and adaptive responses to environmental stressors and challenges.

2.3.2. Self-Compassion as a Buffer to the Psychobiological Stress Response

2.3.2.1. Self-Compassion and Cortisol

The emotional state of compassion, similar to HRV, may be effective in dampening the cortisol response to psychosocial stress by activating the PNS, thus leading to an increased capacity for self-soothing in response to psychosocial stressors (Rockliff et al., 2008). Several studies provide empirical evidence supporting the idea that the cultivation of compassion or mindfulness and possessing high levels of trait

compassion, can attenuate cortisol reactivity to acute social evaluative threat (Abelson et al., 2014; Breines, Thoma, Freeman, et al., 2014; Cruess et al., 2015; Engert et al., 2017). However, the evidence is somewhat mixed (see Morton et al., 2020), as some studies have found no significant effects on cortisol levels (Arch et al., 2014; Lara, 2020; Maeda, 2022; Pace et al., 2009).

Interestingly, recent research suggests that high trait self-compassion is associated with lower perceptions of stress and reduced cortisol response to a social evaluative stressor (Ketay et al., 2022). In addition, another study found that trait self-compassion played a role in moderating the effects of induced self-compassion on cortisol recovery, specifically, participants who engaged in a self-compassion induction exercise demonstrated a quicker cortisol recovery, especially for those with lower levels of trait self-compassion (Maeda, 2022). This is consistent with Arch et al., (2018), who found that individuals with social anxiety disorder benefitted more from a self-compassion writing exercise than healthy controls with higher levels of trait self-compassion (Arch et al., 2018). These findings suggest individuals' level of dispositional self-compassion may be an important factor on their cortisol reactivity/recovery, such that those high in trait self-compassion may be more open towards a compassionate thinking style, thus ultimately impacting one's subjective stress and cortisol response (Maeda, 2022). Given that participants in the current study have no prior experience with self-compassion and mindfulness practices, it is anticipated that even acute self-compassion practices will provide some benefits to mitigating stress.

2.3.2.2. Self-Compassion and Uric Acid

While the relationship between UA and self-compassion remains unexplored, there is robust evidence demonstrating the positive psychological and behavioural health

outcomes of self-compassion, including positive mental health, and reduced negative affect, stress, and inflammation (Breines, Thoma, Gianferante, et al., 2014; Homan & Sirois, 2017; MacBeth & Gumley, 2012; Stutts et al., 2018; Trompetter et al., 2017). Specifically, trait self-compassion has been found to be associated with lower levels of interleukin-6 (IL-6) following exposure to acute psychosocial stress, thus suggesting that self-compassion may have a protective effect against the inflammatory physiological response to stress (Breines, Thoma, Gianferante, et al., 2014). According to a review of UA literature, stress (i.e., pro-oxidative states) and inflammation (i.e., proinflammatory states) are both found to be correlated with elevated levels of UA (Gherghina et al., 2022). Since higher dispositional levels of self-compassion are linked to lower pro-inflammatory cytokines, it can then be proposed that acute self-compassion practices may be one method to reduce UA levels, thereby potentially dampening the oxidative and inflammatory stress within the body as well.

2.3.2.3. Self-Compassion and Osteocalcin

Currently, there is limited research attention exploring self-compassion and osteocalcin. However, osteocalcin has been associated with chronic stress and inflammation through various mechanisms. One method to combat this is through compassionate responding. Self-compassion can inhibit HPA axis activity that is activated through experiences of chronic stress and inhibit SNS activity while activating PNS activity to facilitate affiliative processing and the ability to self-soothe (Porges, 2007). Since chronic stress and inflammation has been shown to negatively impact bone-health, and thus extending the negative effects to osteocalcin (i.e., decreased osteocalcin), it can be proposed that self-compassion may serve to alleviate psychobiological stress and thus indirectly leading to beneficial effects on osteocalcin levels as well.

The exact nature of the relationship between chronic stress, inflammation, and osteocalcin is not well understood, and as such more research is needed to fully understand the relationships. It is also important to note that there are an absence of direct evidence linking self-compassion to osteocalcin, and thus the proposed research is the first to our knowledge to examine this directly.

2.3.2.4. Self-Compassion and Shame

Scholars have proposed that self-compassion may be one method to facilitate adaptive responding to social evaluative stress, including the response of shame (Neff & Vonk, 2009b). The emotional state of self-compassion is considered a direct antonym of shame and self-criticism, (Gilbert & Procter, 2006; Kim et al., 2011; Neff, 2003b), and analogous to self-acceptance (Neff, 2003b). Considerable evidence finds both self-compassion and mindfulness to be inversely associated with the emotional experience of shame (Barnard & Curry, 2012; Kelly et al., 2014; Sedighimornani et al., 2019; Zhang et al., 2018). Self-compassion (state and trait) is also associated positively to indices of psychological well-being (Allen & Leary, 2010; Zessin et al., 2015). In regard to stress, self-compassion has been found to reduce the effect of sport-specific stress on shame in a daily diary study (Röthlin et al., 2023).

One supporting theory to describe self-compassion's protective effect on shame and stress may be explained using Skinner's five core categories of coping, positive cognitive restructuring (Skinner et al., 2003). Positive cognitive restructuring involves changing and adapting one's perspective towards a stressful situation, with the overall intention to view the situation in a more positive light (Allen & Leary, 2010). To a certain extent, self-compassion also involves positive cognitive structuring, as individuals high in self-compassion view stressful events as less distressful than those low in self-

compassion, possibly using secondary control strategies such as acceptance and positive reinterpretation to cope with stress (Allen & Leary, 2010; Neff et al., 2005). A group-based compassionate mind training (CMT) intervention utilizing cognitive restructuring strategies to combat self-criticism and foster self-compassion found significant reduction in participants' self-reported shame, depression, and self-attacking tendencies (Gilbert & Procter, 2006). Particularly, the interventions that draw from Compassion-Focused Therapy (Gilbert, 2010), has been empirically supported in its ability to mitigate shame and self-criticism by fostering compassion for the self and others (Carter et al., 2020; Gilbert, 2010).

A randomized control trial using CFT found that participants in the CFT condition exhibited significant decreased feelings of shame, self-criticism, depression, and stress (Matos et al., 2017). Similarly, another study showed that mindfulness-based cognitive therapy was able to increase self-compassion and decrease shame-proneness in anxious and depressed patients (Proeve et al., 2018). Furthermore, there is evidence suggesting the potential role of self-compassion at alleviating the effect of shame and mitigating negative mental health symptoms (e.g., depression and anxiety), and as well as the effects of traumatic experiences (e.g., post-traumatic stress disorder; (Au et al., 2017; Bhuptani & Messman, 2022; Callow et al., 2021; Kotera, Kotera, et al., 2022; Kotera, Tsuda-McCaie, et al., 2022). Taken together, these findings suggests that self-compassion may be proposed as a coping strategy and resilience factor against negative affective states such as shame.

2.3.2.5. Self-Compassion and Self-Conscious Emotions

There has been consistent evidence negatively linking self-compassion with body specific self-conscious emotions (Breines, Toole, Tu, et al., 2014; Daye et al., 2014; Pila

et al., 2022; Sick et al., 2020). Individuals high in trait self-compassion also report greater emotional well-being compared to those low in trait self-compassion (Bluth et al., 2016). Affect regulation may be one possible explanation towards the negative associations found between self-compassion and self-conscious emotions (Inwood & Ferrari, 2018). As self-compassion has been shown to be able to induce affect regulation, it is proposed that self-compassion may serve to attenuate negative affect, such as body specific self-conscious emotions, through affect regulation (Berking & Whitley, 2014; Inwood & Ferrari, 2018).

2.3.2.6. Self-Compassion and Psychological Distress

Self-compassion has been consistency linked with lower levels of psychological distress (Eccles et al., 2023; Marsh et al., 2018; Pullmer et al., 2019, 2021; Terry et al., 2013). Various studies have documented the positive psychological effects of self-compassion, and its beneficial role in mitigating psychological distress (Marsh et al., 2018; Neff, 2009; Stutts et al., 2018; Walton et al., 2020; Whitehead et al., 2021). One explanation could be that cultivating self-compassion contributes to developing resiliency and adaptive coping mechanisms to negative psychological experiences (Arslan, 2023; Neff, 2011). Extending to the focus to body image, scholars have emphasized the benefits of practicing self-compassion (Braun et al., 2016; Linardon et al., 2020), as cultivating self-compassion may serve to foster effective coping mechanisms for individuals subject to weight stigma (Pullmer et al., 2021). As such, it is evident that self-compassion has the potential to facilitate resilience against psychological distress caused by weight stigmatization.

2.3.2.6. Self-Compassion and Heart Rate Variability

The emotional state of compassion is closely associated with activity within the ANS, in fact, there are empirical evidence suggesting that compassionate responding can exert a positive influence on vagal tone and thus consequently targeting the elevation of HRV (Kirby et al., 2017; Kok et al., 2013; Stellar et al., 2015). For instance, some research has suggested that increased RSA (i.e., increased PNS activity) is associated with compassion (Stellar et al., 2015), and that higher HRV (i.e., elevated PNS activity) is a hallmark of compassionate responding (Kirby et al., 2017).

Meditation is a common intervention method, and studies have shown that participants undergoing a brief self-compassion guided meditation demonstrated increased vagal tone and positive emotions compared to controls (Kok et al., 2013). Similarly, Arch et al., (2014) demonstrated that participants in a self-compassion guided meditation program exhibited buffered psychobiological response to social evaluative stress, through increasing HRV and decreasing subjective anxiety compared to controls (Arch et al., 2014). A study examining the impact of a 12-week CFT intervention on HRV during a self-critical and self-compassion writing task, found that participants exhibited low HRV during a self-compassion writing task compared to baseline with slow increases in HRV following post writing task recovery, thus demonstrating HRV reactivity to the writing activity (Steffen et al., 2021). Though it is important to note, a similar HRV response was seen in the self-critical writing task group as well (Steffen et al., 2021).

Experiments aimed to induce self-compassion in participants through CFT have demonstrated elevated HRV during acute compassionate exercises compared to baseline HRV (Kim et al., 2010). However, individual differences exist as some participants did

not exhibit significant HRV fluctuations, however, it is noteworthy to add that those with lower baseline HRV levels tend to respond and benefit most from compassionate practices (Kim et al., 2010). Luo et al., (2018), investigated HRV response to acute stress (TSST) in a high trait self-compassion group versus low trait self-compassion group. Findings revealed that participants in the high self-compassion group exhibited higher baseline vagally mediated HRV (vmHRV), and that the higher self-compassion group showed faster recovery of their vmHRV during the TSST compared to the low self-compassion group (Luo et al., 2018). Further, participants in the high self-compassion group also demonstrated less negative affect in response to the TSST (Luo et al., 2018). Thus, the results reveal that higher trait level self-compassion is correlated with improved psychobiological response to acute inductions of stress.

2.4. Research Objectives

Weight stigma is a major driver of health inequality, particularly for higher weight women, and necessitates intervention strategies to reduce the deleterious consequences. Acute self-compassion strategies can be effective at attenuating the psychobiological effects induced by a chronic activation of weight-based stigma. This will be the first experimental study to investigate the effects of self-compassion on the psychobiological responses to weight stigma and holds promise for the development of psychological intervention strategies for higher-weight women.

The primary objective of this randomized pilot experiment was to examine feasibility and establish parameter estimates for a laboratory protocol to quantify the psychobiological responses to an acute psychosocial stress induction. Using weight-based social identity threat as a model, this protocol will test if an acute self-compassion intervention can attenuate psychological (i.e., body-related self-conscious emotions,

shame, subjective distress, and internalized weight bias) and physiological responses (i.e., salivary cortisol, uric acid and osteocalcin, and heart rate variability) to induced social stigma. Following the typology for pilot studies outlined by Thabane et al., (2010) specific objectives as follows:

1. Process Assessment: Examine acceptability of both the self-compassion intervention and weight stigma induction to participants. Establish feasibility of recruitment goals and examine participant demand.
 - i. Can we recruit and pre-screen $n=60$ eligible participants from the Western University and London communities?
 - ii. What proportion of interested participants are eligible to participate per inclusion/exclusion criteria?
 - iii. What proportion of eligible participants agree to participate in the experimental manipulation?
 - iv. What is the attrition rate from agreeing to participate to end of study?
 - v. Can participants adhere to the pre-lab lifestyle modification instructions?
 - vi. Are all aspects of the experimental protocol acceptable to participants?
 - vii. What proportion of participants (if any) express objection to the induction, refuse to participate or choose to withdraw due to the induction?
 - viii. What is participant perception of the study?
 - ix. Is deception (i.e., selection on basis of heavier weight identification and purpose of body composition assessment) successful?
2. Resources Assessment: Test the practicality of the proposed experimental protocol.
 - i. Can the experimental protocol be completed with the currently allocated resources (e.g., time, funding, personnel)?

- ii. How long does it take to recruit and screen $n=60$ eligible participants?
 - iii. How long does it take to complete $n=60$ experimental manipulations for all eligible and consenting participants?
 - iv. Can saliva samples be collected, stored, and sent to Salimetrics for analysis in a timely and efficient manner?
 - v. Is the available/procured technology (e.g., heart-rate monitors, saliva collection devices) able to collect data with reliability, validity, and minimal technical complications?
3. Management Assessment: Test research group's ability to implement experimental protocol including self-compassion intervention, weight-based social-evaluative induction, and biological biomarker collection.
- i. Can the researchers/research assistants guide participants through all aspects of experimental protocol, including acute self-compassion induction and weight stigma induction?
 - ii. Can biomarker data be successfully collected per planned protocol (i.e., continuous ECG data; saliva at 5 precise time-points) while maintaining internal validity?
 - iii. Can data be recorded accurately, securely and in an efficient manner?
 - iv. What management or organizational challenges may arise and how can they be effectively resolved?

The secondary objective was to examine proof of concept of the acute laboratory experiment, which entailed (i) investigating the psychobiological responses (i.e., HPA axis reactivity, salivary cortisol, HRV, state distress) to a weight-based social evaluative induction, and (ii) examine whether an acute self-compassion intervention dampened the

negative effects induced by a weight-based social evaluation induction compared to a control condition.

Exploratory objectives of this study were to examine salivary osteocalcin and salivary uric acid responses to the weight-based social-evaluative induction, across conditions.

2.4.1 Hypotheses and Feasibility Criteria

1. Process Criteria:

- i. n=60 eligible participants can be screened and tested within a 1-year timeframe (accounting for an average of ~1-2 eligible participants screened and tested per week).
- ii. <5% of participants withdraw from study during acute experimental manipulation.
- iii. ~25% of screened participants are eligible.
- iv. >95% adherence to pre-lab instructions.
- v. Deception successful in >95% of participants.
- vi. No participants experience reported adverse events (i.e., clinically significant and protracted distress or psychological symptoms).

2. Resources Criteria:

- i. The experimental protocol can be completed (data collected for n=60 participants) within 1-year timeframe, within \$25,000 budget, and with currently identified research team (PI, Co-I, 2 student investigators).
- ii. Biomarker data can be collected with reliability and validity using procured technology (i.e., Polar H10 HR Monitor and Salimetrics SalivaBio Oral Swabs).

3. Management Criteria:

- i. Biomarker data can be successfully collected per protocol with <5% missing or erroneous data.

For secondary objectives, it was hypothesized that the weight stigma induction would elicit heightened psychobiological stress (i.e., salivary cortisol, uric acid, and osteocalcin, HRV, state shame and guilt, internalized weight bias, and subjective distress) across all participants. Secondly, it was hypothesized that women who complete the self-compassion intervention would exhibit a dampened psychobiological stress response reactivity (i.e., lesser increase in cortisol levels and/or less sustained elevation) and attenuated sympathetic nervous system reactivity/increased parasympathetic nervous system reactivity (i.e., greater HRV and/or attenuated decline in HRV) pre/post manipulation when compared to the control condition. It was also expected that participants randomized to the self-compassion intervention would exhibit lower state shame, guilt, subjective distress, and internalized weight bias scores in response to the weight-based social evaluative threat when compared to the control condition.

For the exploratory hypotheses, no a priori hypotheses were made regarding salivary osteocalcin and salivary uric acid responses.

Chapter 3

3 Methodology

3.1 Sample

Cis-gender young adult women (N = 37) aged 18-34 who perceive themselves to be “average”, or “higher weight” were recruited from the London, Ontario community. Inclusion criteria included (I) female-born and women-identifying, (II) aged 18-34 inclusive, (III) can read and communicate in English and provide informed consent, (IV) self-identify as “average” or “higher weight”. Exclusion criteria includes (I) currently smoking nicotine and/or tobacco usage, (II) regular user of cannabis products, (III) current usage of recreational drugs, (IV) current and active use of any oral prescription medication (excepting contraceptives), (V) chronic health conditions as diagnosed by a licensed medical professional (excepting obesity), (VI) fever or illness on the day of experiment, (VII) pregnant or currently breastfeeding, (VIII) prior experience with self-compassion training, compassion interventions, or prior experience with formal mindfulness or mediation training.

The specific group characteristics and inclusion/exclusion criterions were selected for various reasons. The study was limited to cis-gender women as women face higher levels of weight-based social rejection (Puhl & Heuer, 2009) and because sex differences has been observed in cortisol reactivity in response to psychological stressors, with women displaying higher levels of salivary cortisol compared to men (Larsson et al., 2009). Additionally, in order to stimulate weight-based social identity threat, participants must identify as “average” or “higher weight” (Himmelstein et al., 2015). Given the known influences of medication usage, smoking nicotine/tobacco, and recreational drugs

(including alcohol) on cortisol response to acute stress, these criteria are excluded (Granger et al., 2009; Kirschbaum et al., 1999). Prior research has shown inconsistent results pertaining to frequent marijuana use on cortisol levels (Cservenka et al., 2018). However, as several studies have linked frequent marijuana use to higher basal cortisol levels (King et al., 2011) and reduction in salivary flow due to Xerostomia (i.e., dry mouth; Rees, 1998), which can influence the amount of saliva collected and the physical composition of the saliva (i.e., pH, viscosity; (Granger et al., 2009), the decision to exclude this criteria was warranted.

3.1.2. Recruitment

Participants were recruited from the London, Ontario community, both within and beyond the university. Recruitment strategies within Western University were focused on mass emails (Appendix C) directed towards all undergraduate, graduate, and staff faculty members. Additionally, social media posts and flyers around campus were also distributed. See Appendix D for the study's recruitment poster. Recruitment strategies targeting the greater London community were focused on postings at community centers, grocery stores, online social media boards, and other community resources. The study was advertised generally as 'investigating hormones and cardiovascular function in young women'.

3.2 Design

The Western University research ethics board has granted approval for this study (Appendix A). Prior to participant recruitment, the study protocol was pre-registered on *Clinical Trials* (Appendix B). The study consisted of three-parts: (1) a pre-screening phone call to confirm eligibility, (2) initial in-lab assessment, and (3) second in-lab experimental session. Participants received a cash compensation (\$10) for participating in

the initial in-lab assessment and (\$40) for participating in the second experimental lab assessment.

3.2.1. Telephone Pre-screening Interview

Interested prospective participants who contacted the researchers via email were provided a letter information (Appendix E) and scheduled for a brief telephone screening interview to learn more about the study and confirm eligibility. The researcher called the participants at the scheduled date/time and provided an overview of the study, including the screening procedure (Appendix F). After obtaining preliminary verbal consent, the researcher collected participant contact information, and then prospective participants received a random, anonymous ID number which was used for all data collection from this point forward.

The researcher asked participants a series of pre-screening questions in an interview format to determine eligibility. To screen for participants who identify as “average” to “higher weight,” participants were asked a series of unrelated/screening questions, then asked about self-perceptions of weight. It was necessary to include these questions at the screening phase, rather than at the recruitment/study advertisement phase, as to not prime participants of the study intent and thereby risk influencing knowledge about the manipulation. Once the screening interview was completed, the researcher informed participants of whether they were eligible to participate in the next study session. Individuals who did not meet the eligibility criteria were not invited to participate in the subsequent stages, and no further details regarding this invitation were provided to not impact the study knowledge of other potential participants. Ineligible participants were reminded of their right to withdraw their screening data at this point. If eligible, participants were invited to book two visits to the lab for the baseline assessment

and experimental manipulation that are at least 24 hours apart. Upon the completion of the phone call, participants were emailed a confirmation of their appointment times, with a copy of the Letter of Information/Consent (Appendix G) for the experimental manipulation and pre-lab instructions (Appendix H) to prepare for their second lab visit. Participants were asked to review this information prior to coming to the first lab session, so they could ask any questions they have about study procedures before providing written informed consent.

3.2.2. Initial In-Lab Baseline Assessments

The first in-lab session was comprised of the informed written consent and computerized surveys to collect demographic and psychological baseline measures (Appendix I). This session also served as an acclimatization to the lab environment, to minimize anticipatory anxiety and/or novel environment effects that may confound psychobiological stress measures during the experimental manipulation. Participants came to the research lab on their scheduled day for the 20-minute assessment. The researcher went through the informed consent process and verbally described the two parts of the study (i.e., baseline assessment and experimental manipulation session) in impartial and easily understandable terms, following a standardized script (Appendix J). Participants were provided a paper copy of the Letter of Information/Consent (which was emailed to them prior; Appendix G) and were given the opportunity to read through the letter and ask questions. Once signed, participants were provided a copy of the signed consent form.

All participants were then asked to complete the baseline survey on an iPad. Once the baseline measures were completed, the researcher reminded participants of their second scheduled lab visit and reviewed the pre-lab instructions (oral explanation and a

paper copy, previously emailed) to prepare for their next lab visit. The pre-lab instructions were employed to maintain internal validity of collected biomarkers and were selected based on standard practices and evidence-based recommendations for psychobiological research. Participants were instructed to avoid taking any drugs or non-prescription medication (except oral contraceptives) (Arch et al., 2014), consuming any alcohol (Laborde et al., 2017), or engaging in intense physical exercise (e.g., intentional moderate to vigorous intensity exercise sessions such as aerobic training, strength training, circuit training, sports, etc.) (Laborde et al., 2017). In addition, they were asked to adhere to their regular sleep routine the night before the lab session and record their bedtime and wake time (Laborde et al., 2017). Participants were asked to avoid drinking any caffeinated beverages or engaging in exercise in the 3 hours prior to the lab session (Arch et al., 2014). Further, participants were instructed to avoid eating any food or drinking any beverages except water the 1 hour prior to the start of the lab session (Arch et al., 2014).

Participants were asked to bring a sports bra and spandex shorts (Cloudt et al., 2014; Lamarche et al., 2014) for the body compassion part of the experiment, and if they do not have a suitable outfit or prefer to not bring one, the researchers were to provide sports bras and shorts in a range of sizes for use at the lab. Additionally, they were instructed to bring a quiet, non-electronic individual activity (i.e., readings, homework, books, magazines) because some portions of the study may require quiet resting. Neutral magazines were provided as alternatives if participants preferred to read the provided magazines. Lastly, if participants were unable to adhere to these instructions, they were asked to contact the researchers to reschedule their lab session. At the end of the initial session, participants were compensated with \$10 cash.

3.2.3. Experimental Manipulation

All experimental sessions took place between 1 pm and 5 pm to control for diurnal variation in cortisol (following Arch et al., 2014) and were conducted in a light- and temperature-controlled laboratory. Figure 1 displays a flow chart, depicting the experimental design of the study.

3.2.3.1. Randomization

A third-party personnel who was uninvolved in the study was enlisted to perform a randomization protocol for upcoming experimental lab session appointments using an online random number generator. The third-party personnel prepared a series of 60 sealed envelopes that contained allocation into one of the two conditions. The study investigator opened each envelope with the study participant at the start of the second lab visit.

3.2.3.2. Baseline Data Collection and Pre-Lab Protocol Confirmation

Upon arriving to the laboratory, participants were welcomed by a researcher. The researcher refreshed the participants of the general study protocol, reviewing the information they received when they provided informed consent (following a standardized script; Appendix K). A researcher-facing baseline questionnaire (verbally read by the researcher) was administered to the participant to confirm that participants adhered to the pre-lab instructions (i.e., diet, exercise, medication, alcohol, etc.). Further questions requested participants to report on other factors that may affect physiological induces (i.e., sleep, menstrual cycle, caffeine, dental health, acute illness/infection, COVID-specific screening; (Appendix L). If participants reported any deviation from the instructions or other factors that may acutely impact physiological indices –they were asked to re-book their lab visit.

Upon completion of the verbal pre-lab questions, the researcher fitted each participant with a Polar H10 HR Monitor to begin the continuous collection of ECG data. Participants were asked to minimize movement while sitting or standing in order to maintain validity of the ECG measurements. Then, participants were asked to stand quietly for 10 minutes for a baseline HRV measure (Laborde et al., 2017). The researcher sat at a computer in the same room as the participants, but facing away from them, to remove any potential evaluative threat. Half of this period will serve as the 5-minute acclimatization to the HRV baseline measurement posture (i.e., standing) and laboratory environment (Laborde et al., 2017). Then, the baseline HRV measure was taken for the remaining 5 minutes, though was not specifically announced to the participants (Laborde et al., 2017).

After the baseline HRV measurement was collected, the researcher obtained the participants' baseline saliva sample, again recording the precise time of measurement. Then, the participants were asked to complete baseline psychological measurements on a participant iPad.

3.2.3.3. Acute Intervention

Over the next 30 minutes, participants who were randomized into the self-compassion condition were guided through the 30-minute acute intervention. Participants in the no-intervention (resting) control group were asked to sit quietly for 30 minutes. Control participants were able to read neutral magazines provided or the reading material they brought in, or work on pen-and-paper homework, but were asked not to use outside electronic devices or communicate with anyone external. Immediately after the self-compassion induction (or rest), participants completed a measure of state self-compassion

as a manipulation check and repeated state psychological measures taken at baseline on the participant iPad.

3.2.3.4. Self-Compassion Induction

This 30-minute acute self-compassion intervention employed a multimodal, experiential approach that is regularly utilized in self-compassion training (Germer & Neff, 2019) and aimed to maximize efficacy across participants by targeting compassionate states through different modalities.

The intervention began with a brief, 5-minute psychoeducational overview of self-compassion, explaining its conceptual components (Neff, 2003a) and its utility as a self-soothing system in a way that emphasizes threat responses (i.e., shame, self-criticism) as evolved self-protective mechanisms (Gilbert & Procter, 2006; Kirby, 2017). This psychoeducation was delivered by the researcher via a very brief PowerPoint presentation and standard script (Appendix M). Next, participants were guided through an 18-minute self-compassionate meditation, as mindfulness is a key component of self-compassion (Germer & Neff, 2019). Specific strategies that are commonly employed in compassion training and which are known to activate the parasympathetic system – such as breathing practice and somatosensory awareness – were present in the meditation to strengthen the physiological soothing response (Kirby, 2017). This meditation also integrated compassionate imagery, drawing from a paradigm that has been shown efficacy in decreasing cortisol and increasing HRV (Rockliff et al., 2008). The meditation verbally instructed participants to imagine an external source sending them compassion, emphasizing what it would feel like to receive that unconditional love and acceptance.

After the guided meditation, participants completed a 10-minute compassionate writing task (Appendix O). Self-compassion writing inductions have been used in

interventions that have successfully elicited more adaptive physiological (Halamova et al., 2019) and psychological (Leary et al., 2007) responding. Participants were asked to write a compassionate letter to themselves, following Neff's (2017) prompts that instruct participants to consider which self-perceived imperfections make them feel inadequate, and to write a response to themselves from the perspective of an imaginary, unconditionally loving, accepting, and compassionate friend. These prompts invoke all three conceptual components of self-compassion (self-kindness, common humanity, and mindfulness; Neff, 2017) and were intended to help participants adopt a psychologically balanced, mindful, and adaptive perspective towards difficult feelings.

At the end of the compassion intervention (or control), the participants were asked to complete a second psychological survey including a measure for state self-compassion (Neff et al., 2021) as a manipulation check.

3.2.3.5. Weight Stigma induction

An anthropometric assessment including a standard three-site (triceps, iliac crest, thigh) skinfold body composition assessment and height and weight measurements was used to induce weight stigma (Jackson et al., 1980). Participants underwent the assessment while wearing a physically revealing outfit (i.e., sports bra and spandex shorts) which they were asked to change into at the beginning of the weight-stigma induction. This paradigm has been shown to successfully induce social evaluative threat in young women, eliciting cortisol (Lamarche et al., 2012, 2016) and body shame (Cloutier et al., 2014; Lamarche et al., 2014) responses.

Consistent with Social Self-Preservation Theory, this paradigm invokes social-evaluative threat (i.e., participants' body composition is evaluated by researchers; Lamarche et al., 2016) in a socially important domain (i.e., weight and body fat are

central components of body ideals for women in Western societies; Lamarche et al., 2016). This signals potential loss of social status due to negative evaluation (i.e., high weight and/or body fat levels are highly stigmatized in Western society and an anthropometric assessment can serve as a reminder that one embodies a devalued identity). Specific to the present study's higher-weight sample, this paradigm also invokes the two necessary antecedents of Social Identity Threat (per (Major & Schmader, 2018): salience of undesirable traits (high weight/body fat is made pertinent through the explicit measurement of these characteristics) and the belief that the stigmatized identity is relevant (body composition will be perceived as relevant if it is being measured in a School of Kinesiology study collecting anthropometric data, and participants all self-identified as "average" to "higher-weight" during screening). To further enhance the elicited social identity threat, the body composition assessments will be performed by two lean researchers, which will heighten the participants' perceived minority status due to the absence of others with the shared higher-weight social identity (Major & Schmader, 2018).

Two thin researchers performed the body composition assessment together to provide an evaluative audience and to increase the probability of successfully inducing social evaluative threat (following Lamarche et al., 2016). The research technician began the assessment by measuring the participant's height and weight on a scale and read each measurement aloud to the research "assistant," who verbally repeated each value and then recorded it on a clipboard to induce evaluation (Lamarche et al., 2016). Then, participants were asked to stand still for the body measurements. The researchers performed the standard three-site (triceps, iliac crest, thigh) skinfold measurement for the body composition assessment., applying the same method of inducing evaluation whereby the

technician read each value aloud and the assistant repeated and recorded the values down. The assistant denoted the start and stop times of each component of the assessment (i.e., calipers, height, weight).

3.2.3.6. Recovery

Immediately after completing the stigma induction, participants were asked to complete a brief survey assessing psychological outcome measures and to provide a saliva sample. After providing these measures, participants changed back into their street clothes. Then, participants were asked to wait quietly for a 35-minute recovery phase, where they sat and engaged in quiet rest activities such as reading, pen-and-paper homework, browsing provided neutral magazines, etc. Participants were asked to refrain from using outside electronics during this time. During this recovery period, saliva samples were collected at 10, 20 and 35-minutes post-stressor.

3.2.3.7. Saliva Collection

For each saliva sample, participants provided 1–2 mL of saliva by placing a SalivaBio Oral swab (exclusively from Salimetrics, Carlsbad, CA) in their mouth. Participants held the swab in their mouth under their tongue for a timed period of 90 seconds, then deposited it into a swab storage tube. Participants were asked to try not to swallow or chew until the 90 seconds are up. The researcher weighed each swab (in the storage tube) before/after saliva collection so the sample can later be evaluated for saliva flow rate. The samples were stored at -80°C until ready for transport to Salimetrics. Samples were analyzed by Salimetrics for cortisol, osteocalcin and uric acid using highly sensitive commercial-grade assays.

3.2.3.8. Debriefing

After the recovery session was over, participants were asked to respond to open-ended funnel debriefing questions to assess the believability of the cover story (Appendix P) (Bargh & Chartrand, 2000). Participants were asked what they believe to be the purpose of the study and to describe how they felt while participating in the study (Scarapicchia et al., 2013). If a participant is suspicious that the true purpose of the body composition assessment was to elicit weight stigma/body image threat (as opposed to measuring physiological variables), the decision to retain the data would depend on findings from a sensitivity analysis comparing findings with and without “suspicious” participant data. Participants were also asked questions related to the acceptability of the experimental protocol and social-evaluative induction.

Using a prepared debriefing form, the purpose of the study was explained. A list of freely available psychological support resources was provided to all participants in the debriefing letter (i.e., student health contact information for student participants and support/crisis phone lines for community members) (Appendix Q). Participants were thanked for participating in the study and were compensated with \$40 cash for completing the second in-lab session.

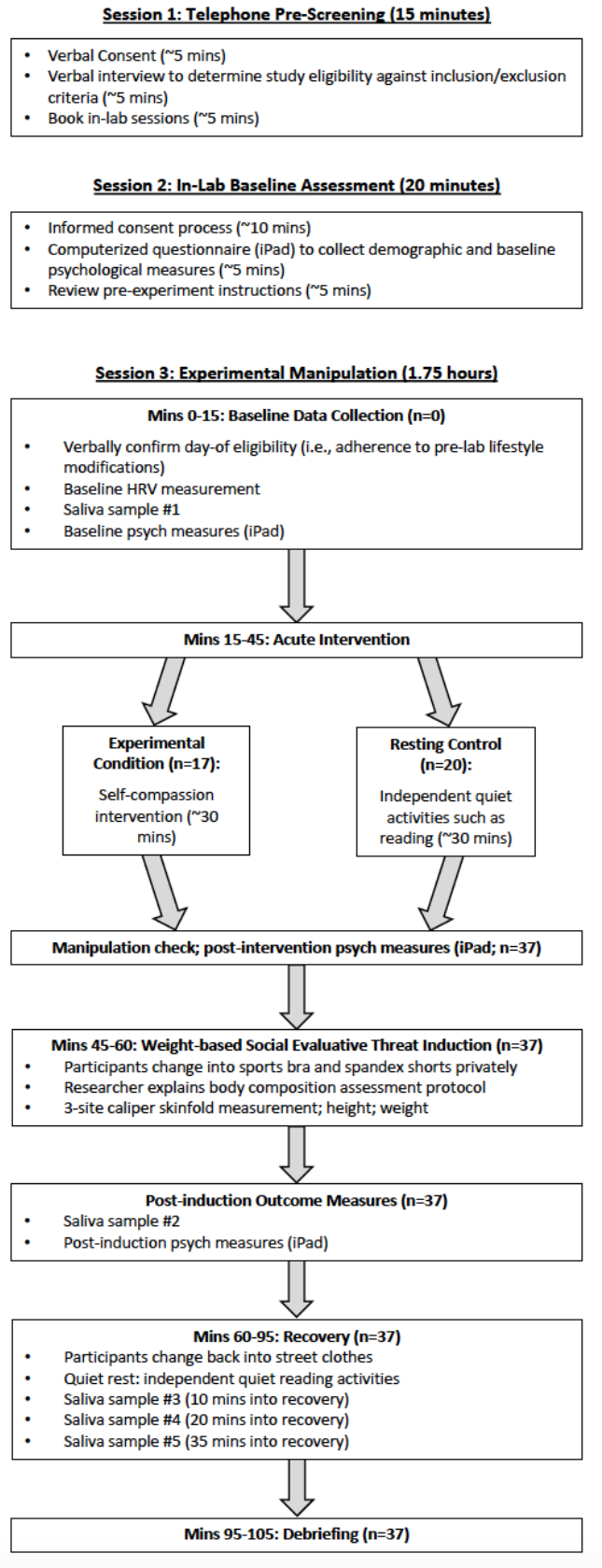


Figure 1. Experimental Design Flow Chart

3.3. Measures

3.3.1. Initial In-lab Demographic & Baseline Psychological Measures

The initial in-lab assessment required participants to complete a computerized survey on Qualtrics consisting of demographic and baseline psychological measures. Demographic measures consisted of self-identified race and ethnicity, level of educational attainment, income level or parents'/family household income level as a proxy for socio-economic status (SES) and other unrelated screening questions to mask the research questions. Baseline measures consisted of the Self-Compassion Scale (Neff, 2003b) which assesses trait levels of self-compassion, and the Perceived Stress Scale (PSS), which measures perceived levels of stress in the last month (Cohen et al., 1983).

3.3.2. Experimental In-Lab Psychological Measures

To measure *state distress*, the self-rated Subjective Units of Distress Scale (SUDS) (Wolpe, 1969) was used (see Appendix R for all measures). The SUDS required participants to indicate their current distress level on a visual analog scale (VAS) of 1 (*a state of absolute calmness*) to 100 (*the worst anxiety ever experienced*; (Wolpe, 1969). State distress was measured at baseline, post self-compassion intervention or control, and post stigma induction.

To measure *state body shame*, *state body guilt*, *state body envy*, and *state body embarrassment*, a purpose-built four-item measure of the body emotion scale was utilized. The scale required participants to indicate the extent they feel this way about their weight in the current moment rated on a 5-point Likert scale from 1 (*very slightly or not at all*) to 5 (*extremely*); measured at baseline, post self-compassion intervention or control, and post stigma induction.

To measure *state shame and guilt*, the State Shame and Guilt Scale (SSGS; (Marschall et al., 1994) was used. On a 5-point Likert scale (1 – *I do not feel this way at all*; 5 – *I feel this way very strongly*) required participants to rate how they are feeling in the current moment. The 15-item SSGS was measured at baseline, post self-compassion intervention or control, and post stigma induction.

To measure *state weight bias internalization*, the modified version of the Weight Bias Internalization Scale (WBIS-M) (Pearl & Puhl, 2014) was used to assess the extent to which individuals internalized weight bias. As such, a modified version fo the scale was used so the scale could be applied across diverse weight categories. Although the original WBIS measured internalized weight bias for individuals who considered themselves as “overweight”, the scale may not be applicable to individuals of different weight statuses (Pearl & Puhl, 2014). An example would be item 1 “as an overweight person, I feel that I am just as competent as anyone” was adapted to “because of my weight, I feel that I am just as competent as anyone else” (Pearl & Puhl, 2014).The 11-item scale was measured on a 7-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*) and participants reported the extent to which they agree or disagree with each statement in the current moment. The WBIS-M was measured at baseline, post self-compassion intervention or control, and post stigma induction.

To measure *physiological responses to stress*, saliva was collected to assess for salivary cortisol, osteocalcin, and uric acid. Salivary cortisol is a known biomarker to measure HPA axis reactivity to exposures of acute stress (Hellhammer et al., 2009) and considered a reliable measurement of free (unbound, biologically active) cortisol alternative to serum free cortisol (El-Farhan et al., 2017). Since the HPA axis is activated immediately upon stressor onset (Smyth et al., 2013), but salivary cortisol peaks

approximately 20-40 minutes post stressor onset (Dickerson & Kemeny, 2004), saliva was collected at baseline, immediately post-task, 10 (~20 minute post stressor onset) (expected peak), and 20- and 35-minute post-task (recovery) (Granger et al., 2007). All samples were collected from participants by placing an SalivaBio Oral swab under their tongue for 90 seconds, then depositing the swab directly into a swab storage tube. All samples were put in a temperature-controlled cooler with ice, before placing in a -80° C freezer the same day to ensure long-term stability of the saliva. Salivary cortisol, osteocalcin, and uric acid concentrations were then determined using a commercial high sensitivity enzyme-linked immunoassay (EIA) kit (Salimetrics; Carlsbad, CA). Vagally mediated HRV was used as a stress-sensitive biomarker for cardiovascular parasympathetic functioning (Kirby et al., 2017). VmHRV was measured using a Polar H10 Heart Rate Monitor worn by the participants throughout the entire laboratory session and electrocardiogram (ECG) was recorded continuously via Bluetooth on the Elite HRV application on an iPad.

3.4. Data Analysis

Data analyses were conducted on SPSS Statistics v28 and Jamovi. Primary objectives were evaluated by comparing study outcomes against a priori feasibility criteria (i.e., process, resources, management, and scientific criteria).

3.4.1. Process Criteria

Process criteria assessed feasibility of recruitment goals and acceptability of study procedures to participants. Date, time and frequency of all pre-screening and in-lab/experimental sessions were recorded to determine whether the desired sample size can be screened and tested within a 1-year time frame. The number of participants that

choose to withdraw from the study during the acute experimental manipulation was recorded, and divided by the total number of participants who complete the experimental manipulation to obtain an acute withdrawal rate. The number of prospective participants deemed eligible per pre-screening responses were divided by the total number of prospective participants to determine what fraction of screened participants are eligible. The number of participants who report deviation from adherence to pre-lab instructions (and who have to therefore re-book their acute experimental manipulation session) were recorded and compared to the number of participants who report full compliance with the pre-lab instructions so that a rate of adherence can be obtained. Success of the study deception were quantified by recording the number of participants who report suspicion during the debriefing and comparing this value to the number of participants who do not report suspicion. Finally, if any adverse events occurred, they would be documented and reported to the Research Ethics Board.

3.4.2. Resources Criteria

Resources criteria tested the practicality of the proposed experimental protocol. The following indices were recorded and compared against a priori process criteria to assess practicality: the length of time to complete data collection for $n=60$ participants, financial costs for all components of study, and average weekly number of hours spent on study activities for all research team members. For salivary biomarker and cardiac data, all deviations from planned collection protocol (e.g., timing, missed collections, swab storage protocol, etc.) and/or technical issues (e.g., complications with heart rate monitor or SalivaBio Oral Swab kits) were tracked to assess the ability to collect data with these technologies.

3.4.3. Management Criteria

Management criteria assessed the research group's ability to implement the proposed experimental protocol, including the self-compassion intervention, weight-based social-evaluative induction and physiological biomarker collection. Management or organizational challenges that arose were recorded (and their effective resolutions documented). Additionally, upon completing all data collection, instances of missing data (survey responses, biomarkers, etc.) were counted to quantify a rate of missing data.

3.4.4. Secondary Objectives

Secondary objectives evaluated the limited efficacy of the self-compassion intervention in attenuating the psychobiological stress response. After testing assumptions of normality, linearity, and homoscedasticity, data was examined for missing values, and list-wise deletion was used for cases where >5% of values are missing. In cases where there was an insufficient amount of saliva to obtain a second repetition of salivary data, the first repetition was utilized as a substitute for the missing data. Descriptive statistics and Pearson's correlations were calculated for all study variables.

Saliva samples were tested for the primary biomarker (cortisol) in duplicate, and reliability and validity indices were reported by Salimetrics (e.g., inter- and intra-assay coefficients of variability, proportion of contaminated samples, etc.). Cronbach's alpha and McDonald's omega were calculated as applicable for all psychometric scales to confirm reliability. ECG data were examined for signal quality (i.e., artifacts) and outliers. Within-participants analysis were conducted to assess whether the weight-based social-evaluative induction elicited a measurable psychobiological stress response (e.g., significant pre/post increases in self-conscious emotions and distress, significant cortisol

reactivity post-manipulation, significant decrease in HRV pre/post). Between-participants variability in physiological responses were assessed to establish parameter estimates for future studies.

Cortisol distributions were normalized with log transformations of nmol/L if normality is violated (Arch et al., 2014). Cortisol, uric acid, and osteocalcin reactivity will be determined by calculating area under the curve (AUC) using the trapezoidal formula recommended by Pruessner et al., (2003): area under curve with regard to baseline (AUC_G , total reactivity) and area under curve with respect to increase (AUC_I , change in total reactivity, i.e., sensitivity of the neuroendocrine system). The trapezoidal formulas for area under the curve (total and change in reactivity) were defined as:

$$AUC_G = \sum_{i=1}^{n-1} \frac{(m_{i+1} + m_i) \cdot t_i}{2}$$

$$AUC_I = \left(\sum_{i=1}^{n-1} \frac{(m_{i+1} + m_i) \cdot t_i}{2} \right) - (m_1 \cdot \sum_{i=1}^{n-1} t_i)$$

Root mean square of successive differences (RMSSD) will be used to quantify vmHRV. RMSSD was calculated by obtaining each successive time difference between heartbeats (in ms), squaring each obtained value, averaging the squares together, and then calculating the square root of the average (Shaffer & Ginsberg, 2017). Upon analysis, ECG data will be collected in 60s epochs, including a time-stamped 5-minute resting HRV baseline measure. The experimental session was divided into 4 phases and vmHRV will be averaged across each 60s epoch and analyzed at 5 time-points for each phase: Baseline = average HRV for minutes 1-5 of resting baseline; Self-compassion induction = average HRV for 5 x 60s epochs spaced evenly throughout intervention (i.e., average HRV in minutes 5, 10, 15, 20 and 25); Weight stigma induction = average HRV for 5 x 60s epochs spaced evenly throughout stigma induction (i.e., average HRV in minutes 0,

3, 6, 9 and 12); and recovery = average HRV for 5 x 60s epochs spaced evenly throughout recovery period (i.e., average HRV in minutes 5, 10, 15, 20 and 25 post-stressor; Arch et al., 2014; Laborde et al., 2017). After correcting artifacts, average RMSSD was calculated for each phase. HF-HRV (i.e., RSA, a frequency-domain measure of vmHRV) was calculated for each phase to confirm correlation with RMSSD in the current data set. Respiration rate will be inferred from the ECG data (Charlton et al., 2016), to confirm that respiratory frequency stays within 9-24 cycles/min. (corresponding to HF band, 0.15 – 0.40 Hz) and that there were no differences in respiratory rate at any phase between groups ($p > 0.14$) (Laborde et al., 2017).

Independent t-tests were conducted for all physiological biomarkers to determine significant differences between groups. A 2 (intervention group versus control group) by 3 (time 1, time 2, time 3) mixed design analysis of variance (ANOVA) was run for each psychological outcome variable (i.e., subjective distress, self-conscious emotions, shame, guilt, and internalized weight bias) to examine main effects and interaction effects of group or time on each dependent variable. All pairwise comparisons utilized Bonferroni's adjustment for multiple comparisons. Finally, reactivity of salivary data was determined by calculating area under the curve (AUC) using formulas recommended by Pruessner et al., (2003): area under curve with regard to baseline (AUC_G , total reactivity or output of cortisol) and area under curve with respect to increase (AUC_I , change in total reactivity of cortisol due to social stressor, i.e., sensitivity of the neuroendocrine system).

Chapter 4

4 Results

4.1. Feasibility and Acceptability

Overall, based on the results from the feasibility and acceptability criteria, there was evidence supporting the feasibility and acceptability of the research study. Each feasibility and acceptability criterion (i.e., process criteria, resource criteria, management criteria, and scientific criteria) is detailed in the subsequent sections.

4.1.1. Process Criteria

Table 1. Summary of Process Criteria

Criterion	A Priori Cut-off	Study Data	Feasibility Determination
Can researchers recruit, pre-screen, and test $n=60$ eligible participants from Western University and the London community within a 1-year timeframe?	$N = 60$ eligible participants can be screened and tested within a 1-year timeframe (accounting for an average of ~1-2 eligible participants screened and tested per week).	The study lasted 1 year and 3 months but did not meet the sample size criteria. Sample size reached ($n = 37$).	Not feasible
What proportion of interested participants are eligible to participate per inclusion/exclusion criteria?	No established a priori cut off.	<p>28.1% of screened participants were eligible to participate.</p> <p>Inclusion:</p> <ul style="list-style-type: none"> i. Read and communicate in English (100%) ii. Identify as cis-gender woman (99.7%). iii. Age 18-34 inclusive (100%) iv. Self-identified as “heavy weight” (i.e., average, slightly heavy, moderately heavy, very heavy; (56.1%) <p>Exclusion:</p> <ul style="list-style-type: none"> i. Currently smoking cigarettes (0.34%) ii. Current users of other nicotine/tobacco products (1.01%) iii. Current cannabis user (5.07%) iv. Current users of recreational drugs (3.38%) v. Current and active users of any oral prescription medication to treat a chronic health condition (except contraceptives; 10.14%) 	Feasible

		vi. Use steroid-based medications (3.76%) vii. Diagnosed with a mental illness or psychiatric condition (13.85%) viii. Diagnosed with substance-use disorder (0%) ix. Diagnosed with eating disorder (10.42%) x. Health disorders related to the neuroendocrine system (8.45%) xi. Heart condition or high blood pressure (3.38%) xii. Oral health problems (4.39%) xiii. Salivary gland disease (0%) xiv. Other chronic health condition (9.80%) xv. Pregnant or breastfeeding (0%) xvi. Prior experience with self-compassion training and/or therapy, compassion interventions (8.11%) xvii. Prior experience with formal mindfulness or meditation training (20.27%).	
What proportion of eligible participants agree to participate in the experimental manipulation?	<5% of participants withdraw from study during acute experimental manipulation.	0% of participants have withdrawn from the study during the acute experimental manipulation.	Feasible
What is the attrition rate from agreeing to participate to end of study?	No established a priori cut off.	Of the 44 eligible participants that agreed to participate in the research study, a total of 7 dropped out indicating an attrition rate of 19.8%.	Feasible

What fraction of screened participants are eligible?	~25% of screened participants are eligible.	83 prospective participants out of 295 screened participants were eligible, yielding 28.1% eligibility rate.	Feasible
Can participants adhere to the pre-lab lifestyle modification instructions?	>95% adherence to pre-lab instructions.	100% of participants have adhered to the pre-lab instructions.	Feasible
Are all aspects of the experimental protocol acceptable to participants?	No established a priori cut off.	All aspects of the experimental research study were well accepted by participants.	Feasible
What proportion of participants (if any) express objection to the induction, refuse to participate or choose to withdraw due to the induction?	No established a priori cut off.	0% of participants expressed objection, refused to participate, or chose to withdraw from the study due to the induction.	Feasible
What is participant perception of the study?	No established a priori cut off.	Majority of participants believed the true purpose of the study was to collect biomarker data (i.e., saliva, HRV) and perform anthropometric assessments to measure cardiovascular function and hormones.	Feasible
Is deception (i.e., selection on basis of heavier weight identification and purpose of body composition assessment) successful?	Deception successful in >95% of participants.	100% of participants did not report suspicion of the experimental manipulation.	Feasible
Have participants reported experiences of reported adverse events?	No participants experience reported adverse events (i.e., clinically significant, and protracted distress or psychological symptoms).	No participants reported experiences of adverse events, significant protracted distress or psychological symptoms.	Feasible

4.1.2. Resources Criteria

Table 2. Summary of Resources Criteria

Criterion	A Priori Cut Off	Study Data	Feasible/Non-feasible
Can the experimental protocol be completed with the currently allocated resources (e.g., time, funding, personnel)?	The experimental protocol can be completed (data collected for $n=60$ participants) within 1-year timeframe, within \$25,000 budget, and with currently identified research team (PI, Co-I, 2 student investigators).	The experimental protocol was not completed for $n = 60$ participants within the 1-year timeframe, within the allocated \$25,000 budget and personnel.	Non-feasible.
How long does it take to recruit and screen $n=60$ eligible participants?	No established a priori cut off specified.	The sample size of $n = 60$ was not completed.	Non-feasible.
How long does it take to complete $n=60$ experimental manipulations for all eligible and consenting participants?	No established a priori cut off specified.	The sample size of $n = 60$ was not completed.	Non-feasible.
Can saliva samples be collected, stored, and sent to Salimetrics for analysis in a timely and efficient manner?	No established a priori cut off specified	Saliva samples were collected, stored, and sent to Salimetrics in a timely and efficient manner.	Feasible.

Is the available/procured technology (e.g., heart-rate monitors, saliva collection devices) able to collect data with reliability, validity, and minimal technical complications?	Biomarker data can be collected with reliability and validity using procured technology (i.e., Polar H10 HR Monitor and Salimetrics SalivaBio Oral Swabs).	Salivary data using Salimetrics SalivaBio Oral Swabs was collected with reliability and validity. Due to the nature of the research study, HRV was potentially impacted by external factors (e.g., participant sweating through HRV straps, movement during study, unknown irregular heartbeats), causing minor artifacts and in some cases, higher than normal HRV. Artifacts were corrected using visual inspections and manual corrections using cubic spline interpolations programmed in Kubios.	Feasible.
---	--	---	-----------

4.1.3. Management Criteria

Table 3. Summary of Management Criteria

Criterion	A Priori Cut Off	Study Data	Feasible/Non-feasible
Can the researchers/research assistants guide participants through all aspects of experimental protocol, including acute self-compassion induction and weight stigma induction?	No established a priori cut off.	Researchers and research assistants were able to guide participants through all aspects of the study successfully.	Feasible.
Can biomarker data be successfully collected per planned protocol (i.e., continuous ECG data; saliva at 5 precise time-points) while maintaining internal validity?	Biomarker data can be successfully collected per protocol with <5% missing or erroneous data.	All salivary data was collected at 5 precise time-points. All ECG data was collected continuously with no disruptions, apart from one participant (2.7%) whose HRV was not saved as Kubios HRV collection software required membership to save data.	Feasible.
Can data be recorded accurately, securely and in an efficient manner?	No established a priori cut off.	Data was accurately recorded, securely, and in an efficient manner.	Feasible.
What management or organizational challenges may arise and how can they be effectively resolved?	No established a priori cut off.	No major management or organizational challenges arose.	Feasible.

Table 4. Salivary Assay Reliability and Validity

	Intra-assay CV	Inter-assay CV	Sensitivity
Cortisol	4.60%	6.00%	0.007 ug/dL
Uric Acid	1.88%	4.46%	0.07 mg/dL
Osteocalcin	7.07%	8.65%	9.77 pg/mL

Table 5. Composite scale reliability analyses

<i>Scale</i>	<i>Number of Items (composite)</i>	<i>Cronbach's Alpha</i>	<i>McDonald's Omega</i>
Subjective Unit of Distress Scale	3	.87	.87
Body Emotions Scale	12	.97	.97
State Shame	15	.92	.92
State Guilt	15	.94	.95
Weight Bias Internalization Scale-M	33	.94	.98
State Self-Compassion Scale-L	18	.90	.89
Trait Self-Compassion Scale	26	.92	.92
Perceived Stress Scale	10	.83	.83

4.2. Secondary Objective: Preliminary Efficacy Results

4.2.1. Data Processing Results

Data were screened for missing values and the percentage of missingness are as follows for each scale across all time points: BES item 1 (8.1%), BES item 2 (2.7%), BES item 3 (5.4%),

BES item 4 (8.1%), SSCS-L items 1 to 18 (5.4%). Of the 37 participants, 33 have a full data set pertaining to the psychological data. 1 participant had missing HRV values (2.7%) due to technological issues at data collection, and list wise deletion was used. There were missing HRV values pertaining to the weight stigma induction at minutes 8 to 12, due to variability in the times taken to perform the weight stigma induction for each participant. Percentages of missingness are as follows: WS_induction_min8 (5.4%), WS_induction_min9 (18.9%), WS_induction_min10 (24.3%), WS_induction_min11 (32.4%), and WS_induction_min12 (40.5%). 1 participant was missing all salivary data since data was collected after saliva was sent for analysis. UA at time 2 is missing 1 value (2.7%) due to the collected saliva was not sufficient in quantity to be run for analysis.

All saliva samples were tested for cortisol, UA, and OCN in duplicate. First, data was examined to test for assumption of normality by analyzing skewness and kurtosis scores. (Kline, 2010). All psychological variables (non-aggregated) were within normal ranges of skewness ($\text{skewness}_{\text{max}} = 2.93$; $\text{skewness}_{\text{min}} = -.204$; $SE = 0.550$) and kurtosis ($\text{kurtosis}_{\text{max}} = 9.48$; $\text{kurtosis}_{\text{min}} = -1.44$; $SE = 1.06$) as specified by Kline (2010). All physiological variables (non-aggregated) were also within the normal ranges of skewness ($\text{skewness}_{\text{max}} = 1.90$; $SE = .54$; $\text{skewness}_{\text{min}} = -.47$; $SE = .64$) and kurtosis ($\text{kurtosis}_{\text{max}} = 4.50$; $SE = .37$; $\text{kurtosis}_{\text{min}} = -1.24$; $SE = 1.23$). HF-HRV (i.e., RSA) was calculated for each phase and there is confirmed correlation with RMSSD. Respiration rate stayed within 9-24 cycles/min, indicated by HF band ranging from 0.15 – 0.40 Hz, and there were no differences in RF between groups ($p > 0.14$).

Table 4 displays the reported intra-assay coefficients of variability (CV), inter-assay CV, and sensitivity analysis for cortisol, UA, and OCN. According to Salimetrics' laboratory reports, all assay values of reliability and validity meets the criteria for accuracy and repeatability in salivary bioscience. Inter-assay CV and Intra-assay CV were both measured at <10%,

representing acceptable ranges compared to Salimetrics' guideline (Salimetrics, 2023).

Additionally, Cronbach's alpha and McDonald's omega were calculated to determine scale internal consistency and reliability of the measurement tools, summarized in Table 5.

4.2.2. Sample Descriptives

Young adult cis-gender women ($N = 40$) ranged in age from 18 to 29 ($M = 21.93$, $SD = 2.97$). Majority of participants identified as Asian (42.5%) and White (42.5%) and possess a high school diploma or equivalent (50.0%) or bachelor's degree (40.0%) as their highest completed education. Family household income was included in the survey as a proxy for socioeconomic status and majority of participants reported over \$100,000 (35.0%). Most participant self-identified their weight status as slightly heavy (57.5%) and average (42.5%). At baseline, mean trait self-compassion was ($M = 3.09$; $SD = 0.62$), which represents moderate levels of self-compassion and mean baseline PSS was ($M = 18.05$; $SD = 5.89$), which represents moderate levels of stress within the sample of participants. Sociodemographic characteristics, perceived weight status, and baseline psychological measures of participants are summarized in Table 6.

Table 6. Sociodemographic Characteristics and Perceived Weight Variable

Descriptive Measure	<i>M</i>
Age, years, mean (SD)	21.93 (2.97)
Race, <i>n</i> (%)	
Asian	17 (42.5%)
White	17 (42.5%)
Latin/South/Central American	3 (7.5%)
Middle Eastern	3 (7.5%)
Highest Education, <i>n</i> (%)	
High School Diploma or Equivalent	20 (50.0%)

Bachelor's Degree	16 (40.0%)
Master's Degree	3 (7.5%)
College Diploma	1 (2.5%)
Socioeconomic Status n (%)	
Less than \$20,000	5 (12.5%)
\$20,000 to \$34,999	3 (7.5%)
\$35,000 to \$49,999	5 (12.5%)
\$50,000 to \$74,999	4 (10.0%)
\$75,000 to \$99,999	5 (12.5%)
Over \$100,000	14 (35.0%)
Prefer not to say	4 (10.0 %)
Perceived Weight	
Slightly Heavy	23 (57.5%)
Average	17 (42.5%)
Moderately Heavy	3 (7.5%)

Note: All variables ($n = 40$)

Table 10 displays bivariate Pearson's correlations across all main outcome study variables. Particularly, there were moderate significant negative correlations between trait self-compassion and perceived stress, self-conscious emotions (i.e., body shame, body guilt, body embarrassment, and body envy), weight bias internalization, shame, and subjective distress. Significant positive correlations were found between subjective distress and perceived stress, self-conscious emotions, guilt, shame, and weight bias internalization. There were also significant positive and strong correlations found between self-conscious emotions and weight bias internalization, and strong positive correlations between shame and guilt. In regards to the salivary biomarkers, a significant

negative correlation was found between shame and cortisol response, and positive correlation was found between shame and OCN response.

4.2.2. Baseline Condition Differences

At baseline, there were no significant differences between the intervention and control group for perceived stress ($t = 0.054$, $df = 35$, $p = 0.957$) and trait self-compassion ($t = 0.899$, $df = 35$, $p = 0.178$).

Table 7. Descriptive Statistics for Baseline and Main Study Variables

	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Skewness</i>	<i>Kurtosis</i>
Trait Self-Compassion	40	3.09	0.62	1.65	4.75	0.21	0.31
Perceived Stress	40	18.05	5.89	4	28	-0.18	-0.43
Body Emotions	37	2.63	1.16	1.00	5.00	0.51	-0.80
Shame	37	1.54	0.63	1.00	3.80	1.67	3.33
Guilt	37	1.55	0.72	1.00	4.00	1.78	2.86
Subjective Distress	37	18.9	19.36	0	74.0	1.41	1.39
State Self-Compassion	35	3.32	0.70	2.00	4.89	0.44	-0.22
Weight Bias Internalization	37	3.34	1.53	1.09	6.97	0.50	-0.41
Baseline HRV	36	25.00	15.52	7	75	1.25	1.75
Intervention HRV	36	43.67	24.92	9.33	123.10	1.46	2.31
Weight Induction HRV	36	41.20	16.77	18.75	79.88	0.67	-0.28
Recovery HRV	36	54.74	35.27	16.48	191.88	2.11	5.81
Cortisol Baseline	36	7.62	3.56	2.46	16.42	0.71	-0.10
UA Baseline	36	5.29	2.28	1.00	12.03	1.12	2.45
OCN Baseline	36	70.88	55.41	10.21	239.80	1.45	1.77
Overall Mean Cortisol	36	6.19	2.53	2.57	15.89	1.729	5.26
Overall Mean UA	36	5.38	2.17	1.26	12.69	0.96	2.67
Overall Mean Osteocalcin (pg/ml)	36	69.74	48.10	11.92	265.76	2.10	6.93

Note: Baseline measures are the perceived stress and trait self-compassion measured at the initial in lab. Cortisol is measured in nmol/l. Units for UA is measured in mg/dl. Units for OCN is measured in pg/ml.

Table 8. Means and Standard Deviations of Time-Aggregated Psychological Outcome Variables by Condition

	Self-Compassion Intervention	Resting Control Condition
Variables	M (<i>SD</i>)	M (<i>SD</i>)
Trait Self-Compassion	2.19 (0.82)	3.00 (1.30)
Perceived Stress	18.29 (5.39)	18.40 (6.33)
Body Emotions	2.19 (0.82)	3.00 (1.30)
Shame	1.21 (0.30)	1.82 (0.70)
Guilt	1.20 (0.22)	1.86 (0.86)
Subjective Distress	10.47 (11.50)	26.10 (21.93)
State Self-Compassion	3.57 (0.75)	3.08 (0.57)
Weight Bias Internalization	2.83 (1.23)	3.77 (1.65)

Note: *M* = Mean. *SD* = Standard Deviation.

4.3. Main Efficacy Results

The final analytic sample consisted of $N = 37$ participants who participated in the full research study. The intervention group contained $n = 17$ participants while the control group contained $n = 20$. Descriptive statistics for all study outcome variables are displayed in Table 7, and Table 8 presents descriptive statistics by condition (intervention vs. resting control). Table 9 reveals means and standard deviation scores for non-aggregated variables by condition and time, and also effect size scores (i.e., Cohen's d). Figures 2 to 11 illustrate line graphs depicting the mean values of the study's main outcome variables across condition (coded as 0 for the control group and 1 for the intervention group), and across timepoints 1 (baseline), 2 (post-self-compassion intervention or resting control), and 3 (post weight stigma induction).

4.3.1. State Self-Compassion

State self-compassion was examined as a manipulation check following the acute self-compassion intervention. Independent t-test revealed that there were significant differences between groups ($t = -2.195, p < 0.035$) with higher levels of self-compassion displayed among the intervention group ($M = 3.57$) compared to the control group ($M = 3.08$). Therefore, the acute self-compassion intervention was successful at inducing self-compassion among participants.

4.3.2. Self-Conscious Emotions

There was no significant time by group interaction effect found for self-conscious emotions ($F = 2.74, df = 2, p = .072$), suggesting that there were no significant differences in self-conscious emotion scores between the intervention and control group over time. Table 9 shows that between the intervention and control groups, there were moderate sized differences in for participants' self-conscious emotions at baseline ($d = 0.537$) and post weight stigma induction ($d = 0.585$), and a large sized differences ($d = 0.946$) for self-conscious emotions during the self-compassion intervention or quiet rest. Tests of within-subjects effects showed that there was a statistically significant effect of time on self-conscious emotions ($F = 21.77, df = 2, p < .001$). Specifically, self-conscious emotion scores significantly decreased ($p < .001$) from baseline ($M = 2.56$) to post-intervention/rest ($M = 2.28$), and significantly increased ($p < .001$) from post-intervention/rest ($M = 2.28$) to post weight stigma induction ($M = 2.93$). In tests of between-subjects effects, statistical significance was demonstrated between groups ($F = 210.29, df = 1, p = 0.036$), suggesting that participants' levels of self-conscious emotions averaged across time were significantly different between the intervention and control group. Specifically, self-conscious emotion scores were higher on average for the control ($M = 3.00$) versus intervention ($M = 2.19$) condition. Figure 2 displays a line graph representing mean levels of self-conscious emotions in participants across time.

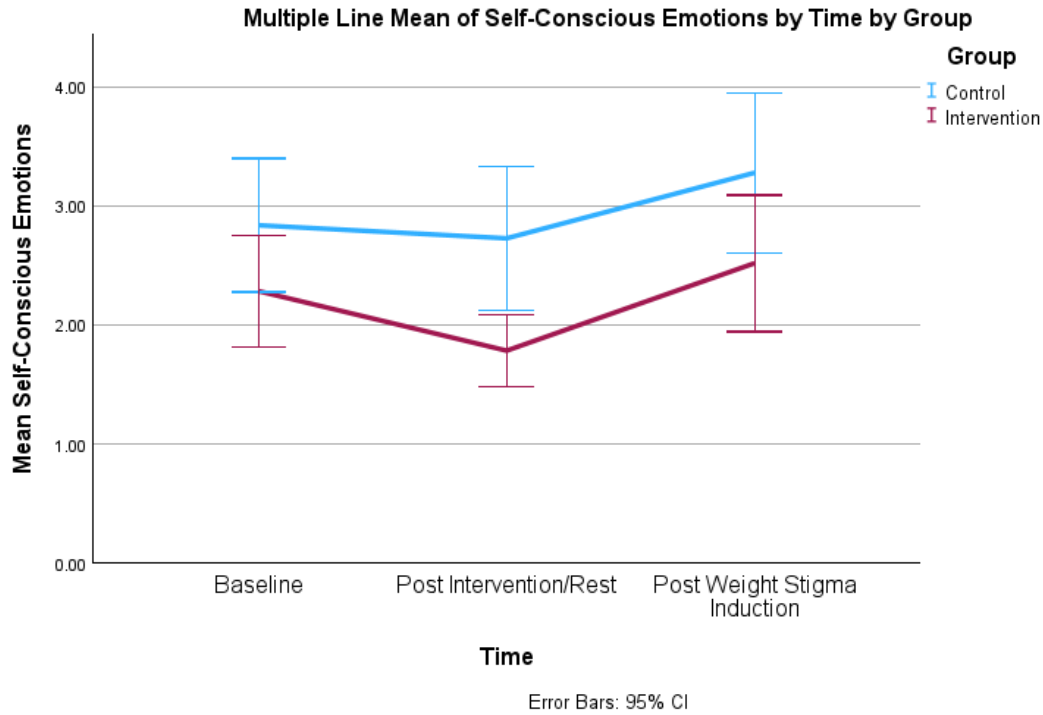


Figure 2. Mean self-conscious emotions across time

4.3.3. Shame

There was no statistically significant time by group interaction effect for shame ($F = 1.710$, $df = 2$, $p = 0.188$), indicating that changes in shame across time were not influenced by condition. Table 9 shows that between the intervention and control groups, there were moderate sized differences in for participants' shame at baseline ($d = 0.788$) and post self-compassion intervention ($d = 0.730$), and a large sized difference ($d = 1.035$) for shame post weight stigma induction. Tests of within-subjects effects show that there was a statistically significant effect of time on shame ($F = 10.415$, $df = 2$, $p < .001$). Specifically, shame scores significantly increased ($p < .001$) from baseline ($M = 1.52$) to post-intervention/rest ($M = 1.89$), and significantly decreased ($p < .001$) from post-intervention/rest ($M = 1.89$) to post weight stigma induction ($M = 1.61$). Tests of between subjects' effects demonstrate that there is a statistically significant difference ($F = 9.010$, $df = 1$, $p = .005$) in mean shame scores between groups. Specifically, levels of shame

were higher on average for the control ($M = 1.82$) versus intervention ($M = 1.21$) condition. Figure 3 displays a line graph representing mean levels of shame across participants.

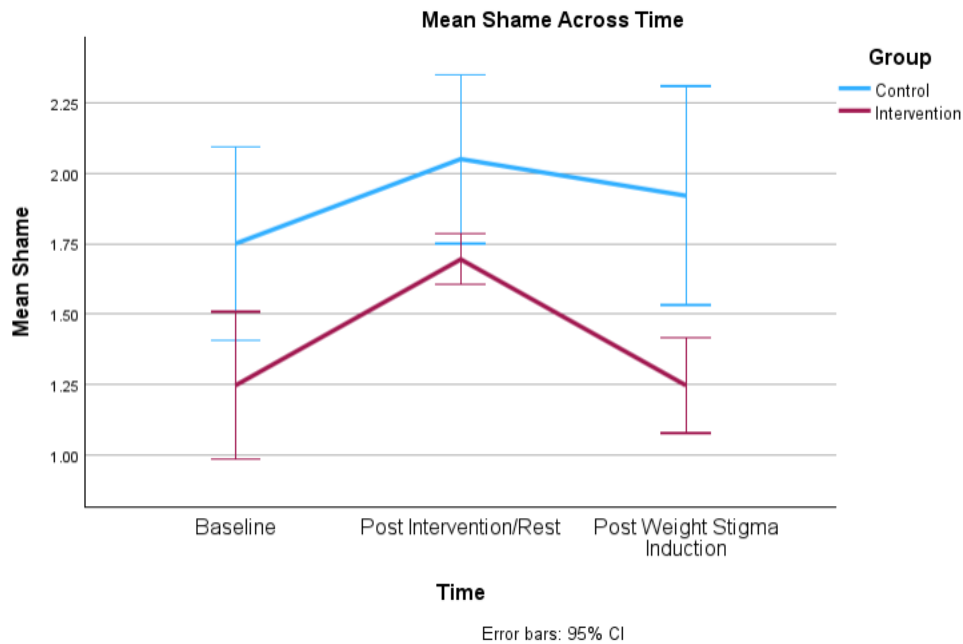


Figure 3. Mean shame across time

4.3.4. Guilt

Results show that there were no statistically significant interaction effects of time and group on guilt ($F = .398$, $df = 1.34$, $p = .592$), implying that there were no significant differences in participants' level of guilt as time progressed or among the groups at each time point. Table 9 shows that between the intervention and control groups, there were large sized differences in for participants' guilt scores at baseline ($d = 1.131$) and post self-compassion intervention ($d = 0.904$), and a moderate sized difference ($d = 0.747$) for guilt post weight stigma induction.

Tests of within-subjects' effects revealed no significant main effects of time ($F = 1.659$, $df = 1.34$, $p = .206$). Tests of between-subjects effects found statistically significant difference ($F = 201.22$, $df = 1$, $p = 0.004$) in mean guilt scores between groups. Specifically, levels of guilt were

higher on average for the control ($M = 1.86$) versus intervention ($M = 1.20$) condition. Figure 4 displays a line graph representing mean levels of guilt in participants across time.

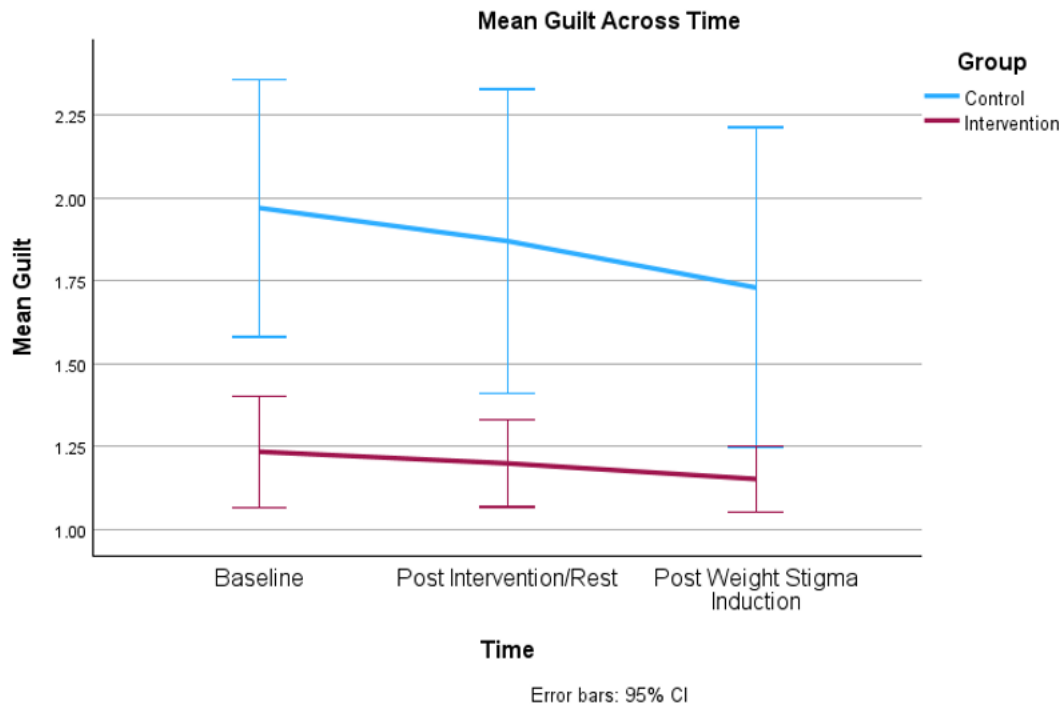


Figure 4. Mean guilt across time

4.3.5. Subjective Distress

No statistically significant interaction effects of time and group ($F = .678$, $df = 2$, $p = .511$) were found on subjective distress within participants. Table 9 shows that between the intervention and control groups, there were moderate sized differences in for participants' subjective distress scores at baseline ($d = 0.612$) and post self-compassion intervention ($d = 0.699$), and a large sized difference ($d = 1.001$) for subjective distress post weight stigma induction. Tests of within-subject effects did not reveal any significant effects of time ($F = 1.487$, $df = 2$, $p = .233$) on subjective distress. Tests of between-subjects' effects show that there are significant differences in mean subjective distress scores averaged across time between groups ($F = 6.95$, $df = 1$, $p < .001$). In particular, the intervention group had lower levels of subjective distress ($M = 10.47$), while the

control group had higher average levels compared to the intervention group ($M = 26.10$). Figure 5 displays line graph revealing similar patterns for both groups in which mean distress increases slightly from baseline at time 1 to post-intervention or quiet rest at time 2. Figure 5 displays a line graph representing mean levels of subjective distress in participants across time.

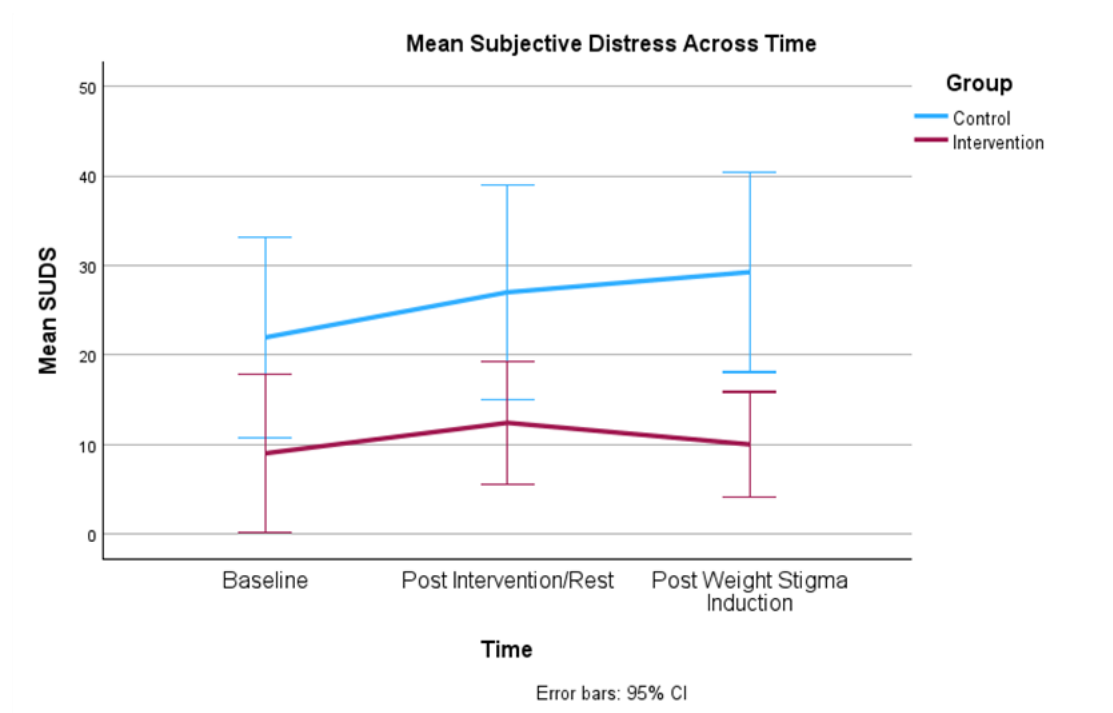


Figure 5. Mean subjective distress across time

4.3.6. Weight Bias Internalization

Findings reveal that there was no statistically significant interaction effect of time and group found for weight bias internalization ($F = .710$, $df = 1$, $p = .405$). Table 9 shows that between the intervention and control groups, there were moderate sized differences in for participants' weight bias internalization scores at baseline ($d = 0.510$), post self-compassion intervention ($d = 0.738$), and post weight stigma induction ($d = 0.510$). Tests of within subjects effects revealed a significant effect of time on participants' weight bias internalization ($F = 6.15$, $df = 1$, $p = .018$), suggesting that differences in weight bias internalization may be influenced by

time. However, pairwise comparisons using Bonferroni's correction reveal the significance of time to be not statistically significant ($p = .054$). Therefore, it is concluded that the effect of time was not significant. Tests of between subjects' effects found no statistically significant differences in mean weight bias internalization between groups ($F = 3.20$, $df = 1$, $p = .082$). Figure 6 illustrates a line graph revealing mean weight bias internalization in participants across time.

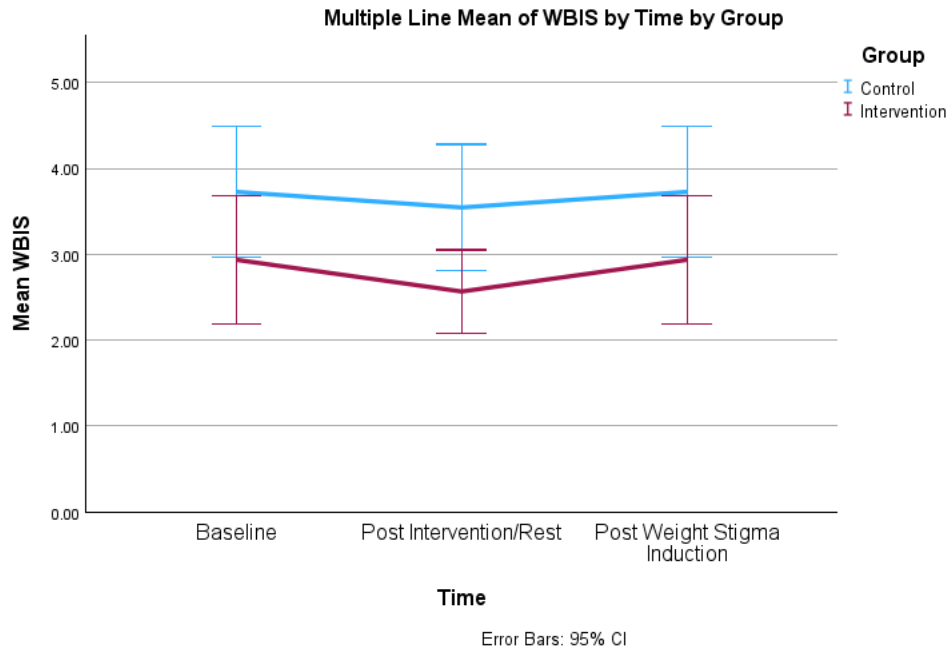


Figure 6. Mean internalized weight stigma across time

4.3.7. Cortisol

All salivary cortisol data was converted from ug/dL to nmol/L by multiplying the unit conversion of 27.6. Between both groups, mean cortisol response was 6.44 nmol/l for the intervention group and 5.96 nmol/l for the control group, indicating both groups had a similar low stress response. Figure 7 depicts a line graph displaying mean cortisol levels from baseline at time 1, post-weight stigma induction at time 2, and recovery at 10 minutes, 20 minutes, and 35 minutes into recovery at times 3, 4, and 5, respectively. Findings show that for both groups, mean cortisol level decreased from baseline to times 2 and 3. From time 3 to time 4 and 5, mean cortisol for the

control group increased while mean cortisol continued to decline for participants in the intervention group. Table 12 reveals the independent samples t-tests, which found a non-significance for cortisol (i.e., AUC_G and AUC_I). Thus, it can be concluded that there were no differences in total cortisol and cortisol reactivity between groups.

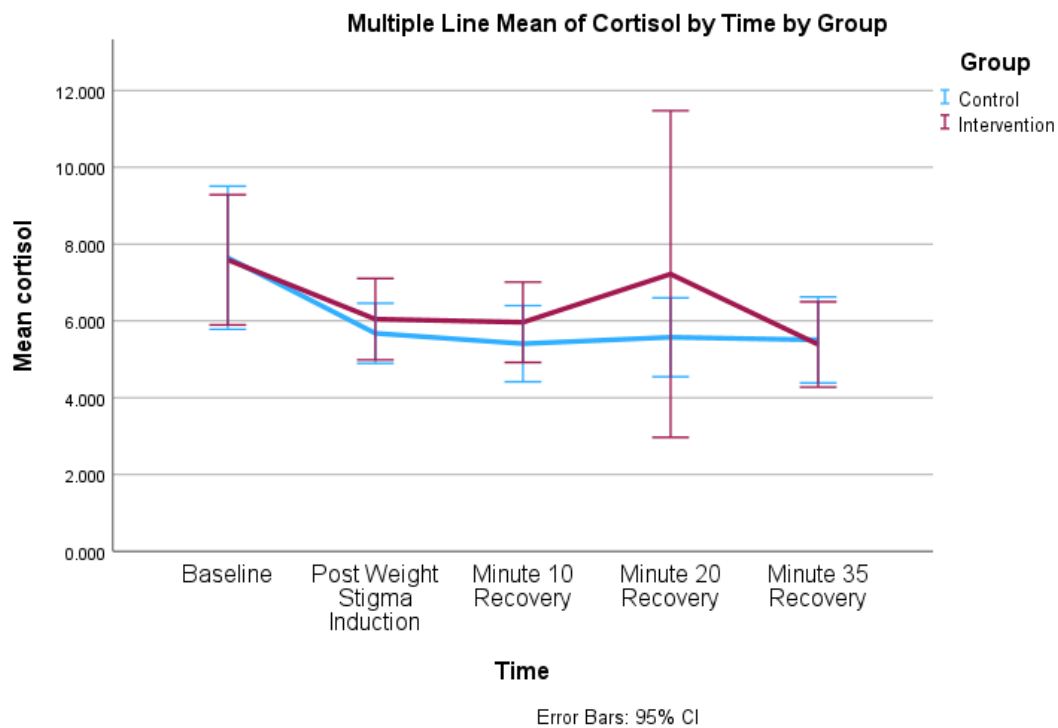


Figure 7. Mean cortisol across time

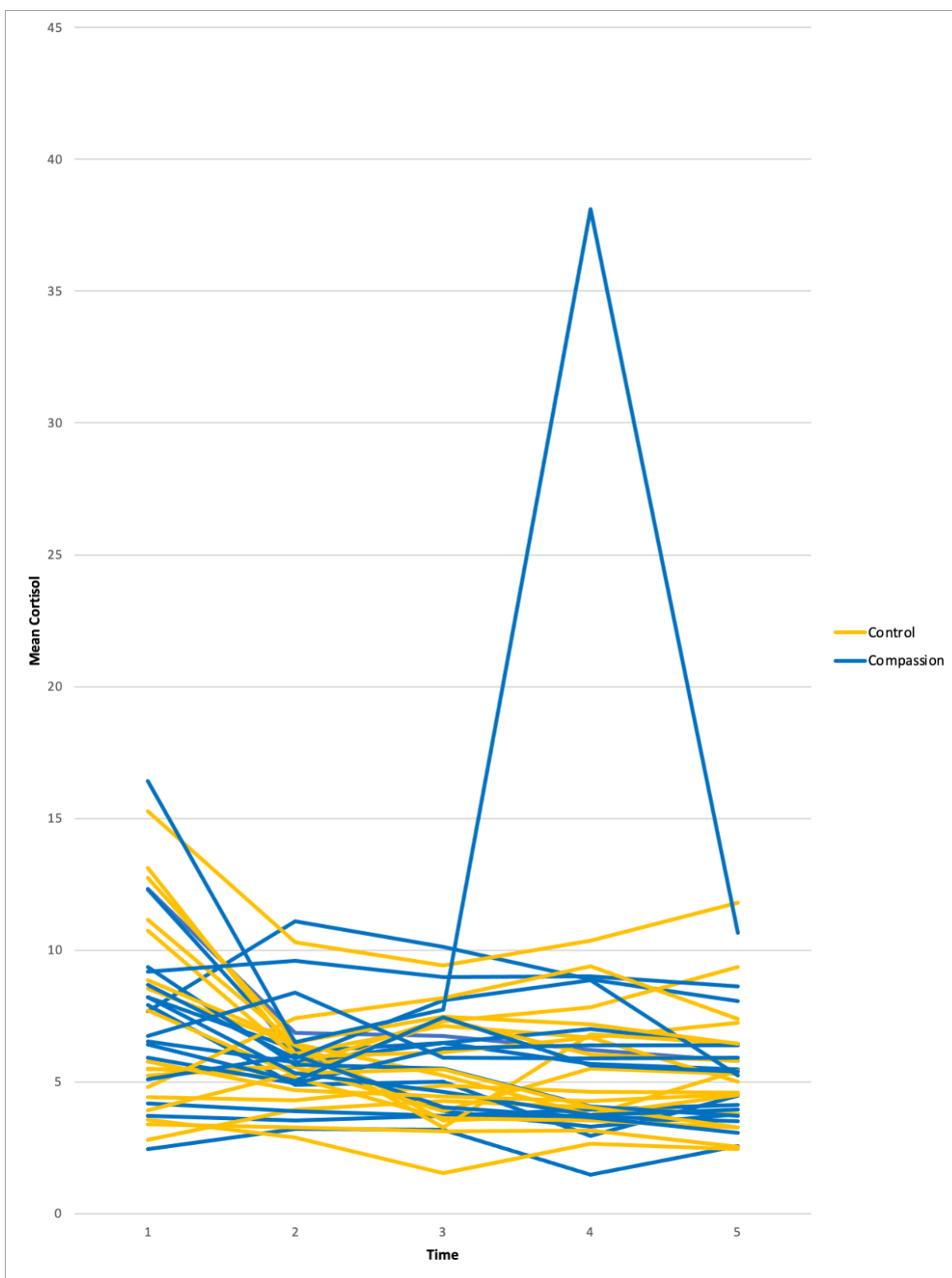


Figure 8. Individual participant data points for cortisol across time

4.3.8. Heart Rate Variability

Figure 9 depicts a line graph representing mean HRV during the 30-minute acute intervention or quiet rest. Independent samples t-test revealed a non-significant finding for HRV during the self-compassion intervention or quiet rest, thus concluding that there are no differences in HRV during acute intervention or quiet rest. From the self-compassion psychoeducation to the self-compassion meditation, both groups exhibited decreased in HRV, and during the self-compassion guided writing exercise, the intervention group maintained their HRV, while the control group slightly decreased.

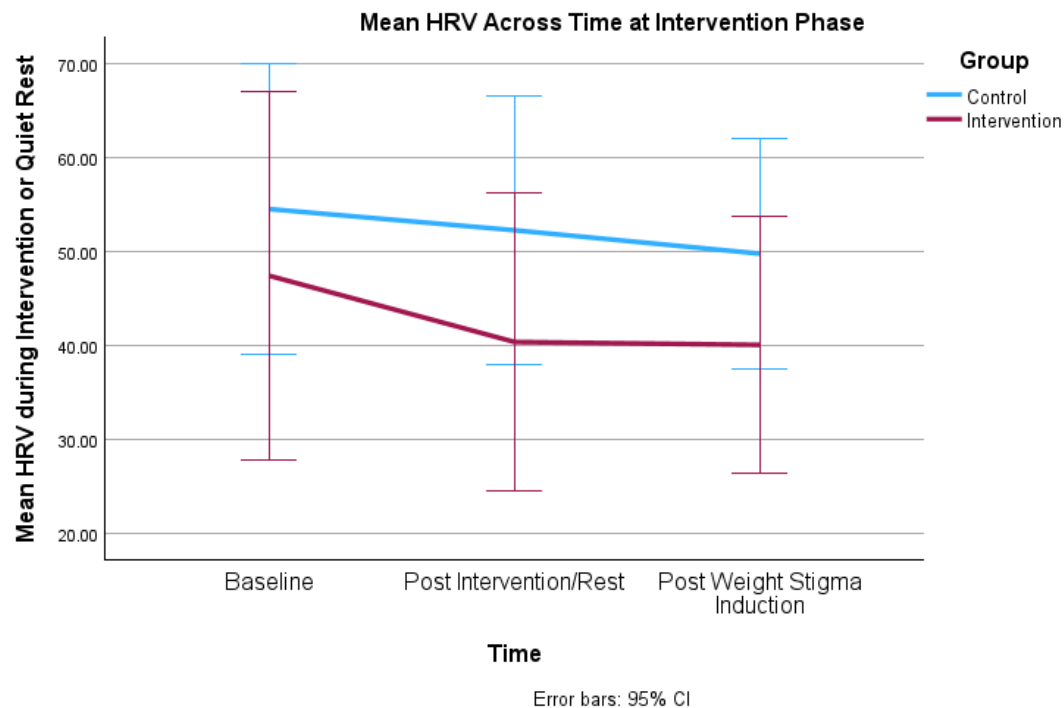


Figure 9. Mean HRV during intervention or quiet rest

Figure 10 displays a line graph representing mean HRV during the weight stigma induction across time points 1 to 6, with each timepoint corresponding to ascending 2-minute durations (e.g., time 1 = minutes 1 and 2, time 2 = minutes 3 and 4, etc.). According to the graph, both groups follow different trajectories. The intervention group decreases from time 1 to 2, while

the control group increases. From times 2 to 6, the intervention group gradually increased their HRV, while the control group have a small reduction in HRV before linearly decreasing their HRV at time 6. Overall, mean HRV during the experimental manipulation decreased compared to baseline for both groups. An independent samples t-test found a non-significance for HRV post weight stigma induction, thus concluding that there are no differences between groups.

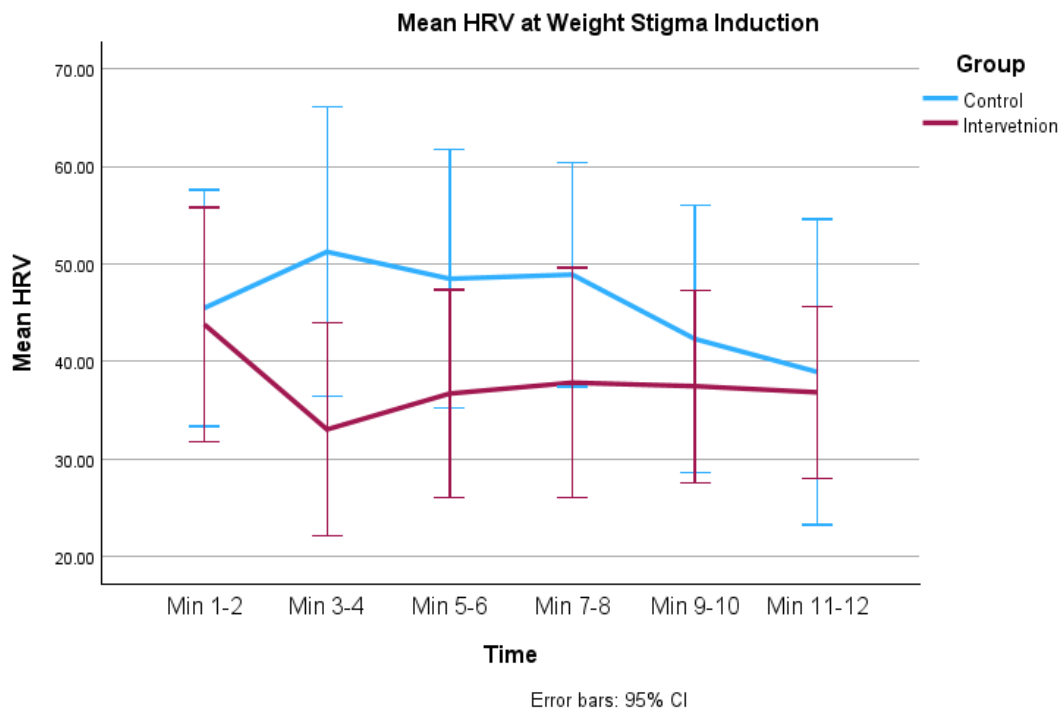


Figure 10. Mean HRV during weight stigma induction

Figure 11 depicts the line graph representing average HRV during recovery at 5-minute intervals (e.g., time 1 = 5 minutes, time 2 = 10 minutes, etc.). From the graph, average HRV for the control group decreased from minute 5 to minute 15, before increasing at minute 20. For the intervention group, average HRV increased slightly from minute 5 to 15, before decreasing at minute 20 and 25. Again, independent t-tests revealed a non-significance for variance, therefore concluding no differences between groups in HRV during recovery.

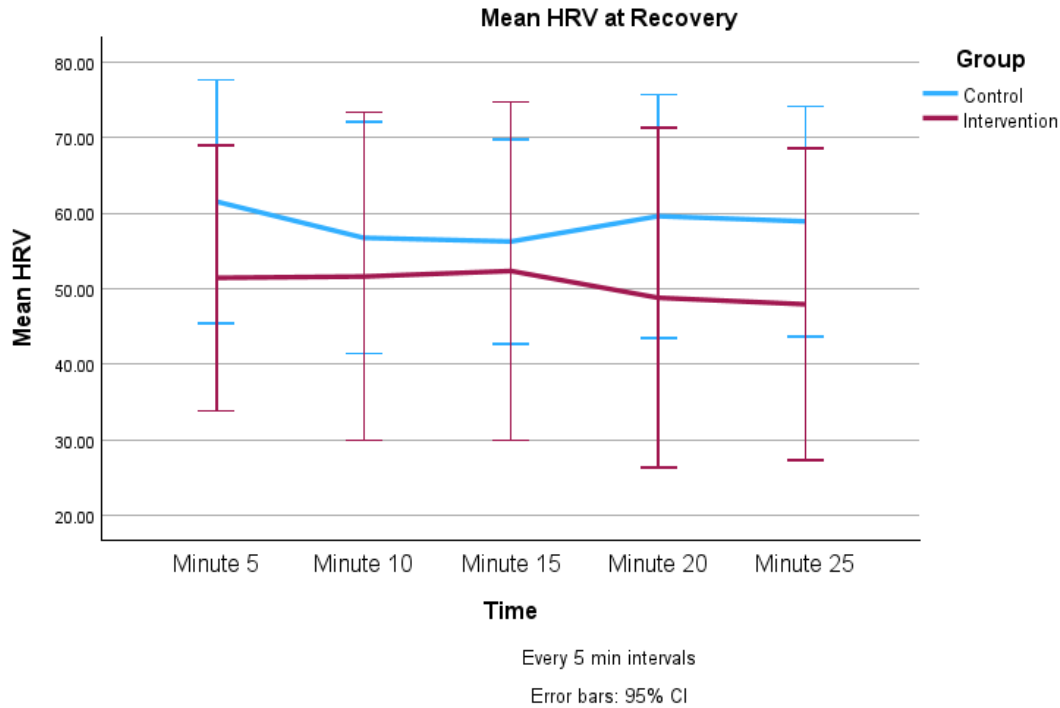


Figure 11. Mean HRV during recovery

4.4. Exploratory Analyses

4.4.1. Uric Acid

Figure 12 displays a graph representing mean UA levels at baseline (time 1), post weight stigma induction (time 2), and recovery (times 3-5). The graph shows that from baseline at time 1 to post weight stigma induction at time 2, the control group exhibited increased mean UA, while the intervention group had a reduction in UA. From post weight stigma induction to 20 minutes into recovery, both groups displayed a similar trajectory whereby mean UA levels continue to decrease until 35 minutes into recovery. At 35 minutes into recovery mean UA levels for the control group increased, while the intervention saw a small reduction. Similar to cortisol, both groups have large and overlapping error bars, meaning there may not be any statistically significant difference between groups. Figure 13 depicts the individual participant data points for UA plotted across time, differentiated by group. Similar to cortisol, an independent samples t-test

found a non-significance for UA, thus concluding there are no differences in total UA and UA reactivity between groups.

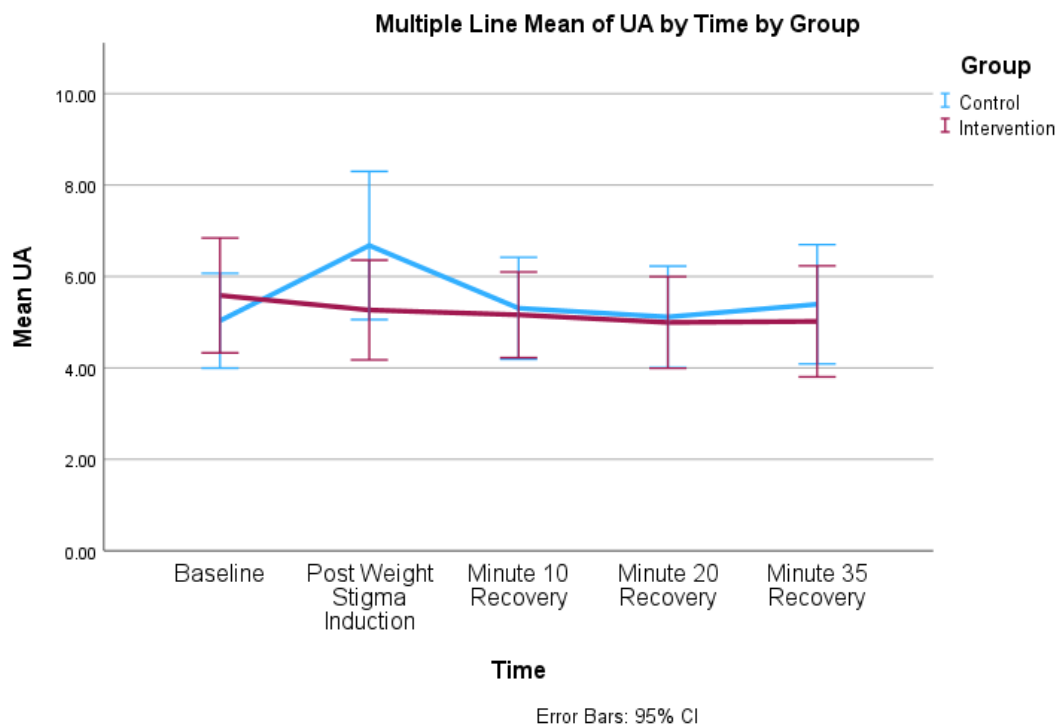


Figure 12. Mean uric acid across time

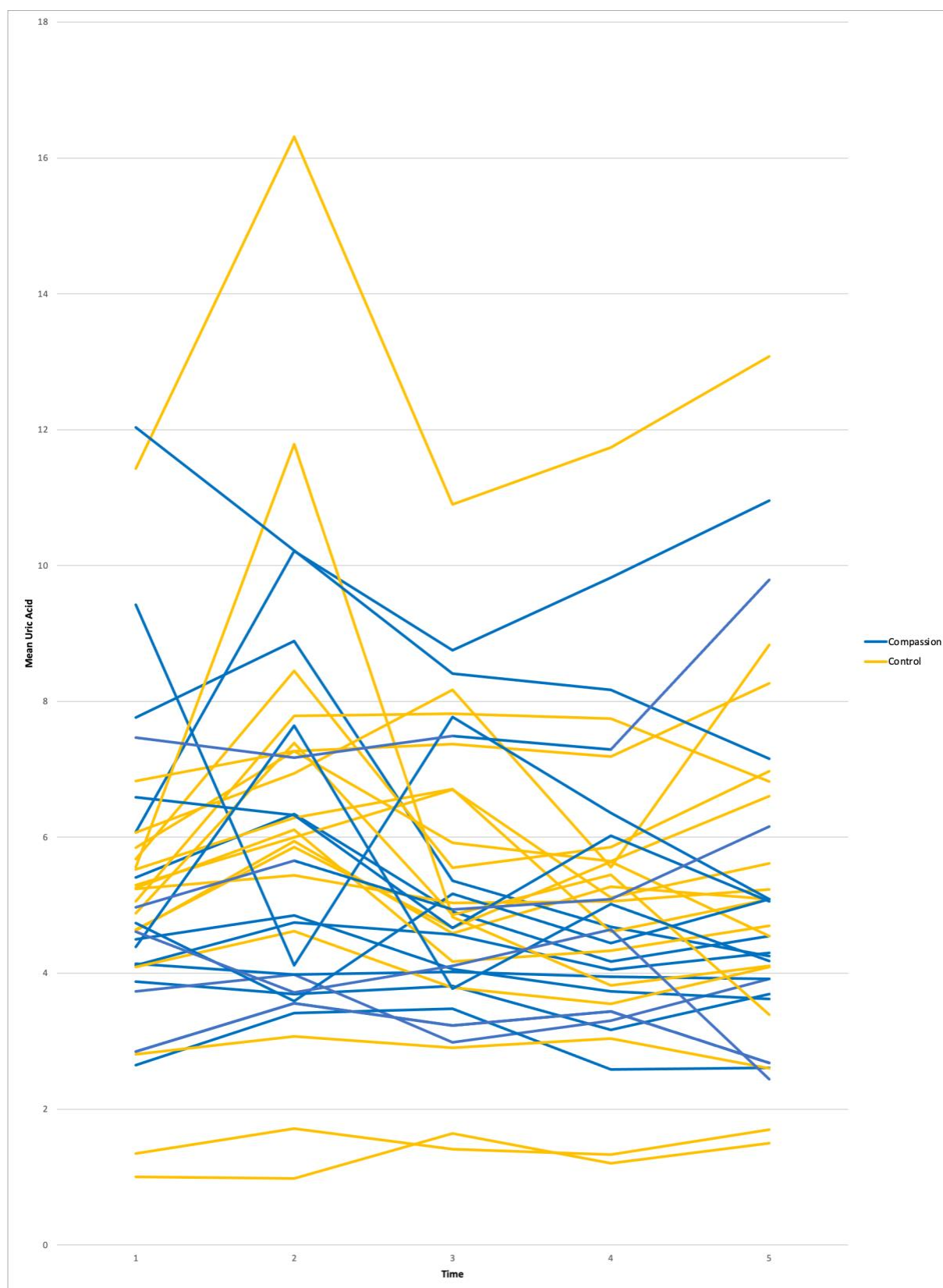


Figure 13. Individual participant data points for uric acid levels across time

4.4.2. Osteocalcin

Figure 14 shows the line graph for OCN (similar to cortisol and UA; Figures 7 and 9 respectively). The graph reveals that from baseline to post intervention or quiet rest, mean OCN level decreased for the intervention group but increased for the control group. At post weight stigma induction to 20 minutes into recovery, average OCN levels decrease for the control group and is slightly increasing for the intervention group. Lastly, from 20 to 35 minutes into recovery, both the intervention and the control group saw an increase in OCN levels. Similar to cortisol and UA, the 95% CI error bars for mean OCN across participants is also extremely far ranging and overlapping as well. Thus, there may not be any true differences between groups. Figure 15 displays a line graph with the individual participant data points for OCN plotted across time, separated by group. Independent samples t-tests found non-significance for OCN. Therefore, it is concluded that there are no differences in total OCN and OCN reactivity between groups.

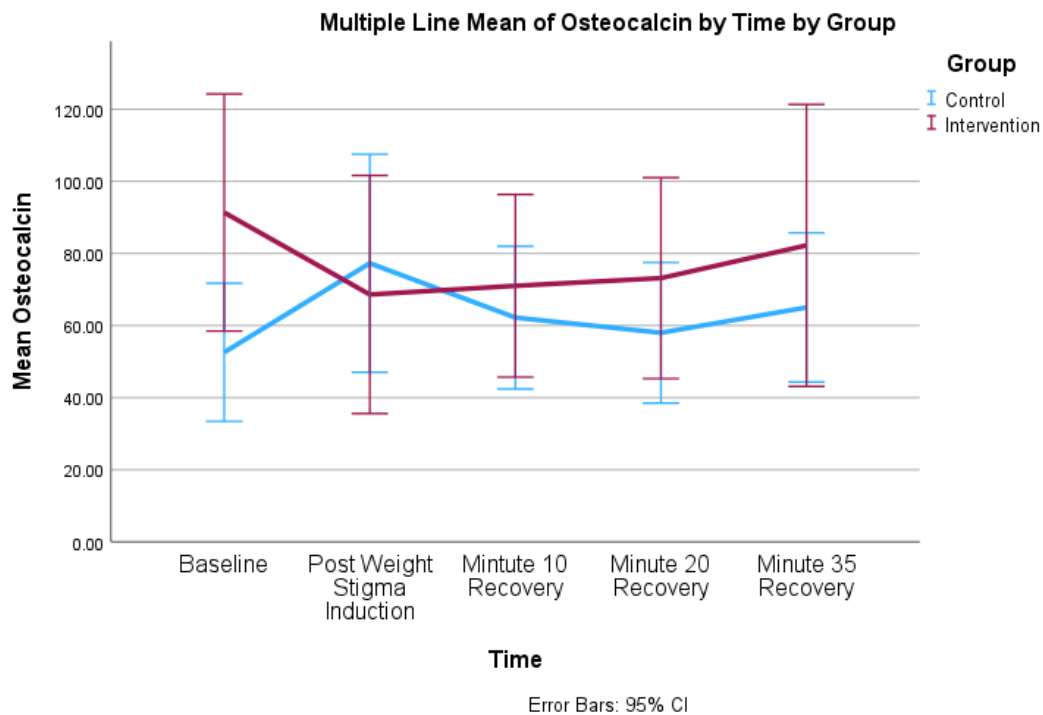


Figure 14. Mean osteocalcin across time

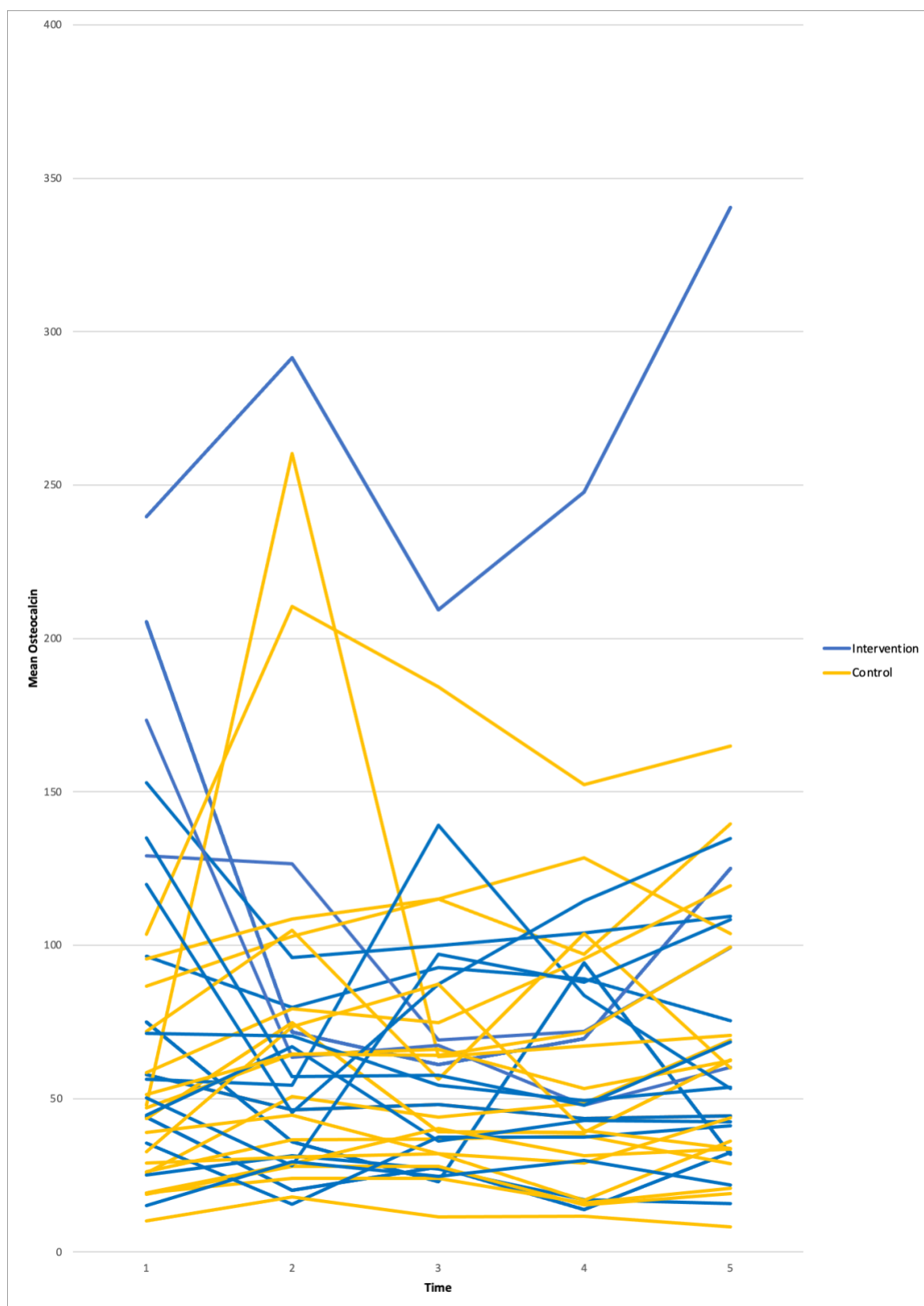


Figure 15. Individual participant data points for osteocalcin levels across time

Table 9. Effectiveness Indicator Scores and Means and Standard Deviations Across Time

Outcome Variables	Time	Intervention		Control		Cohen's d
		<i>N</i>	<i>M(SD)</i>	<i>N</i>	<i>M(SD)</i>	
Self-Conscious Emotions	Baseline	17	2.28(0.91)	18	2.83(1.13)	0.537
	Post Intervention or Resting Control	17	1.78(0.59)	19	2.72(1.25)	0.946
	Post Weight Stigma Induction	17	2.51(1.12)	20	3.28(1.43)	0.585
Shame	Baseline	17	1.25(0.51)	20	1.75(0.73)	0.788
	Post Intervention or Resting Control	17	1.69(0.17)	20	2.05(0.64)	0.730
	Post Weight Stigma Induction	17	1.25(0.33)	20	1.92(0.83)	1.035
Guilt	Baseline	17	1.24(0.33)	20	1.97(0.83)	1.131
	Post Intervention or Resting Control	17	1.20(0.26)	20	1.87(0.98)	0.904
	Post Weight Stigma Induction	17	1.15(0.19)	20	1.73(1.03)	0.747
Subjective Distress	Baseline	17	9.00(17.15)	20	21.95(24.03)	0.612
	Post Intervention or Resting Control	17	12.41(13.21)	20	27.00(25.58)	0.699
	Post Weight Stigma Induction	17	10.00(11.42)	20	29.25(23.91)	1.001
Weight Bias	Baseline	17	2.94(1.45)	20	3.73(1.63)	0.510
	Post Intervention or Resting Control	17	2.57(0.95)	20	3.55(1.58)	0.738
	Post Weight Stigma Induction	17	2.94(1.45)	20	3.73(1.63)	0.510
State Self Compassion	Post Intervention	17	3.57(0.75)	18	3.08(0.57)	-0.74
Cortisol	AUC _g	17	657.04(298.18)	19	593.28 (214.86)	-0.248
	AUC _i	17	-115.35(156.01)	19	-148.49(220.06)	-0.172
Uric Acid	AUC _g	17	541.08(202.11)	19	551.08(254.37)	0.043
	AUC _i	17	23.22(120.90)	19	64.43(62.68)	0.435
Osteocalcin	AUC _g	17	7789.30(6440.89)	19	6414.36(4612.24)	-0.248
	AUC _i	17	-436.46(2696.47)	19	1323.25(3460.05)	0.563
Heart Rate Variability	Baseline	17	21.00(12.26)	19	28.58(17.50)	0.497
	Intervention or Resting Control	17	39.14(25.41)	19	47.72(24.43)	0.345

Weight Stigma Induction	17	36.74(15.65)	19	45.20(17.13)	0.514
Recovery	17	50.43(40.25)	19	58.60(30.74)	0.230

Note: Time 1 = Baseline. Time 2 = Post Intervention or Resting Control. Time 3 = Weight Stigma Induction. AUC_g = Area Under the Curve with respect to the ground. AUC_i = Area Under the Curve with respect to the increase.

Table 10. Bivariate Pearson Correlation Between All Main Outcome Variables

	Trait SC	PSS	BES	Shame	Guilt	WBIS	SUDS	State SC	Cortisol Response	UA Response	OCN Response
Trait SC	-										
PSS	-0.48**	-									
BES	-0.47**	0.23	-								
Shame	-0.36*	0.30	0.63**	-							
Guilt	-0.13	0.17	0.51**	0.78**	-						
WBIS	-0.42*	0.29	0.95**	0.55**	0.45**	-					
SUDS	-0.38*	0.44**	0.41*	0.57**	0.43**	0.37*	-				
State SC	0.59**	-0.63**	-0.38*	-0.41*	-0.30	-0.44**	-0.46**	-			
Cortisol Response	0.07	0.02	-0.023	-0.15*	-0.19	-0.24	0.01	0.01	-		
UA Response	-0.04	-0.22	0.17	0.22	0.05	0.15	0.22	0.16	0.18	-	
OCN Response	-0.18	0.04	0.26	0.50**	0.24	0.16	0.26	-0.23	0.15	0.20	-

Note: Pearson correlations are in the bottom diagonal. * $p < .05$. ** $p < .01$. SC = Self-Compassion. PSS = Perceived Stress Scale. BES = Body Emotions Scale. WBIS = Weight Bias Internalization Scale. SUDS = Subjective Unit of Distress Scale. UA = Uric Acid. OCN = Osteocalcin. All salivary response correlations are calculated with AUC_i values.

Table 11. Independent Samples T-Tests for Salivary Biomarkers

Variables	<i>t</i>	<i>p</i>	Compassion Condition	Control Condition
			<i>M (SD)</i>	<i>M (SD)</i>
AUC _G Cortisol	-0.742	0.463	657.04 (209.18)	593.28 (214.86)
AUC _I Cortisol Response	-0.516	0.610	-115.35 (156.01)	-148.49 (220.06)
AUC _G UA	0.129	0.898	541.08 (202.11)	551.08 (254.37)
AUC _I UA Response	1.204	0.201	23.22(120.90)	64.43 (62.68)
AUC _G OCN	-0.742	0.463	7789.30(6440.89)	6414.36 (46.12.24)
AUC _I OCN Response	1.687	0.101	-436.46(2696.47)	1323.25 (3460.05)
Baseline HRV	1.498	0.146	30.71 (46.74)	28.58 (17.50)
Intervention HRV	1.032	0.309	41.46 (28.73)	51.83 (28.00)
Weight Induction HRV	1.541	0.133	38.23 (20.15)	48.32 (19.83)
Recovery HRV	0.689	0.496	50.74 (35.37)	58.60 (30.74)

Note: significance was interpreted using the two-sided *p*.

Chapter 5

5 Discussion

It has been well-documented that experienced weight stigma imposes profound, far-reaching, and detrimental consequences on individuals, significantly impacting various aspects in life ((Puhl & Heuer, 2010). Specifically, the effects of weight stigmatization have been proposed to have a negative impact on the health of individuals who are or perceive themselves to be higher weight (Major et al., 2014, 2017). As such, scholars have emphasized the necessity for research to investigate intervention strategies that address the effects of weight stigma (Ratcliffe & Ellison, 2015). To address this critical need, the present study explored the feasibility and acceptability and establish proof-of-concept of an acute self-compassion intervention intended to attenuate the psychobiological stress response from a weight stigma induction in young women.

Grounded in the weight-based social identity threat model (Hunger et al., 2015), the study aimed to replicate a weight stigmatizing task (using body composition assessment) to induce the psychobiological stress. Using elements from self-compassion focused therapy, such as psychoeducation, guided meditations, and self-compassion focused writing exercises, the intervention aimed to buffer the psychobiological stress via acute activation of affiliative processing. Overall, the present study's results demonstrated that while the study protocol was generally feasible and acceptable, the weight stigma induction may not have been sufficient to elicit a coordinated psychobiological stress response, and that a self-compassion induction may not be effective in mitigating the psychobiological effects of a weight stigma induction. However, as the weight stigma induction was not consistently effective at eliciting stress within participants, the efficacy of self-compassion to attenuate stress cannot be fully elucidated. These results may be attributable to various factors, such as individual differences and a small sample size, which limits

the ability to draw definite conclusions. As a preliminary pilot study, the present investigation is the first step in examining psychobiological stress responses (beyond cortisol) to a weight based social evaluation induction and testing the efficacy of self-compassion in mitigating stress induced by a weight stigma induction.

5.1. Primary Objective

The present pilot investigation was examined for feasibility of recruitment goals and participant perceptions of the acceptability of the self-compassion intervention and the weight stigma induction. Overall, the study was deemed to be feasible based on meeting 9 of 10 process criteria for feasibility and acceptability. Despite overall evidence of feasibility, there were notable challenges with the study protocol that could be used to inform future research using similar paradigms. First, challenges were encountered in attempting to recruit, screen, and test the target $N = 60$ sample size. This challenge may be attributed to the stringent inclusion and exclusion criteria of the study, that while contributed to enhanced internal validity, posed a threat to feasibility and ecological validity. Specifically, recruitment efforts commenced late December of 2021, and within the first four months, only 5 out of 74 participants were screened eligible and able to proceed with the protocol. Despite continued and diversified recruitment efforts (i.e., social media ads, posters across Western University campus and the London community), there was a dearth of potential participants in the proceeding months (i.e., May to July 2022). In an attempt to access a larger pool of participants, the experimental study underwent two amendments which were informed by emerging research recommendations to broaden the inclusion criteria.

Initially, the study inclusion criteria only comprised of participants using oral contraceptive to control hormonal fluctuations related to the menstrual cycle, but an emerging meta-analysis found no significant differences in cortisol reactivity in oral contraceptive users versus non-users (Gervasio et al., 2022). Therefore, the oral contraceptive eligibility criterion was

omitted in subsequent recruitment efforts. The study eligibility criteria were also initially limited to participants who identified as “higher weight”, in an effort to ensure that only participants who aligned with the threatened social identity were tested. However, after careful consideration, recognizing that weight stigma primarily affects individuals who are *not* in socially idealized thin bodies, and the lack of research on the psychobiological effects in individuals identifying with “average” weight statuses, we decided to broaden the eligibility criteria to also include participants who perceived their weight to be “average” – similar to other protocols (Himmelstein et al., 2015).

It can be reasoned that recruitment efforts were challenging due to the rigorous eligibility criteria. There was considerable interest in the study by participants who responded to the recruitment ads, but a large fraction was deemed ineligible. As the majority of interested participants who were ineligible were recruited from Western University, it is possible that the student population is not suitable for recruitment for this study. Future research efforts necessitate recruitment from the broader London community. Furthermore, the majority of prospective participants were recruited through the mass email system, which indicates that students were responsive to the advertisement. However, a lack of interest was communicated through other advertising avenues (i.e., flyers, posters, social media ads), which indicates that it is possible that participants are not responsive to physical and social media advertisements. This may be due to a large saturation of social media advertisements for other Western University research studies, clubs, and news outlets that may overshadow the current study. Future research can consider offering greater incentives to capture attention and/or engaging with community events to optimize recruitment.

In addition to the stringent eligibility criteria, the challenges of the recruitment process may be attributed to several other factors, including concerns about COVID-19 when collecting

saliva and mask-wearing (mandatory at the initial stages of recruitment), and the potentially arduous research commitment which involved two-day in-lab sessions following pre-screening. To combat this and to reduce attrition, one solution may be to streamline the in-lab sessions by condensing both sessions into one. Following similar research procedures (Cloudt et al., 2014; Lamarche et al., 2014, 2016, 2017; Smyth et al., 2020), participants can provide informed consent and sit for 10 minutes (pre-threat resting period) to acclimatize to the lab environment, before beginning the second experimental session immediately after.

Overall, participants perceived the study protocol to be acceptable. The general thoughts and reactions to participating in the study were well favoured with some participants describing the process as calm, comfortable and the study as interesting. When sharing perceptions of the self-compassion intervention, some participants noted that the self-compassion activities were interesting, helpful, and de-stressing, and that the writing exercises were thought-provoking, while others emphasized mind wandering and sleepiness during the meditation. Some emphasized the application of self-compassion during the skin calliper assessment helped them “take their mind off of it”. On the other hand, one specific participant was disinterested in the self-compassion meditation, since the laboratory environment disrupted the meditation practice.

Addressing these findings, it is evident the self-compassion intervention is likely too artificial in the laboratory environment. Future replications of the intervention could explore alternative approaches to induce self-compassion. For instance, designing a more comfortable environment during the intervention or administering self-compassion practices (e.g., meditations and journaling) at home to enhance comfort. Prior longitudinal research examining self-compassion responses to psychosocial stress utilized at home meditation practice sessions through the utilization of a compact disk (CD) containing meditation recording (Pace et al., 2009). In addressing the mind-wandering and sleepiness effect of the meditation, the current self-

compassion intervention entails a loving kindness meditation that is approximately 18 minutes long. It is likely that the length of the meditation may be too long, and thus contributing to mind wandering, which has negative implications to our research findings as participants are not fully engaged to the contents of the meditation. Future research should consider using a meditation that is shorter in duration, especially since participants in this study have no prior experience with self-compassion and mindfulness meditation practices. A meditation lasting 10 to 15 minutes should be sufficient as an introductory meditation in this acute intervention.

The second primary objective was to test the practicality of the proposed experimental study. The data suggests that the allocated resources were insufficient to complete the study within the projected one-year timeframe. Despite being intended to run for one year, the present study extended beyond one year, and the projected sample size was not achieved. This can be attributed to a combination of resource-related factors, such as insufficient funding and a shortage of research personnel managing the study. Additional personnel to assist with the study's operations would result in increased efforts aimed at participant recruitment. Additionally, the study's budget of \$25,000 allocated for research operations could be increased to allow for more resources to be directed towards recruitment and the acquisition of advanced technology for analysis (e.g., Kubios Scientific). It is evident that additional time, personnel, and funding are required to successfully conclude the study and meet the necessary sample size.

Overall, the data suggests that the experimental study was not practical enough to be completed within the projected time frame with the allocated resources, however, increased resources (i.e., funding, personnel, time) has the potential to support the completion the study. HRV data collection methods were adequate for this pilot study, but future research efforts can dedicate increased funding for more advanced/efficient data analysis technology (e.g., Kubios Scientific) to reliably analyze heart rate data. Then, the usage of EliteHRV to collect HRV data

can be eradicated, as most advanced HRV analysis programs allow for direct measurement to be recorded onto their platform.

The tertiary primary objective was to test the research's group's ability to implement the experimental protocol, including the self-compassion intervention, weight-based social-evaluative induction, and biological biomarker collection. All aspects of the experimental study were guided by the primary researcher successfully, including the 30-minute self-compassion intervention and the weight stigma induction with no complications. Regarding the biomarker data, HRV data was collected using the Polar H10 HRV chest straps and recorded on the EliteHRV application for Apple iPad. ECG and HRV data were continuously recorded throughout the study with no technical complications that arose during data collection. However, due to the extended duration of the current study, the presence of artifacts was uncertain as recordings were saved onto a cloud for later analysis. Additionally, the analysis process was time-consuming, considering the shorter epoch period (60 seconds) and limited advanced technologies for analysis. Given that there is currently limited research literature on editing artifacts, it is recommended for this future replication of this study to omit measures of HRV, unless specialty technology is used for analysis. Past research has used Mindware (Gahanna, OH) hardware and software with success (Arch et al., 2014). In replacement, measure of other similar biomarkers of stress, such as salivary alpha amylase is common in stress research. Doing so, will also broaden the eligibility criteria to include any participants with heart issues or high blood pressure.

To ensure internal validity of the biomarker stress data, numerous external factors that could potentially influence and confound the results were taken to account, considering that various factors may contribute to stress during the experimental study. For instance, stress arising from the unfamiliar laboratory environment was acknowledged and addressed by requiring participants to arrive for an initial in-lab to provide informed consent. Ultimately, this allowed

participants to become familiarized and acclimatized to the lab environment. The addition, randomization and the adoption of a control group in this experiment also increased the internal validity of this study. However, it is important to recognize that stress may be impacted by various factors, and not every element (e.g., daily stressors) could be considered.

Overall, the research group was able to successfully implement all procedures related to data collection and all aspects of the experimental study (i.e., self-compassion intervention and weight stigma induction) with minimal complications. Taken together, the current experimental study has potential for future investigations on the link between psychobiological stress and weight stigma. The experimental protocol was well accepted by participants and feasible to conduct. Adapting the present pilot study based on recommended future research directions will support future iterations of this study.

5.2. Objective 2: Preliminary Efficacy

5.2.1. Weight Stigma Induction and Psychobiological Stress

Direct experiences of weight stigma and even anticipated stigma can lead to an activation of a weight based social identity threat, in which one's perceived identity of being higher weight is threatened, and anxieties over identity devaluation and rejection arise. Studies have shown that an activation of the weight based social identity threat can elicit a psychobiological stress response (Hunger et al., 2015). Overall, the findings from this study demonstrate that a weight stigma induction via anthropometric body composition assessment was not able to induce a weight based social identity threat from most participants. A likely explanation is that the study was underpowered to detect significant differences. Despite this, some psychological effects were found, and are discussed further below.

Specifically, the results indicate that the experimental manipulation via the skin calliper assessment did not elicit majority of the psychological stress outcome variables as hypothesized,

apart from increased self-conscious emotions. Contrary to hypotheses, there was a decrease in global experiences of shame in response to the weight stigma induction. Recent research suggests self-identifying higher weight individuals generally experience greater levels of body-shame, and this was related to higher levels of internalized weight stigma (Lucibello et al., 2021). Hence, the experimental manipulation might have been able to elicit negative emotions (self-conscious emotions) considering the sample consisted of higher weight identifying women, who may be more susceptible to experiencing feelings of body-related self-conscious emotions and social threat. Furthermore, as the body composition assessment was aimed to measure body fat, this may have induced emotions specific to participants' perceptions about their bodies, such as body-related self-conscious emotions. Self-conscious emotions are thought to have an evaluative component (Park & Lewis, 2021), and may explain why these constructs were more sensitive to change than other related constructs.

Furthermore, previous experimental studies examining psychobiological responses to social evaluative threat consistently found increased body shame, similar to the findings in this study (Cloudt et al., 2014; Lamarche et al., 2014, 2017; Smyth et al., 2020). However, although self-conscious emotions (body shame, body guilt, body embarrassment, and body envy) increased, global feelings of shame decreased to baseline levels. Thus, the weight stigma induction was able to induce weight-specific body emotions within participants, however, was unable to elicit global feelings of shame. This may be due to the fact that the weight stigma induction was specifically targeting participants' weight-specific social identity and perceptions about their body weight. The scale used to measure self-conscious emotions may be more sensitive to change as it asked direct questions in regard to one's weight (e.g., "I feel embarrassed about my weight"). Since participants completed the question immediately following the body composition assessment, these questions containing words such as "weight" may serve as a reminder to participants of the

weight-related experience they just felt. Therefore, the body composition assessment may trigger specific emotions related to one's weight, such as feeling shameful of one's physical appearance, but may not be sufficient to impact global shame. Global shame is inherently tied to one's self-worth, and it is a broader form of shame that encompasses all aspects of an individual's self-concept and sense of worth (Tangney & Tracy, 2012). In contrast to body-specific self-conscious emotions, global shame is not limited to negative emotions about one's physical attributes, but it involves a wide array of individual-level characteristics that communicates one's identity. Thus, it may be that the weight stigma induction was able to elicit body-specific negative emotions, but not enough to impact global feelings of shame. These may be some possible explanations as to why the experimental manipulation was able to elicit body-related self-conscious emotions, and shame but no other psychological variables (i.e., subjective distress, internalized weight bias, and guilt). Taken together, the current study did not find evidence supporting the experimental manipulation in inducing the hypothesized psychobiological stress response (apart from self-conscious emotions). Nevertheless, it is critical to recognize that individual differences and other factors may contribute to the participants' responses to the weight stigma induction, and these factors may explain the variability in the psychobiological stress response in the results.

To activate a weight-based social identity threat, it is crucial that participants must identify with the social identity of higher weight. In this study, over 50% of participants identified with the "Slightly Heavy" weight status, while over 40% of participants identified with the "Average" weight status. Less than 10% of participants identified as "Moderately Heavy" and no participants identified as "Very Heavy". Prior research using a weight stigma induction has found that participants who identify as heavy weight showed significant sustained cortisol elevation compared to participants that identified as thin/average weight, to which their cortisol levels recovered and returned to baseline (Himmelstein et al., 2015). Another research study that utilized

weight stigmatizing media messages to induce social identity threat also found significant effects for weight based social identity threat for perceived high-weight compared to participants who did not perceive themselves to be high-weight (Major et al., 2014). Therefore, it is likely that the substantial representation of “Slightly Heavy” and “Average” weight identifying participants in the sample may have contributed to the variability in the psychobiological stress reactivity, and possibly explains the lack of psychobiological effects observed in response to the experimental manipulation. However, previous studies that used the same weight stigma induction via body composition assessments successfully have found no differences in stress response when controlling for BMI, weight, and body fat (Lamarch et al., 2016). In the present study, it is likely that due to sample size limitations, the significant effects could not be fully established. Future studies should extend and replicate investigations on how individuals with different objective and perceived weight statuses might respond to social evaluation and establish if there are any differences in stress reactivity in individuals who identify as “average” vs. “heavier weight”.

Furthermore, following Himmelstein et al. (2015), although only self-perceived higher weight participants were recruited for this study, it was decided that since weight stigmatization is only implausible for participants who perceive themselves as “thin” the inclusion criteria encompassed participants who identified as “average” weight. However, other similar studies conducting weight stigma inductions instead grouped average weight with thin weight identifying participants (Major et al., 2014). Moreover, since the strength of the weight identification was not measured, it is possible that participants who identified as “Average” or “Slightly Heavy” did not strongly identify with these weight statuses. It is probable that a sample with a higher perceived weight identification would elicit a higher level of psychobiological stress reactivity in participants when exposed to the weight stigma induction. Future research should examine

strength of individual's weight identification to provide a more nuanced approach to examining if there are any differences in stress response in individuals with different perceived weight statuses.

There are also numerous studies that consistently report blunted cortisol response as a characteristic among individuals who are chronically stressed (Matheson & Anisman, 2012). Studies have documented blunted cortisol reactions in individuals with past experiences of childhood victimization or racial discrimination when exposed to acute stressors (Matheson et al., 2008; Richman & Jonassaint, 2008). There is also evidence to suggest that individuals who are chronically stressed, such as higher weight individuals who often experience weight stigmatization in everyday life, exhibit a blunted cortisol response to stressors when exposed to a weight stigma induction compared to "normal" weight participants (McCleary-Gaddy et al., 2019). Likewise, another study investigated internalized weight bias and cortisol reactivity in a group of higher weight adults following psychosocial stress also found blunted cortisol response in individuals with high internalized weight bias, concluding that these individuals may be categorized as cortisol non-responders (Jung et al., 2020). Therefore, it is possible that participants in this study who did not exhibit a cortisol reactivity may be in part due to being a cortisol non-responder because of chronic stress exposure from weight-based stigmatization.

The present study did not observe any significant changes in the levels of UA and OCN in response to the weight stigma induction nor was a buffered stress response demonstrated for the intervention group compared to control. Although the results may not indicate statistical significance, there was considerable variability in the changes of UA and OCN among participants across time as illustrated in Figures 10 and 12. Since the projected sample size of this study was not met due to recruitment challenges, it is likely that the study was underpowered to detect significant effects, and increasing the sample size may provide more concrete results. In addition, the current study did not analyze participants' dietary behaviours, and as such, could

have impacted participants' levels of UA through the consumption of high purine foods and high fat diets (Choi et al., 2005; Woerner et al., 2019).

Current literature only identified two studies examining salivary UA in response to a social evaluation induction (TSST) (Lucas et al., 2020; Woerner et al., 2019), and both examined a largely identical African American population, which precludes the generalizability of their findings to other racial-ethnic groups. Regarding OCN, only one previous study examined salivary OCN in response to a social evaluation induction, and it was found that OCN reactivity in response to stressor task (i.e., TSST) was only demonstrated among men. One other study examining the association between serum OCN, and subjective distress found OCN to be a biomarker associated with chronic stress, but the study was specific to individuals with depression and type 2 diabetes (Nguyen et al., 2020). Thus, there is a current lack of literature on the potential of these biomarkers for stress reactivity in response to social evaluative stress.

Although the present study was not able to find statistical significance in the findings, feasibility and acceptability of the experimental protocol supports the utilization of salivary UA and OCN to measure stress reactivity in response to social evaluative stress in participants. Further, current known studies on UA and OCN in stress reactivity research were primarily focused within an African American sample, with limited control for stress-related confounders. Elucidating stress reactivity in these biomarkers (UA and OCN) can help establish them as stress indicators, which can inform various health outcomes, as UA and OCN are related to various health implications. For instance, UA has linked to inflammatory responses and cardiovascular health and OCN is associated with bone health (Gherghina et al., 2022; Komori, 2020). The present research study provides valuable insights by incorporating novel salivary biomarkers as a measure of interest.

Furthermore, this study was modeled closely after the social evaluative induction by Lamarche et al. (2016), which aimed to utilize anthropometric assessments to induce social evaluation. However, the standard anthropometric body composition assessments might be limited in eliciting the expected stress response associated with the weight-based social identity threat. These assessments heavily depend on the participants' perceptions of negative evaluation and anticipated threats. The stress response triggered by the skin calliper assessment primarily hinges on the participants' suspicions and/or anticipation of being stigmatized based on their weight. Consequently, it is probable that the body assessment may have not been stressful enough to elicit the suspected/anticipated stress related to weight stigma. Alternatively, Himmelstein et al., (2015), conducted a novel weight stigma manipulation, which mimics real-life discriminatory experiences of interpersonal rejection, and the authors theorized the direct experience of rejection to be a more powerful experience to trigger psychological reactions compared to other weight stigma manipulations (e.g., reading weight stigma news article, weight stigmatizing video, weight-visible videotaped interview; Major et al., 2012, 2014; Schvey et al., 2014).

Additionally, the social evaluation induction via the body composition assessment is arguably a negative body-related experience rather than a weight stigmatizing experience. The experimental manipulation as followed using Lamarche et al., (2016), used a skin calliper assessment as the social evaluation threat induction given prior research identifying various uncomfortable body-related experiences, with being in a bathing suit as the main source of stress (Lamarche et al., 2012). Previous experimental manipulations to elicit body image concerns utilize increasing levels of body exposure as a main induction paradigm (Carron & Prappavesis, 1997; Gammage et al., 2004; Martin Ginis et al., 2008). Thus, the stigmatizing nature of the manipulation can be questioned, and argued against as it may represent a negative body related experience rather than a weight stigmatizing experience. Future research directions should explore

anthropometric assessments to ascertain whether they represent weight stigmatizing experience for individuals and additionally investigate other experimental manipulation paradigms, such as interpersonal rejection, would be beneficial to advance the understanding on weight stigma induction research.

Lastly, this study examined stress in a multidimensional approach, as the weight stigma induction is based on an individuals' perceived experience of negative evaluation and stigmatization, psychological stress may be a better indicator of stress as it is inherently tied to an individual's subjective experience. However, it is recommended for future research to examine stress in multidimensional ways to capture all aspects of human's responses to acute stressors.

5.2.3. Acute Self-Compassion Intervention

The present study did not find evidence supporting the acute self-compassion intervention in mitigating the negative effects of the weight-based social evaluation induction compared to a control condition, as hypothesized. However, due to the limited sample size, the experimental study was not adequately powered to determine statistically significant effects, precluding the ability to draw concrete conclusions on its effectiveness.

It is possible that the laboratory environment was not sufficient in fostering a state of compassion and mindfulness during the meditation component as it lacks the comfort and tranquility needed for such practices. Participants were instructed to remain seated and close their eyes during the meditation. As the majority of participants were current students, it is likely that instances of mind-wandering and sleepiness resulted in diminished focus during the meditation, which precludes the intended purpose of the meditation. Furthermore, recent research suggested that self-compassion did not buffer negative effects for students who are chronically stressed (Kroshus et al., 2021). Since stigma and discrimination are considered chronic stressors (Kroshus et al., 2021; Sikorski et al., 2015), and given that studies have linked weight stigmatization to

chronic stress (Gómez-Pérez et al., 2021; Jackson et al., 2016; Tomiyama et al., 2014), it can be suggested that weight stigmatization are sources of chronic stressors (Emmer et al., 2020; McCleary-Gaddy et al., 2019). Thus, it is plausible to consider that participants could have experiences of chronic stress that are not taken into account in this study (e.g., financial issues, problems with family and partners, other sources of discrimination), which could have influenced the outcomes. In addition, the efficacy of the self-compassion to attenuate stress cannot be properly evaluated as the weight stigma induction did not elicit the hypothesized psychobiological stress response.

Despite the null effects, the intervention was proved to be effective at inducing a self-compassionate state among participants in the intervention group compared to the control group. One plausible explanation for why self-compassion, despite being effective, was unable to mitigate psychobiological stress may be due to the acute nature of the intervention. A recent systematic review examining self-compassion interventions mostly found durations of three weeks to three months (Biber & Ellis, 2019). In addition, a recent meta-analysis found that self-compassion interventions of at least 12 weeks may be most optimal on physical health, but further research is necessary to explicate the findings (Phillips & Hine, 2021). A comprehensive review found that the longer the duration of the self-compassion intervention, the bigger the effect sizes (Wakelin et al., 2022). Taken together, it is recommended for future research to explore the effectiveness of a longitudinal self-compassion intervention at attenuating psychobiological stress responses to a weight stigma induction. Indeed, there is evidence that longitudinal self-compassion interventions show potential for alleviating stress and enhancing well-being (Schnepper et al., 2020). Other directions for the future research could explore the optimal duration of practicing self-compassion to reap benefits against stress.

5.6. Limitations and Future Directions

While this study may lead to valuable insights on the relationships between negative psychobiological responses, affiliative processing, and negative social evaluation, it is important to recognize the study limitations. Given that this research is a pilot study, its preliminary nature limits the scope and depth of the research study as the primary aims are to establish proof of concept and determine parameter estimates, feasibility, and acceptability, rather than drawing definitive conclusions.

One major limitation to the study was its small sample size due to not being able to adequately meet the sample size planned. This limits the generalizability of the conclusions drawn, and thus impacts the ability to accurately represent the target population. Furthermore, considering individuals from marginalized groups are thought of to be more negatively impacted by stigma and social stressors, it is important to note that the present sample, characterized by elevated average levels of socioeconomic status, might present a constraint on the extent to which findings can be applied broadly. This particular sample composition could potentially account for the lack of observed impacts on stress, given that research demonstrates a correlation between lower socioeconomic status and heightened stress (Baum et al., 1999). Furthermore, the limited data collection methods may also be one factor that poses as a limitation. Although the study examines various physiological markers, only cortisol and HRV were looked at as the primary biomarker for stress. Thus, future research should consider elucidating the effects of social evaluation on other primary salivary biomarkers for stress, such as immune or inflammatory responses (e.g., salivary alpha amylase, interleukin-6, TNF-alpha, c-reactive protein, and IgA).

Given the nature of the research study, external factors such as participant sweating through HRV chest straps, unintentional movements during the study, HRV chest strap displacements, and unknown causes of irregular heartbeats may contribute to the presence of

artifacts (Peltola, 2012). Artifacts were corrected using visual inspections and manual corrections using interpolation of degree zero substitutions and cubic spline interpolations programmed in Kubios under recommended threshold levels for young adults (i.e., very low to low frequencies; Alcantara et al., 2020; Giles & Draper, 2018). However, there is a recommended in previous sections, future research should invest in more advanced technologies to accurately analyze heart rate data with a higher level of precision. Also, this study's sole manipulation checks to evaluate the effectiveness of the self-compassion intervention at inducing acute self-compassion within participants is examined using the SSC (Neff et al., 2020). Although widely used, there are a multitude of other methodologies to test for state self-compassion, such as physiological measures (e.g., skin conductance, EEG; (Kirschner et al., 2019).

Another potential limitation is the influence of selection bias in the present study. Interested prospective participants may be not representative of the general population, as the study was advertised as “investigating hormones and cardiovascular function,” which may attract specific groups of participants compared to others. The sample's inclusion characteristics of identifying as cis-gender women between the ages of 18 to 34 inclusive, and self-identifying as average or higher weight, may be less inclined to participate in a study that may assess their cardiovascular function, given the term “cardiovascular function” could be associated with exercise-related connotations, deterring certain participants from expressing interest in the study. Moreover, following the pre-screening interview, eligible participants agree to participate in the study, including participation in the body composition assessment, which limits the sample to those who may be comfortable in having their bodies examined in a sports bra and spandex shorts. Future research studies should broaden recruitment efforts outside of university students to broaden the population in order to enhance external validity and decrease selection bias.

Another potential limitation is determining the optimal self-compassion intervention modality to protect against weight stigma. In this study, three main modalities are utilized to induce acute self-compassion (i.e., psychoeducation, compassion guided meditation, and compassion focused writing exercise). However, there are limited research that specify the unique effects of each modality for fostering a compassionate responding to social evaluative stress. Since this research study examines whether self-compassion may attenuate the negative effects of weight stigma, it is unclear whether the components of the self-compassion intervention should be body-specific or generalized. In the current study, the psychoeducation, meditation, and writing exercise are all generalized, and activities does not pertain to specific body image related cognitions. Therefore, it is worthwhile for future studies to investigate if there are differences in psychobiological responses in participants that underwent body specific compared to generalized self-compassion intervention modalities.

Similarly, it is not known if self-compassion may be better induced acutely when participants are in a group versus individual setting, and future directions may be to elucidate if any differences arise due to the contextual environment. Further, for this study, as participants were required to have no prior experience with formal self-compassion/mindfulness training/therapy (as indicated in the exclusion criteria), it is possible that an acute 30-minute self-compassion intervention was not sufficient enough to mitigate acute stress. Future research directions could investigate a longitudinal self-compassion focused intervention at inducing self-compassion and examine its effectiveness at mitigating psychobiological stress. Another future avenue for research investigations on self-compassion interventions may be introducing the self-compassion following the weight stigma induction to examine stress and coping effects.

Lastly, the duration of the experimental manipulation varied among participants due to various factors. For instance, participants seeking clarifications regarding the procedure of the

skin calliper assessment, finding the suitable sports bra and/or spandex shorts for participants who did not bring their own, participant change time, and some participants expressing self-consciousness during the assessment. These factors all could have prolonged or shortened the duration of the weight stigma induction for different individuals, thus potentially impacting the stress reactivity for participants. In the present study, it was found that although most inductions were 12-minutes (as predicted), some durations ranged from 5 minutes to 12 minutes. Future research should standardize the duration of the weight stigma induction.

5.6. Study Implications

To our knowledge, this is the first study to examine the effectiveness of an acute self-compassion intervention at attenuating psychobiological stress of a weight stigma induction. This study will contribute to understanding the foundational processes that link negative social evaluative, affiliative processing systems, and associated psychobiological responses. Elucidating the conditions in which social evaluation activates physiological systems has important implications understanding psychobiological processes that predict human motivation and behaviour. Simultaneously assessing neuroendocrine and autonomic processes which underpin social evaluation and affiliative processing will contribute towards understanding the how humans respond to (and are protected from) negative social evaluation. It is critical to understand the psychobiological responses perceived experiences of weight stigma, as adaptive compared to maladaptive stress responses may cause individuals to maintain in chronic stages of stress or a dysregulation of stress response, both factors that are associated with poorer psycho-physical health (Cloudt et al., 2014). Weight stigma is a fitting model upon which to investigate these questions, as there is a large and growing body of literature to suggest that weight-based stigma is

pervasive in Western society (Pearl, 2018; Puhl & Heuer, 2010) and thus it is imperative to identify strategies that may attenuate the psychobiological effects of these stigmatized states.

Self-compassion interventions could serve as effective and accessible tools to build women's resilience to weight stigma threats and reduce the deleterious physical and psychological risks associated with chronic activation of stress. Moreover, there is limited empirical research upon which many important weight stigma theories rely, so replication and extension of existing work is essential. This novel study will support the establishment and potential of a foundational program of research in the psychobiological aspects of social evaluation, to advance our understanding of the psychobiological processes that underpin variability in how humans respond to negative social threats and drive disparate health outcomes across socially marginalized groups.

5.6.1. Methodological Implications

Social evaluation inductions, such as the Trier Social Stress Test (TSST), are widely used in stress research to induce psychobiological stress associated with social self-preservation (Cloudt et al., 2014; Kirschbaum et al., 1993). Generally, previous research using the TSST to induce social evaluative stress have been able to elicit negative psychobiological stress consistently, with evidence indicating the negative effects (e.g., shame, cortisol) are more prominent in inductions emphasizing social evaluation compared to inductions without social evaluative stress (Dickerson, 2008; Dickerson & Kemeny, 2004; Gruenewald et al., 2004). Other scholars have extended the social evaluation induction paradigm to other social evaluative designs to test for stress (Rohleder et al., 2007). In more recent years, body image has been an investigation of interest in the context of social evaluation, and various methods of inducing social evaluative threat have been manipulated (Cloudt et al., 2014; Lamarche et al., 2014, 2016, 2017; Smyth et al., 2020). The present research expands upon existing experimental manipulation

designs involving social evaluative threat in the context of body image to weight stigma, a topic that, to the best of our knowledge, has previously been explored by Himmelstein et al., (2015).

Furthermore, current research studies investigating psychobiological stress responses to social evaluation in the domain of body image have primarily focused on examining salivary cortisol (Cloudt et al., 2014; Himmelstein et al., 2015; Lamarche et al., 2014, 2016, 2017; Smyth et al., 2020). This study is the first to extend social stress research beyond examining traditional physiological indices of stress, such as salivary cortisol, to salivary uric acid and osteocalcin, and thus, contributes valuable insight to the current literature on the feasibility and efficacy of these salivary biomarkers as indicators of stress responses.

5.7. Conclusion

Weight stigma is pervasive for higher-weight individuals in Western society. However, the psychobiological stress of weight stigma remains inadequately established as there are limited empirical research. Therefore, replication and extension of existing work is essential to advance our understanding in this area. This study aimed to examine the psychobiological stress responses to a weight-based stigma induction to understand the processes that link social evaluation and psychobiological responses. Moreover, it is imperative to identify strategies that may help cope with the psychobiological effects of weight stigma. Self-compassion may be one intervention method to help build women's resiliency and coping mechanisms against social threats, and further research to uncover the affiliative processing systems may enhance resilience and coping with weight stigmatizing states.

Contrary to the hypothesis, the weight stigma induction via body composition assessment did not elicit the hypothesized psychobiological response. Findings indicated significant negative affective responses (i.e., self-conscious emotions), and may point to the sensitivity of negative affective states to be surfaced when experiencing weight-based negative evaluations. Furthermore,

as the experimental manipulation was unable to elicit stress, the effectiveness of self-compassion to attenuate stress was undermined. Nonetheless, there was evidence supporting acute self-compassion intervention to promote compassionate states within participants. Thus, future research should examine if the acute state of compassion extends to responding compassionately in the face of weight based social evaluative threat. Despite the findings, the preliminary study confirms feasibility and acceptability, and has the potential for future research replication and extension. This study extends the current weight stigma literature and contributes to a novel experimental protocol extending past research on psychobiological stress responses beyond cortisol to uric acid and osteocalcin and is the first to our knowledge to test the efficacy of self-compassion to attenuate weight-based psychobiological stress.

References

- Abelson, J. L., Erickson, T. M., Mayer, S. E., Crocker, J., Briggs, H., Lopez-Duran, N. L., & Liberzon, I. (2014). Brief cognitive intervention can modulate neuroendocrine stress responses to the Trier Social Stress Test: Buffering effects of a compassionate goal orientation. *Psychoneuroendocrinology*, *44*, 60–70.
<https://doi.org/10.1016/j.psyneuen.2014.02.016>
- Acevedo, A. M., Fortier, M. A., Campos, B., Brown, Y. C., & Riis, J. (2022). Salivary uric acid reactivity and baseline associations with physiological stress response. *Psychoneuroendocrinology*, *146*. <https://doi.org/10.1016/j.psyneuen.2022.105948>
- Alberga, A. S., Nutter, S., MacInnis, C., Ellard, J. H., & Russell-Mayhew, S. (2019). Examining weight bias among practicing canadian family physicians. *Obesity Facts*, *12*(6), 632–638.
<https://doi.org/10.1159/000503751>
- Alcantara, J. M. A., Plaza-florido, A., Amaro-gahete, F. J., Acosta, F. M., Migueles, J. H., Molina-garcia, P., Sacha, J., Sanchez-delgado, G., & Martinez-tellez, B. (2020). Impact of using different levels of threshold-based artefact correction on the quantification of heart rate variability in three independent human cohorts. *Journal of Clinical Medicine*, *9*(2).
<https://doi.org/10.3390/jcm9020325>
- Alimoradi, Z., Golboni, F., Griffiths, M. D., Broström, A., Lin, C. Y., & Pakpour, A. H. (2020). Weight-related stigma and psychological distress: A systematic review and meta-analysis. In *Clinical Nutrition* (Vol. 39, Issue 7, pp. 2001–2013). Churchill Livingstone.
<https://doi.org/10.1016/j.clnu.2019.10.016>
- Allen, A. B., & Leary, M. R. (2010). Self-Compassion, Stress, and Coping. *Social and Personality Psychology Compass*, *4*(2), 107–118. <https://doi.org/10.1111/j.1751-9004.2009.00246.x>
- Allen, A. P., Kennedy, P. J., Cryan, J. F., Dinan, T. G., & Clarke, G. (2014). Biological and psychological markers of stress in humans: Focus on the Trier Social Stress Test. *Neuroscience & Biobehavioral Reviews*, *38*, 94–124.
<https://doi.org/10.1016/J.NEUBIOREV.2013.11.005>
- Amy, N. K., Aalborg, A., Lyons, P., & Keranen, L. (2006). Barriers to routine gynecological cancer screening for White and African-American obese women. *International Journal of Obesity*, *30*(1), 147–155. <https://doi.org/10.1038/sj.ijo.0803105>
- Arch, J. J., Brown, K. W., Dean, D. J., Landy, L. N., Brown, K. D., & Laudenslager, M. L. (2014). Self-compassion training modulates alpha-amylase, heart rate variability, and subjective responses to social evaluative threat in women. *Psychoneuroendocrinology*, *42*, 49–58. <https://doi.org/10.1016/j.psyneuen.2013.12.018>
- Arch, J. J., Landy, L. N., Schneider, R. L., Koban, L., & Andrews-Hanna, J. R. (2018). Self-compassion induction enhances recovery from social stressors: Comparing adults with social anxiety disorder and healthy controls. *Anxiety, Stress and Coping*, *31*(5), 594–609.
<https://doi.org/10.1080/10615806.2018.1504033>
- Arslan, G. (2023). My inner perfectionist and nasty side! Self-compassion, emotional health, and subjective well-being in college students. *Personality and Individual Differences*, *210*, 112232. <https://doi.org/10.1016/J.PAID.2023.112232>
- Ashmore, J. A., Friedman, K. E., Reichmann, S. K., & Musante, G. J. (2008). Weight-based stigmatization, psychological distress, & binge eating behavior among obese treatment-seeking adults. *Eating Behaviors*, *9*(2), 203–209.
<https://doi.org/10.1016/j.eatbeh.2007.09.006>

- Ata, R. N., & Thompson, J. K. (2010). Weight bias in the media: A review of recent research. In *Obesity Facts* (Vol. 3, Issue 1, pp. 41–46). <https://doi.org/10.1159/000276547>
- Au, T. M., Sauer-Zavala, S., King, M. W., Petrocchi, N., Barlow, D. H., & Litz, B. T. (2017). Compassion-Based Therapy for Trauma-Related Shame and Posttraumatic Stress: Initial Evaluation Using a Multiple Baseline Design. In *Behavior Therapy* (Vol. 48). www.sciencedirect.comwww.elsevier.com/locate/bt
- Bacon, L., & Aphramor, L. (2011). Weight science: Evaluating the evidence for a paradigm shift. In *Nutrition Journal* (Vol. 10, Issue 1). <https://doi.org/10.1186/1475-2891-10-9>
- Barnard, L. K., & Curry, J. F. (2012). The Relationship of Clergy Burnout to Self-Compassion and Other Personality Dimensions. *Pastoral Psychology*, 61(2), 149–163. <https://doi.org/10.1007/s11089-011-0377-0>
- Batson, C. D., Fultz, J., & Schoenrade, P. A. (1987). Distress and Empathy: Two Qualitatively Distinct Vicarious Emotions with Different Motivational Consequences. In *Journal of Personality* (Vol. 55, Issue 1).
- Baum, A., Garofalo, J. P., & Yali, A. M. (1999). Socioeconomic status and chronic stress. Does stress account for SES effects on health? *Annals of the New York Academy of Sciences*, 896, 131–144. <https://doi.org/10.1111/j.1749-6632.1999.tb08111.x>
- Berger, J. M., Singh, P., Khrimian, L., Morgan, D. A., Chowdhury, S., Arteaga-Solis, E., Horvath, T. L., Domingos, A. I., Marsland, A. L., Yadav, V. K., Rahmouni, K., Gao, X. B., & Karsenty, G. (2019). Mediation of the Acute Stress Response by the Skeleton. *Cell Metabolism*, 30(5), 890–902.e8. <https://doi.org/10.1016/j.cmet.2019.08.012>
- Berking, M., & Whitley, B. (2014). Emotion Regulation: Definition and Relevance for Mental Health. In *Affect Regulation Training* (pp. 5–17). Springer.
- Bhuptani, P. H., & Messman, T. L. (2022). Self-compassion and Shame Among Rape Survivors. *Journal of Interpersonal Violence*, 37(17–18), NP16575–NP16595. <https://doi.org/10.1177/08862605211021994>
- Biber, D. D., & Ellis, R. (2019). The effect of self-compassion on the self-regulation of health behaviors: A systematic review. *Journal of Health Psychology*, 24(14), 2060–2071. <https://doi.org/10.1177/1359105317713361>
- Bidstrup, H., Brennan, L., Kaufmann, L., & de la Piedad Garcia, X. (2022). Internalised weight stigma as a mediator of the relationship between experienced/perceived weight stigma and biopsychosocial outcomes: a systematic review. In *International Journal of Obesity* (Vol. 46, Issue 1). Springer Nature. <https://doi.org/10.1038/s41366-021-00982-4>
- Blodorn, A., Major, B., Hunger, J., & Miller, C. (2016). Unpacking the psychological weight of weight stigma: A rejection-expectation pathway. *Journal of Experimental Social Psychology*, 63, 69–76. <https://doi.org/10.1016/j.jesp.2015.12.003>
- Bluth, K., Roberson, P. N. E., Gaylord, S. A., Faurot, K. R., Grewen, K. M., Arzon, S., & Girdler, S. S. (2016). Does Self-Compassion Protect Adolescents from Stress? *Journal of Child and Family Studies*, 25(4), 1098–1109. <https://doi.org/10.1007/s10826-015-0307-3>
- Brauhardt, A., Rudolph, A., & Hilbert, A. (2014). Implicit cognitive processes in binge-eating disorder and obesity. *Journal of Behavior Therapy and Experimental Psychiatry*, 45(2), 285–290. <https://doi.org/10.1016/j.jbtep.2014.01.001>
- Braun, T. D., Park, C. L., & Gorin, A. (2016). Self-compassion, body image, and disordered eating: A review of the literature. *Body Image*, 17, 117–131. <https://doi.org/10.1016/J.BODYIM.2016.03.003>
- Breines, J. G., Mcinnis, C. M., Kuras, Y. I., Thoma, M. v., Gianferante, D., Hanlin, L., Chen, X., Rohleder, N., & Breines, J. (2015). Self-compassionate young adults show lower salivary

- alpha-amylase responses to repeated psychosocial stress HHS Public Access. *Self Identity*, 14(4), 390–402. <https://doi.org/10.1080/15298868.2015.1005659>
- Breines, J. G., Thoma, M. V., Freeman, T., Wu, Z., & Rohleder, N. (2014). *Self-compassion as a predictor of cortisol responses to repeated acute psychosocial stress*. <https://www.researchgate.net/publication/296331564>
- Breines, J. G., Thoma, M. V., Gianferante, D., Hanlin, L., Chen, X., & Rohleder, N. (2014). Self-compassion as a predictor of interleukin-6 response to acute psychosocial stress. *Brain, Behaviour, and Immunity*. <https://doi.org/10.1016/j.bbi.2013.11.006>
- Breines, J., Toole, A., Tu, C., & Chen, S. (2014). Self-compassion, Body Image, and Self-reported Disordered Eating. *Self and Identity*, 13(4), 432–448. <https://doi.org/10.1080/15298868.2013.838992>
- Brown, A., Flint, S. W., & Batterham, R. L. (2022). *Pervasiveness, impact and implications of weight stigma*. <https://doi.org/10.1016/j>
- Brown, D. M., Muir, C., & Gammage, K. L. (2023). Muscle Up: Male Athletes' and Non-Athletes' Psychobiological Responses to, and Recovery From, Body Image Social-Evaluative Threats. *American Journal of Men's Health*, 17(1). <https://doi.org/10.1177/15579883231155089>
- Buske-Kirschbaum, A., Gierens, A., Höllig, H., & Hellhammer, D. H. (2002). *Stress-induced immunomodulation is altered in patients with atopic dermatitis*. www.elsevier.com/locate/jneuroim
- Callow, T. J., Moffitt, R. L., & Neumann, D. L. (2021). External shame and its association with depression and anxiety: the moderating role of self-compassion. *Australian Psychologist*, 56(1), 70–80. <https://doi.org/10.1080/00050067.2021.1890984>
- Carron, A. V., & Prapavesis, H. (1997). Self-presentation and group influences. *Small Group Research*, 28, 500–516.
- Carter, A., Gilbert, P., & Kirby, J. N. (2020). *Compassion-focused therapy for body weight shame: A mixed methods pilot trial*. <https://doi.org/10.1002/cpp.2488>
- Chapleau, M. W., & Sabharwal, R. (2011). Methods of assessing vagus nerve activity and reflexes. *Heart Failure Reviews*, 16(2), 109–127. <https://doi.org/10.1007/s10741-010-9174-6>
- Cheng, M. Y., Wang, S. M., Lam, Y. Y., Luk, H. T., Man, Y. C., & Lin, C. Y. (2018). The Relationships between Weight Bias, Perceived Weight Stigma, Eating Behavior, and Psychological Distress among Undergraduate Students in Hong Kong. *Journal of Nervous and Mental Disease*, 206(9), 705–710. <https://doi.org/10.1097/NMD.0000000000000869>
- Chida, Y., & Steptoe, A. (2010). Greater cardiovascular responses to laboratory mental stress are associated with poor subsequent cardiovascular risk status: A meta-analysis of prospective evidence. *Hypertension*, 55(4), 1026–1032. <https://doi.org/10.1161/HYPERTENSIONAHA.109.146621>
- Choi, H. K., Liu, S., & Curhan, G. (2005). Intake of purine-rich foods, protein, and dairy products and relationship to serum levels of uric acid: The third national health and nutrition examination survey. *Arthritis and Rheumatism*, 52(1), 283–289. <https://doi.org/10.1002/art.20761>
- Cloudt, M. C., Lamarche, L., & Gammage, K. L. (2014). The impact of the amount of social evaluation on psychobiological responses to a body image threat. *Body Image*, 11(4), 350–356. <https://doi.org/10.1016/j.bodyim.2014.06.003>
- Cruess, D. G., Finitsis, D. J., Smith, A. L., Goshe, B. M., Burnham, K., Burbridge, C., & O'Leary, K. (2015). Brief stress management reduces acute distress and buffers physiological response to a social stress test. *International Journal of Stress Management*, 22(3), 270–286. <https://doi.org/10.1037/a0039130>

- Cservenka, A., Lahanas, S., & Dotson-Bossert, J. (2018). Marijuana use and hypothalamic pituitary-adrenal axis functioning in humans. *Frontiers in Psychiatry*, 9(OCT). <https://doi.org/10.3389/FPSYT.2018.00472/FULL>
- Curll, S. L., & Brown, P. M. (2020). Weight stigma and psychological distress: A moderated mediation model of social identification and internalised bias. *Body Image*, 35, 207–216. <https://doi.org/10.1016/j.bodyim.2020.09.006>
- Daye, C. A., Webb, J. B., & Jafari, N. (2014). Exploring self-compassion as a refuge against recalling the body-related shaming of caregiver eating messages on dimensions of objectified body consciousness in college women. *Body Image*, 11(4), 547–556. <https://doi.org/10.1016/j.bodyim.2014.08.001>
- De Bellis, M. D., Chrousos, G. P., Dorn, L. D., Burke, L., Helmers, K., Kling, M. A., Trickett, P. K., Putnam, F. W., & Bellis, D. (1994). *Hypothalamic-Pituitary-Adrenal Axis Dysregulation in Sexually Abused Girls*. <https://academic.oup.com/jcem/article/78/2/249/2655383>
- Decker, W. H. (1987). Attributions Based on Managers' Self-Presentation, Sex, and Weight. In *Psychological Refiorts* (Vol. 61).
- Desbordes, G., Negi, L. T., Pace, T. W. W., Alan Wallace, B., Raison, C. L., & Schwartz, E. L. (2012). Effects of mindful-attention and compassion meditation training on amygdala response to emotional stimuli in an ordinary, Nonmeditative State. *Frontiers in Human Neuroscience*, OCTOBER 2012. <https://doi.org/10.3389/fnhum.2012.00292>
- Dickerson, S. S. (2008). Emotional and Physiological Responses to Social-Evaluative Threat. *Social and Personality Psychology Compass*, 2(3), 1362–1378. <https://doi.org/10.1111/j.1751-9004.2008.00095.x>
- Dickerson, S. S., Gruenewald, T. L., & Kemeny, M. E. (2004). When the Social Self Is Threatened: Shame, Physiology, and Health. In *Journal of Personality* (Vol. 72). Blackwell Publishing.
- Dickerson, S. S., Gruenewald, T. L., & Kemeny, M. E. (2009). Psychobiological responses to social self threat: Functional or detrimental? *Self and Identity*, 8(2–3), 270–285. <https://doi.org/10.1080/15298860802505186>
- Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. In *Psychological Bulletin* (Vol. 130, Issue 3, pp. 355–391). <https://doi.org/10.1037/0033-2909.130.3.355>
- Durso, L. E., & Latner, J. D. (2008). Understanding self-directed stigma: Development of the weight bias internalization scale. *Obesity*, 16(SUPPL. 2). <https://doi.org/10.1038/oby.2008.448>
- Durso, L. E., Latner, J. D., & Ciao, A. C. (2016). Weight bias internalization in treatment-seeking overweight adults: Psychometric validation and associations with self-esteem, body image, and mood symptoms. *Eating Behaviors*, 21, 104–108. <https://doi.org/10.1016/j.eatbeh.2016.01.011>
- Durso, L. E., Latner, J. D., & Hayashi, K. (2012). Perceived discrimination is associated with binge eating in a community sample of non-overweight, overweight, and obese adults. *Obesity Facts*, 5(6), 869–880. <https://doi.org/10.1159/000345931>
- Dutton, G. R., Lewis, T. T., Durant, N., Halanych, J., Kiefe, C. I., Sidney, S., Kim, Y., & Lewis, C. E. (2014). Perceived weight discrimination in the CARDIA study: Differences by race, sex, and weight status. *Obesity*, 22(2), 530–536. <https://doi.org/10.1002/oby.20438>
- Eccles, F. J. R., Sowter, N., Spokes, T., Zarotti, N., & Simpson, J. (2023). Stigma, self-compassion, and psychological distress among people with Parkinson's. *Disability and Rehabilitation*, 45(3), 425–433. <https://doi.org/10.1080/09638288.2022.2037743>

- Eisenberg, N., Fabes, R. A., Miller, P. A., Fultz, J., Shell, R., Mathy, R. M., Reno, R. R., Bustamante, D., Grinder, E., Rhodes, K., Provendar, C., Scott, J., & Wilson, M. (1989). Relation of Sympathy and Personal Distress to Prosocial Behavior: A Multimethod Study. *Journal of Personality and Social Psychology*.
- El Ridi, R., & Tallima, H. (2017). Physiological functions and pathogenic potential of uric acid: A review. *Journal of Advanced Research*, 8(5), 487–493. <https://doi.org/10.1016/j.jare.2017.03.003>
- El-Farhan, N., Rees, A., & Evans, C. (2017). Measuring cortisol in serum, urine and saliva—are our assays good enough? *Annals of Clinical Biochemistry*, 54(3), 308–322. <https://doi.org/10.1177/0004563216687335>
- Emmer, C., Bosnjak, M., & Mata, J. (2020). The association between weight stigma and mental health: A meta-analysis. *Obesity Reviews*, 21(1). <https://doi.org/10.1111/obr.12935>
- Engert, V., Kok, B. E., Papassotiriou, I., Chrousos, G. P., & Singer, T. (2017). Specific reduction in cortisol stress reactivity after social but not attention-based mental training. *Clinical Psychology*. <https://www.science.org>
- Fettich, K. C., & Chen, E. Y. (2012). Coping with obesity stigma affects depressed mood in African-American and white candidates for bariatric surgery. *Obesity*, 20(5), 1118–1121. <https://doi.org/10.1038/oby.2012.12>
- Fleshner, M. (2013). Stress-evoked sterile inflammation, danger associated molecular patterns (DAMPs), microbial associated molecular patterns (MAMPs) and the inflammasome. In *Brain, Behavior, and Immunity* (Vol. 27, Issue 1, pp. 1–7). <https://doi.org/10.1016/j.bbi.2012.08.012>
- Forsén, L., Meyer, H. E., Sjøgaard, A. J., Næss, S., Schei, B., & Edna, T. H. (1999). Mental distress and risk of hip fracture. Do broken hearts lead to broken bones? *Journal of Epidemiology and Community Health*, 53(6), 343–347. <https://doi.org/10.1136/jech.53.6.343>
- Friedman, K. E., Ashmore, J. A., & Applegate, K. L. (2008). Recent experiences of weight-based stigmatization in a weight loss surgery population: Psychological and behavioral correlates. *Obesity*, 16(SUPPL. 2). <https://doi.org/10.1038/oby.2008.457>
- Gammage, K. L., Hall, C. R., & Martin Ginis, K. A. (2004). Self-presentation in exercise contexts: Differences between high and low frequency exercisers. *Journal of Applied Social Psychology*, 34(8), 1638–1651. <https://doi.org/10.1111/j.1559-1816.2004.tb02791.x>
- Germer, C., & Neff, K. D. (2019). Mindful Self-Compassion (MSC). In *The handbook of mindfulness-based programs: Every established interventions, from medicine to education* (pp. 357–367).
- Gervasio, J., Zheng, S., Skrotzki, C., & Pachete, A. (2022). The effect of oral contraceptive use on cortisol reactivity to the Trier Social Stress Test: A meta-analysis. *Psychoneuroendocrinology*, 136. <https://doi.org/10.1016/j.psyneuen.2021.105626>
- Gherghina, M. E., Peride, I., Tiglis, M., Neagu, T. P., Niculae, A., & Checherita, I. A. (2022). Uric Acid and Oxidative Stress—Relationship with Cardiovascular, Metabolic, and Renal Impairment. *International Journal of Molecular Sciences*, 23(6). <https://doi.org/10.3390/ijms23063188>
- Gilbert, P. (1997). The evolution of social attractiveness and its role in shame, humiliation, guilt and therapy. *British Journal of Medical Psychology*, 70(2), 113–147. <https://doi.org/10.1111/j.2044-8341.1997.tb01893.x>
- Gilbert, P. (2000). The Relationship of Shame, Social Anxiety and Depression: The Role of the Evaluation of Social Rank. *Clinical Psychology and Psychotherapy*, 7(3), 174–189. [https://doi.org/10.1002/1099-0879\(200007\)7:3<174::AID-CPP236>3.0.CO;2-U](https://doi.org/10.1002/1099-0879(200007)7:3<174::AID-CPP236>3.0.CO;2-U)

- Gilbert, P. (2010). *Compassion focused therapy: Distinctive features*. Routledge/Taylor & Francis Group.
- Gilbert, P. (2014). The origins and nature of compassion focused therapy. *British Journal of Clinical Psychology*, 53(1), 6–41. <https://doi.org/10.1111/bjc.12043>
- Gilbert, P., & Procter, S. (2006). Compassionate mind training for people with high shame and self-criticism: Overview and pilot study of a group therapy approach. *Clinical Psychology and Psychotherapy*, 13(6), 353–379. <https://doi.org/10.1002/cpp.507>
- Giles, D. A., & Draper, N. (2018). Heart rate variability during exercise: A comparison of artefact correction methods. *Journal of Strength and Conditioning Research*, 32(3), 726–735. www.nscs.com
- Goetz, J. L., Keltner, D., & Simon-Thomas, E. (2010). Compassion: An Evolutionary Analysis and Empirical Review. *Psychological Bulletin*, 136(3), 351–374. <https://doi.org/10.1037/a0018807>
- Gómez-Pérez, D., Cancino, M., Moreno, P. I., & Ortiz, M. S. (2021). Weight Stigma, Chronic Stress, Unhealthy Diet, and Obesity in Chilean Adults. *International Journal of Behavioral Medicine*, 28(3), 292–298. <https://doi.org/10.1007/s12529-020-09917-1>
- Granger, D. A., Hibel, L. C., Fortunato, C. K., & Kapelewski, C. H. (2009). Medication effects on salivary cortisol: Tactics and strategy to minimize impact in behavioral and developmental science. *Psychoneuroendocrinology*, 34(10), 1437–1448. <https://doi.org/10.1016/j.psyneuen.2009.06.017>
- Granger, D. A., Kivlighan, K. T., El-Sheikh, M., Gordis, E. B., & Stroud, L. R. (2007). Salivary α -amylase in biobehavioral research: Recent developments and applications. *Annals of the New York Academy of Sciences*, 1098, 122–144. <https://doi.org/10.1196/annals.1384.008>
- Gruenewald, T. L., Kemeny, M. E., Aziz, N., & Fahey, J. L. (2004). Acute threat to the social self: Shame, social self-esteem, and cortisol activity. *Psychosomatic Medicine*, 66(6), 915–924. <https://doi.org/10.1097/01.psy.0000143639.61693.ef>
- Guo, W., Li, F., Zhu, C., Wang, B., Wang, K., Dai, C., Jia, H., Wei, H., He, Q., Cui, J., Yuan, M., Tang, S., Liu, W., Zhu, T., Gao, Z., Zheng, F., Ma, Z., Qu, H., & Zhu, M. (2018). Effect of hypercortisolism on bone mineral density and bone metabolism: A potential protective effect of adrenocorticotrophic hormone in patients with Cushing's disease. *Journal of International Medical Research*, 46(1), 492–503. <https://doi.org/10.1177/0300060517725660>
- Guthrie, B., & Wyke, S. (2006). Personal continuity and access in UK general practice: A qualitative study of general practitioners' and patients' perceptions of when and how they matter. *BMC Family Practice*, 7. <https://doi.org/10.1186/1471-2296-7-11>
- Haines, J., Neumark-Sztainer, D., Hannan, P. J., Van Den Berg, P., & Eisenberg, M. E. (2008). Longitudinal and secular trends in weight-related teasing during adolescence. *Obesity*, 16(SUPPL. 2). <https://doi.org/10.1038/oby.2008.447>
- Halamova, J., Koroniova, J., Kanovsky, M., Tuniyova, M. K., & Kupeli, N. (2019). Psychological and physiological effects of emotion focused training for self-compassion and self-protection. *Research in Psychotherapy: Psychopathology, Process and Outcome*, 22, 265–280. <https://doi.org/10.4081/ripppo.2019.358>
- Harkness, K. L., Stewart, J. G., & Wynne-Edwards, K. E. (2011). Cortisol reactivity to social stress in adolescents: Role of depression severity and child maltreatment. *Psychoneuroendocrinology*, 36(2), 173–181. <https://doi.org/10.1016/j.psyneuen.2010.07.006>
- Harter, S. (2012). The Inextricable Link between Perceived Physical Appearance and Self-Esteem. In S. Harter (Ed.), *The construction of the self* (2nd ed., pp. 158–193). Guilford Press.

- Hatzenbuehler, M. L., Keyes, K. M., & Hasin, D. S. (2009). Associations between perceived weight discrimination and the prevalence of psychiatric disorders in the general population. *Obesity*, 17(11), 2033–2039. <https://doi.org/10.1038/oby.2009.131>
- Hatzenbuehler, M. L., Phelan, J. C., & Link, B. G. (2013). Stigma as a Fundamental Cause of Population Health Inequalities. *Public Health*, 103, 813–821. <https://doi.org/10.2105/AJPH>
- Hayden-Wade, H. A., Stein, R. I., Ghaderi, A., Saelens, B. E., Zabinski, M. F., & Wilfley, D. E. (2005). Prevalence, characteristics, and correlates of teasing experiences among overweight children vs. non-overweight peers. *Obesity Research*, 13(8), 1381–1392. <https://doi.org/10.1038/oby.2005.167>
- Hellhammer, D. H., Wüst, S., & Kudielka, B. M. (2009). Salivary cortisol as a biomarker in stress research. *Psychoneuroendocrinology*, 34(2), 163–171. <https://doi.org/10.1016/j.psyneuen.2008.10.026>
- Heuer, C. A., McClure, K. J., & Puhl, R. M. (2011). Obesity stigma in online news: A visual content analysis. *Journal of Health Communication*, 16(9), 976–987. <https://doi.org/10.1080/10810730.2011.561915>
- Hilbert, A., Baldofski, S., Zenger, M., Löwe, B., Kersting, A., & Braehler, E. (2014). Weight bias internalization scale: Psychometric properties and population norms. *PLoS ONE*, 9(1). <https://doi.org/10.1371/journal.pone.0086303>
- Hilbert, A., Braehler, E., Schmidt, R., Lowe, B., Hauser, W., & Zenger, M. (2015). Self-Compassion as a Resource in the Self-Stigma Process of Overweight and Obese Individuals. *Obesity Facts*, 8(5), 293–301. <https://doi.org/10.1159/000438681>
- Himmelstein, M. S., Incollingo Belsky, A. C., & Janet Tomiyama, A. (2015). The weight of stigma: Cortisol reactivity to manipulated weight stigma. *Obesity*, 23(2), 368–374. <https://doi.org/10.1002/OBY.20959>
- Himmelstein, M. S., Puhl, R. M., & Quinn, D. M. (2019). Overlooked and Understudied: Health Consequences of Weight Stigma in Men. *Obesity*, 27(10), 1598–1605. <https://doi.org/10.1002/oby.22599>
- Hofmann, S. G., Grossman, P., & Hinton, D. E. (2011). Loving-kindness and compassion meditation: Potential for psychological interventions. *Clinical Psychology Review*, 31(7), 1126–1132. <https://doi.org/10.1016/j.cpr.2011.07.003>
- Homan, K. J., & Sirois, F. M. (2017). Self-compassion and physical health: Exploring the roles of perceived stress and health-promoting behaviors. *Health Psychology Open*, 4(2). <https://doi.org/10.1177/2055102917729542>
- Hooper, L., Puhl, R., Eisenberg, M. E., Crow, S., & Neumark-Sztainer, D. (2021). Weight teasing experienced during adolescence and young adulthood: Cross-sectional and longitudinal associations with disordered eating behaviors in an ethnically/racially and socioeconomically diverse sample. *International Journal of Eating Disorders*, 54(8), 1449–1462. <https://doi.org/10.1002/eat.23534>
- Hunger, J. M., Major, B., Blodorn, A., & Miller, C. T. (2015). Weighed Down by Stigma: How Weight-Based Social Identity Threat Contributes to Weight Gain and Poor Health. *Social and Personality Psychology Compass*, 9(6), 255–268. <https://doi.org/10.1111/spc3.12172>
- Inwood, E., & Ferrari, M. (2018). Mechanisms of Change in the Relationship between Self-Compassion, Emotion Regulation, and Mental Health: A Systematic Review. *Applied Psychology: Health and Well-Being*, 10(2), 215–235. <https://doi.org/10.1111/aphw.12172>
- Jackson, Andrew. S., Pollock, M. L., & Ward, A. (1980). Generalized equations for predicting body density of women. *Medicine and Science in Sports and Exercise*, 12(3), 175–182.

- Jackson, S. E., Kirschbaum, C., & Steptoe, A. (2016). Perceived weight discrimination and chronic biochemical stress: A population-based study using cortisol in scalp hair. *Obesity*, 24(12), 2515–2521. <https://doi.org/10.1002/oby.21657>
- Janssen, I., Craig, W. M., Boyce, W. F., & Pickett, W. (2004). *Associations Between Overweight and Obesity With Bullying Behaviors in School-Aged Children*. http://publications.aap.org/pediatrics/article-pdf/113/5/1187/1003855/zpe00504001187.pdf?casa_token=EUQ53WjP3XQAAAAA:LuDqgxnbCnrB87zWso2G--5gp-ZS3M3ho3Bj64radyMJxZucpaR6JMrbMxi55
- Jay, M., Kalet, A., Ark, T., McMacken, M., Messito, M. J., Richter, R., Schlair, S., Sherman, S., Zabar, S., & Gillespie, C. (2009). Physicians' attitudes about obesity and their associations with competency and specialty: A cross-sectional study. *BMC Health Services Research*, 9. <https://doi.org/10.1186/1472-6963-9-106>
- Jezova, D., Makatsori, A., Duncko, R., Moncek, F., & Jakubek, M. (2004). High trait anxiety in healthy subjects is associated with low neuroendocrine activity during psychosocial stress. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 28(8), 1331–1336. <https://doi.org/10.1016/j.pnpbp.2004.08.005>
- Jordan, K. D., & Smith, T. W. (2023). Adaptation to social-evaluative threat: Effects of repeated acceptance and status stressors on cardiovascular reactivity. *International Journal of Psychophysiology*, 183, 61–70. <https://doi.org/10.1016/j.ijpsycho.2022.11.008>
- Jung, F. U., Bae, Y. J., Kratzsch, J., Riedel-Heller, S. G., & Luck-Sikorski, C. (2020). Internalized weight bias and cortisol reactivity to social stress. *Cognitive, Affective and Behavioral Neuroscience*, 20(1), 49–58. <https://doi.org/10.3758/s13415-019-00750-y>
- Karin, O., Raz, M., Tendler, A., Bar, A., Korem Kohanim, Y., Milo, T., & Alon, U. (2020). A new model for the HPA axis explains dysregulation of stress hormones on the timescale of weeks. *Molecular Systems Biology*, 16(7). <https://doi.org/10.15252/msb.20209510>
- Kelly, A. C., Carter, J. C., & Borairi, S. (2014). Are improvements in shame and self-compassion early in eating disorders treatment associated with better patient outcomes? *International Journal of Eating Disorders*, 47(1), 54–64. <https://doi.org/10.1002/eat.22196>
- Ketay, S., Beck, L. A., & Dajci, J. (2022). Self-compassion and social stress: Links with subjective stress and cortisol responses. *Self and Identity*. <https://doi.org/10.1080/15298868.2022.2117733>
- Kiecolt-Glaser, J. K., Preacher, K. J., MacCallum, R. C., Atkinson, C., Malarkey, W. B., & Glaser, R. (2003). Chronic stress and age-related increases in the proinflammatory cytokine IL-6. In *PNAS* (Vol. 100, Issue 15). www.pnas.org/cgi/doi/10.1073/pnas.1531903100
- Kim, S., Thibodeau, R., & Jorgensen, R. S. (2011). Shame, Guilt, and Depressive Symptoms: A Meta-Analytic Review. *Psychological Bulletin*, 137(1), 68–96. <https://doi.org/10.1037/a0021466>
- King, G. R., Ernst, T., Deng, W., Stenger, A., Gonzales, R. M. K., Nakama, H., & Chang, L. (2011). *Behavioral/Systems/Cognitive Altered Brain Activation During Visuomotor Integration in Chronic Active Cannabis Users: Relationship to Cortisol Levels*. <https://doi.org/10.1523/JNEUROSCI.4148-11.2011>
- Kirby, J. N. (2017). Compassion interventions: The programmes, the evidence, and implications for research and practice. *Psychology and Psychotherapy: Theory, Research and Practice*, 90(3), 432–455. <https://doi.org/10.1111/papt.12104>
- Kirby, J. N., Doty, J. R., Petrocchi, N., & Gilbert, P. (2017). The current and future role of heart rate variability for assessing and training compassion. *Frontiers in Public Health*, 5. <https://doi.org/10.3389/fpubh.2017.00040>

- Kirschbaum, C., Kudielka, B. M., Gaab, J., Schommer, N. C., & Hellhammer, D. H. (1999). *Impact of Gender, Menstrual Cycle Phase, and Oral Contraceptives on the Activity of the Hypothalamus-Pituitary-Adrenal Axis*.
- Kirschbaum, C., Pirke, K., & Hellhammer, D. H. (1993). The “Trier Social Stress Test” - A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, 28(1–2), 76–81.
- Kirschner, H., Kuyken, W., Wright, K., Roberts, H., Brejcha, C., & Karl, A. (2019). Soothing Your Heart and Feeling Connected: A New Experimental Paradigm to Study the Benefits of Self-Compassion. *Clinical Psychological Science*, 7(3), 545–565. <https://doi.org/10.1177/2167702618812438>
- Klassen, M. L., Jasper, C. R., & Harris, R. J. (1993). The role of physical appearance in managerial decisions. *Journal of Business and Psychology*, 8(2), 181–198. <https://doi.org/10.1007/BF02230384>
- Klein, D., Najman, J., Kohrman, A. F., Munro, C., Lansing, E., & Australia, B. (1982). *Patient Characteristics that Elicit Negative Responses from Family Physicians*.
- Kok, B. E., Coffey, K. A., Cohn, M. A., Catalino, L. I., Vacharkulksemsuk, T., Algoe, S. B., Brantley, M., & Fredrickson, B. L. (2013). How Positive Emotions Build Physical Health: Perceived Positive Social Connections Account for the Upward Spiral Between Positive Emotions and Vagal Tone. *Psychological Science*, 24(7), 1123–1132. <https://doi.org/10.1177/0956797612470827>
- Komori, T. (2020). Functions of osteocalcin in bone, pancreas, testis, and muscle. *International Journal of Molecular Sciences*, 21(20), 1–15. <https://doi.org/10.3390/ijms21207513>
- Kotera, Y., Kotera, H., Taylor, E., Wilkes, J., Colman, R., & Riswani, R. (2022). Mental Health of Indonesian University Students: U.K. Comparison and Relationship Between Mental Health Shame and Self-Compassion. *Stigma and Health*. <https://doi.org/10.1037/sah0000420>
- Kotera, Y., Tsuda-McCaie, F., Maughan, G., & Green, P. (2022). Cross-cultural comparison of mental health in social work students between UK and Ireland: Mental health shame and self-compassion. *British Journal of Social Work*, 52(6), 3247–3267. <https://doi.org/10.1093/bjsw/bcab240>
- Kroshus, E., Hawrilenko, M., & Browning, A. (2021). Stress, self-compassion, and well-being during the transition to college. *Social Science and Medicine*, 269. <https://doi.org/10.1016/j.socscimed.2020.113514>
- Laborde, S., Mosley, E., & Thayer, J. F. (2017). Heart Rate Variability and Cardiac Vagal Tone in Psychophysiological Research – Recommendations for Experiment Planning, Data Analysis, and Data Reporting. *Frontiers in Psychology*, 08, 213. <https://doi.org/10.3389/fpsyg.2017.00213>
- Lamarche, L., Gammage, K. L., Klentrou, P., Kerr, G., & Faulkner, G. (2014). *Examining Psychobiological Responses to an Anticipatory Body Image Threat in Women*.
- Lamarche, L., Gammage, Kimberley, L., Kerr, G., Faulkner, G., & Klentrou, P. (2016). Psychological and cortisol responses to and recovery from exposure to a body image threat. *Sage Journal*, 1–9. <https://doi.org/10.1177/2158244016642378>
- Lamarche, L., Kerr, G., Faulkner, G., Gammage, K. L., & Klentrou, P. (2012). A qualitative examination of body image threats using Social Self-Preservation Theory. *Body Image*, 9(1), 145–154. <https://doi.org/10.1016/J.BODYIM.2011.10.004>
- Lamarche, L., Ozimok, B., Gammage, K. L., & Muir, C. (2017). Men Respond Too: The Effects of a Social-Evaluative Body Image Threat on Shame and Cortisol in University Men. *American Journal of Men's Health*, 11(6), 1791–1803. <https://doi.org/10.1177/1557988317723406>

- Lampard, A. M., MacLehose, R. F., Eisenberg, M. E., Neumark-Sztainer, D., & Davison, K. K. (2014). Weight-Related Teasing in the School Environment: Associations with Psychosocial Health and Weight Control Practices Among Adolescent Boys and Girls. *Journal of Youth and Adolescence*, 43(10), 1770–1780. <https://doi.org/10.1007/s10964-013-0086-3>
- Lara, J. (2020). *Psychophysiological and self-reported stress: Effects of mindfulness and self-compassion*.
- Larsson, C. A., Gullberg, B., Råstam, L., & Lindblad, U. (2009). Salivary cortisol differs with age and sex and shows inverse associations with WHR in Swedish women: a cross-sectional study. <https://doi.org/10.1186/1472-6823-9-16>
- Latner, J. D., Barile, J. P., Durso, L. E., & O'Brien, K. S. (2014). Weight and health-related quality of life: The moderating role of weight discrimination and internalized weight bias. *Eating Behaviors*, 15(4), 586–590. <https://doi.org/10.1016/j.eatbeh.2014.08.014>
- Lawson, E. A., Donoho, D., Miller, K. K., Misra, M., Meenaghan, E., Lydecker, J., Wexler, T., Herzog, D. B., & Klibanski, A. (2009). Hypercortisolemia is associated with severity of bone loss and depression in hypothalamic amenorrhea and anorexia nervosa. *Journal of Clinical Endocrinology and Metabolism*, 94(12), 4710–4716. <https://doi.org/10.1210/jc.2009-1046>
- Leary, M. R., Tate, E. B., Adams, C. E., Allen, A. B., & Hancock, J. (2007). Self-compassion and reactions to unpleasant self-relevant events: The implications of treating oneself kindly. *Journal of Personality and Social Psychology*, 92(5), 887–904. <https://doi.org/10.1037/0022-3514.92.5.887>
- Li, W., & Rukavina, P. (2012). The nature, occurring contexts, and psychological implications of weight-related teasing in urban physical education programs. *Research Quarterly for Exercise and Sport*, 83(2), 308–317. <https://doi.org/10.1080/02701367.2012.10599862>
- Lick, D. J., Durso, L. E., & Johnson, K. L. (2013). Minority Stress and Physical Health Among Sexual Minorities. *Perspectives on Psychological Science*, 8(5), 521–548. <https://doi.org/10.1177/1745691613497965>
- Linardon, J., Susanto, L., Tepper, H., & Fuller-Tyszkiewicz, M. (2020). Self-compassion as a moderator of the relationships between shape and weight overvaluation and eating disorder psychopathology, psychosocial impairment, and psychological distress. *Body Image*, 33, 183–189. <https://doi.org/10.1016/j.bodyim.2020.03.001>
- Lucas, T., Riis, J. L., Buchalski, Z., Drolet, C. E., Dawadi, A., & Granger, D. A. (2020). Reactivity of salivary uric acid in response to social evaluative stress in African Americans. *Biological Psychology*, 153. <https://doi.org/10.1016/j.biopsycho.2020.107882>
- Lucibello, K. M., Nesbitt, A. E., Solomon-Krakus, S., & Sabiston, C. M. (2021). Internalized weight stigma and the relationship between weight perception and negative body-related self-conscious emotions. *Body Image*, 37, 84–88. <https://doi.org/10.1016/j.bodyim.2021.01.010>
- Lucibello, K. M., Sabiston, C. M., Pila, E., Arbour-Nicitopolous, K., & Gilchrist, J. D. (2022). Associations among experienced weight stigma, internalized weight stigma, and body-related self-conscious emotions in weight-diverse adolescents: A daily diary study. *Exercise Psychology*, 53(1).
- Lucibello, K. M., Sabiston, C. M., Pila, E., & Arbour-Nicitopoulos, K. (2023). An integrative model of weight stigma, body image, and physical activity in adolescents. *Body Image*, 45, 1–10. <https://doi.org/10.1016/j.bodyim.2023.01.003>
- Luo, X., Qiao, L., & Che, X. (2018). Self-compassion Modulates Heart Rate Variability and Negative Affect to Experimentally Induced Stress. *Mindfulness*, 9(5), 1522–1528. <https://doi.org/10.1007/s12671-018-0900-9>

- MacBeth, A., & Gumley, A. (2012). Exploring compassion: A meta-analysis of the association between self-compassion and psychopathology. In *Clinical Psychology Review* (Vol. 32, Issue 6, pp. 545–552). <https://doi.org/10.1016/j.cpr.2012.06.003>
- Maeda, S. (2022). Trait and state self-compassion interactively predict cortisol recovery following an acute stressor in healthy males. *Psychoneuroendocrinology*, 144. <https://doi.org/10.1016/j.psychneuen.2022.105864>
- Magallares, A., Bolaños-Rios, P., Ruiz-Prieto, I., Benito De Valle, P., Irlles, J. A., & Jáuregui-Lobera, I. (2017). The Mediation Effect of Weight Self-Stigma in the Relationship between Blatant and Subtle Discrimination and Depression and Anxiety. *Spanish Journal of Psychology*, 20. <https://doi.org/10.1017/sjp.2017.1>
- Major, B., Eliezer, D., & Rieck, H. (2012). The psychological weight of weight stigma. *Social Psychological and Personality Science*, 3(6), 651–658. <https://doi.org/10.1177/1948550611434400>
- Major, B., Hunger, J. M., Bunyan, D. P., & Miller, C. T. (2014). The ironic effects of weight stigma. *Journal of Experimental Social Psychology*, 51, 74–80. <https://doi.org/10.1016/j.jesp.2013.11.009>
- Major, B., & Schmader, T. (2018). The Oxford Handbook of Stigma, Discrimination, and Health. In B. Major, John. F. Dovodio, & B. G. Link (Eds.), *Oxford Library of Psychology. The Oxford Handbook of Stigma, Discrimination, and Health* (pp. 85–103). Oxford University Press.
- Marschall, D., Sanftner, J., & Tangney, J. P. (1994). *The State Shame and Guilt Scale*. George Mason University.
- Marsh, I. C., Chan, S. W. Y., & MacBeth, A. (2018). Self-compassion and Psychological Distress in Adolescents—a Meta-analysis. In *Mindfulness* (Vol. 9, Issue 4, pp. 1011–1027). Springer New York LLC. <https://doi.org/10.1007/s12671-017-0850-7>
- Martin Ginis, K. A., Prapavessis, H., & Haase, A. M. (2008). The effects of physique-salient and physique non-salient exercise videos on women’s body image, self-presentational concerns, and exercise motivation. *Body Image*, 5(2), 164–172. <https://doi.org/10.1016/j.bodyim.2007.11.005>
- Maslanik, T., Mahaffey, L., Tannura, K., Beninson, L., Greenwood, B. N., & Fleshner, M. (2013). The inflammasome and danger associated molecular patterns (DAMPs) are implicated in cytokine and chemokine responses following stressor exposure. *Brain, Behavior, and Immunity*, 28, 54–62. <https://doi.org/10.1016/j.bbi.2012.10.014>
- Matheson, K., & Anisman, H. (2012). Biological and psychosocial responses to discrimination. In J. Jetten, C. Haslam, & A. S. Haslam (Eds.), *The social cure: Identity, health and well-being* (pp. 133–153). Psychology Press.
- Matheson, K., Jorden, S., & Anisman, H. (2008). Relations between trauma experiences and psychological, physical and neuroendocrine functioning among Somali refugees: Mediating role of coping with acculturation stressors. *Journal of Immigrant and Minority Health*, 10(4), 291–304. <https://doi.org/10.1007/s10903-007-9086-2>
- Mauldin, K., May, M., & Clifford, D. (2022). The consequences of a weight-centric approach to healthcare: A case for a paradigm shift in how clinicians address body weight. In *Nutrition in Clinical Practice* (Vol. 37, Issue 6, pp. 1291–1306). John Wiley and Sons Inc. <https://doi.org/10.1002/ncp.10885>
- McCleary-Gaddy, A. T., Miller, C. T., Grover, K. W., Hodge, J. J., & Major, B. (2019). Weight Stigma and Hypothalamic-Pituitary-Adrenocortical Axis Reactivity in Individuals Who Are Overweight. *Annals of Behavioral Medicine*, 53(4), 392–398. <https://doi.org/10.1093/abm/kay042>

- McCraty, R., & Shaffer, F. (2015). Heart rate variability: New perspectives on physiological mechanisms, assessment of self-regulatory capacity, and health risk. *Global Advances In Health and Medicine*, 4(1), 46–61. <https://doi.org/10.7453/gahmj.2014.073>
- McEwen, B. S. (1998). Stress, adaptation, and disease: allostasis and allostatic load. *Annals of the New York Academy of Sciences*, 840, 33–44. <https://doi.org/10.1111/j.1749-6632.1998.tb09546.x>
- McEwen, B. S., Mirsky, A. E., & Hatch, M. M. (2007). *Physiology and Neurobiology of Stress and Adaptation: Central Role of the Brain*. <https://doi.org/10.1152/physrev.00041.2006>
- Mensinger, J. L., Tylka, T. L., & Calamari, M. E. (2018). Mechanisms underlying weight status and healthcare avoidance in women: A study of weight stigma, body-related shame and guilt, and healthcare stress. *Body Image*, 25, 139–147. <https://doi.org/10.1016/j.bodyim.2018.03.001>
- Millar, S. A., Zala, I., Anderson, S. I., & O'Sullivan, S. E. (2020). Osteocalcin does not influence acute or chronic inflammation in human vascular cells. *Journal of Cellular Physiology*, 235(4), 3414–3424. <https://doi.org/10.1002/jcp.29231>
- Myers, H. F. (2009). Ethnicity- and socio-economic status-related stresses in context: An integrative review and conceptual model. In *Journal of Behavioral Medicine* (Vol. 32, Issue 1, pp. 9–19). <https://doi.org/10.1007/s10865-008-9181-4>
- Napal, J., Amado, J. A., Riancho, J. A., Olmos, J. M., & González-Macías, J. (1993). Stress decreases the serum level of osteocalcin. *Bone and Mineral*, 21(2), 113–118. [https://doi.org/10.1016/S0169-6009\(08\)80013-X](https://doi.org/10.1016/S0169-6009(08)80013-X)
- Neff, K. (2017). *Self-Compassion Guided Practices and Exercises*. <https://self-compassion.org/category/exercises/>
- Neff, K. D. (2003a). Self-Compassion: An Alternative Conceptualization of a Healthy Attitude Toward Oneself. *Self and Identity*. <https://doi.org/10.1080/15298860390129863>
- Neff, K. D. (2003b). The development and validation of a scale to measure self-compassion. *Self and Identity*, 2, 223–250. <https://doi.org/10.1080/15298860390209035>
- Neff, K. D. (2009). The role of self-compassion in development: A healthier way to relate to oneself. In *Human Development* (Vol. 52, Issue 4, pp. 211–214). <https://doi.org/10.1159/000215071>
- Neff, K. D. (2011). Self-compassion, self-esteem, and well-being. *Social and Personality Psychology Compass*, 5(1), 1–12. <https://doi.org/10.1111/j.1751-9004.2010.00330.x>
- Neff, K. D., Hsieh, Y.-P., & DeJitterat, K. (2005). Self-compassion, Achievement Goals, and Coping with Academic Failure. *Self and Identity*, 4(3), 263–287. <https://doi.org/10.1080/13576500444000317>
- Neff, K. D., Tóth-Király, I., Knox, M. C., Kuchar, A., & Davidson, O. (2021). The Development and Validation of the State Self-Compassion Scale (Long- and Short Form). *Mindfulness*, 12(1), 121–140. <https://doi.org/10.1007/s12671-020-01505-4>
- Neff, K. D., & Vonk, R. (2009a). Self-compassion versus global self-esteem: Two different ways of relating to oneself. *Journal of Personality*, 77(1), 23–50. <https://doi.org/10.1111/j.1467-6494.2008.00537.x>
- Neff, K. D., & Vonk, R. (2009b). Self-compassion versus global self-esteem: Two different ways of relating to oneself. *Journal of Personality*, 77(1), 23–50. <https://doi.org/10.1111/j.1467-6494.2008.00537.x>
- Ng, J. S., & Chin, K. Y. (2021). Potential mechanisms linking psychological stress to bone health. *International Journal of Medical Sciences*, 18(3), 604–614. <https://doi.org/10.7150/ijms.50680>

- Nguyen, M. M., Anita, N. Z., Darwish, L., Major-Orfao, C., Colby-Milley, J., Wong, S. K., Sugamori, K. S., Lancôt, K. L., Herrmann, N., Oh, P. I., Yang, P., Shah, B. R., Gilbert, J., Assal, A., Halperin, I. J., Mitchell, J., & Swardfager, W. (2020). Serum osteocalcin is associated with subjective stress in people with depression and type 2 diabetes. *Psychoneuroendocrinology*, 122. <https://doi.org/10.1016/j.psyneuen.2020.104878>
- Nutter, S., Ireland, A., Alberga, A. S., Brun, I., Lefebvre, D., Hayden, K. A., & Russell-Mayhew, S. (2019). Weight Bias in Educational Settings: a Systematic Review. In *Current Obesity Reports* (Vol. 8, Issue 2, pp. 185–200). Current Medicine Group LLC 1. <https://doi.org/10.1007/s13679-019-00330-8>
- O'Brien, K. S., Latner, J. D., Puhl, R. M., Vartanian, L. R., Giles, C., Griva, K., & Carter, A. (2016). The relationship between weight stigma and eating behavior is explained by weight bias internalization and psychological distress. *Appetite*, 102, 70–76. <https://doi.org/10.1016/j.appet.2016.02.032>
- Pace, T. W. W., Negi, L. T., Adame, D. D., Cole, S. P., Sivilli, T. I., Brown, T. D., Issa, M. J., & Raison, C. L. (2009). Effect of compassion meditation on neuroendocrine, innate immune and behavioral responses to psychosocial stress. *Psychoneuroendocrinology*, 34(1), 87–98. <https://doi.org/10.1016/j.psyneuen.2008.08.011>
- Panaite, V., Salomon, K., Jin, A., & Rottenberg, J. (2015). Cardiovascular recovery from psychological and physiological challenge and risk for adverse cardiovascular outcomes and all-cause mortality. In *Psychosomatic Medicine* (Vol. 77, Issue 3, pp. 215–226). Lippincott Williams and Wilkins. <https://doi.org/10.1097/PSY.0000000000000171>
- Panza, G. A., Puhl, R. M., Taylor, B. A., Zaleski, A. L., Livingston, J., & Pescatello, L. S. (2019). Links between discrimination and cardiovascular health among socially stigmatized groups: A systematic review. *PLoS ONE*, 14(6). <https://doi.org/10.1371/journal.pone.0217623>
- Papadopoulos, S., & Brennan, L. (2015). Correlates of weight stigma in adults with overweight and obesity: A systematic literature review. *Obesity*, 23(9), 1743–1760. <https://doi.org/10.1002/oby.21187>
- Park, P. S., & Lewis, M. (2021). On the Measurement of Self-Conscious Emotions. *Child Psychiatry and Human Development*, 52(6), 1164–1172. <https://doi.org/10.1007/s10578-020-01094-2>
- Pearce, M. J., Boergers, J., & Prinstein, M. J. (2002). Adolescent obesity, overt and relational peer victimization, and romantic relationships. *Obesity Research*, 10(5), 386–393. <https://doi.org/10.1038/oby.2002.53>
- Pearl, R. L. (2018). Weight Bias and Stigma: Public Health Implications and Structural Solutions. *Social Issues and Policy Review*, 12(1), 146–182. <https://doi.org/10.1111/sipr.12043>
- Pearl, R. L., Himmelstein, M. S., Puhl, R. M., Wadden, T. A., Wojtanowski, A. C., & Foster, G. D. (2019). Weight bias internalization in a commercial weight management sample: prevalence and correlates. *Obesity Science and Practice*, 5(4), 342–353. <https://doi.org/10.1002/osp4.354>
- Pearl, R. L., & Puhl, R. M. (2014). Measuring internalized weight attitudes across body weight categories: Validation of the Modified Weight Bias Internalization Scale. *Body Image*, 11(1), 89–92. <https://doi.org/10.1016/j.bodyim.2013.09.005>
- Pearl, R. L., & Puhl, R. M. (2016). The distinct effects of internalizing weight bias: An experimental study. *Body Image*, 17, 38–42. <https://doi.org/10.1016/j.bodyim.2016.02.002>
- Pearl, R. L., & Puhl, R. M. (2018). Weight bias internalization and health: a systematic review. In *Obesity Reviews* (Vol. 19, Issue 8, pp. 1141–1163). Blackwell Publishing Ltd. <https://doi.org/10.1111/obr.12701>

- Pearl, R. L., Puhl, R. M., & Dovidio, J. F. (2015). Differential effects of weight bias experiences and internalization on exercise among women with overweight and obesity. *Journal of Health Psychology, 20*(12), 1626–1632. <https://doi.org/10.1177/1359105313520338>
- Peltola, M. A. (2012). Role of editing of R-R intervals in the analysis of heart rate variability. *Frontiers in Physiology, 3* MAY. <https://doi.org/10.3389/fphys.2012.00148>
- Phelan, S. M., Burgess, D. J., Yeazel, M. W., Hellerstedt, W. L., Griffin, J. M., & van Ryn, M. (2015). Impact of weight bias and stigma on quality of care and outcomes for patients with obesity. In *Obesity Reviews* (Vol. 16, Issue 4, pp. 319–326). Blackwell Publishing Ltd. <https://doi.org/10.1111/obr.12266>
- Phillips, W. J., & Hine, D. W. (2021). Self-compassion, physical health, and health behaviour: a meta-analysis. *Health Psychology Review, 15*(1), 113–139. <https://doi.org/10.1080/17437199.2019.1705872>
- Pila, E., Gilchrist, J. D., Kowalski, K. C., & Sabiston, C. M. (2022). Self-compassion and body-related self-conscious emotions: Examining within- and between-person variation among adolescent girls in sport. *Psychology of Sport and Exercise, 58*, 102083. <https://doi.org/10.1016/J.PSYCHSPORT.2021.102083>
- Pittas, A. G., Harris, S. S., Eliades, M., Stark, P., & Dawson-Hughes, B. (2009). Association between Serum Osteocalcin and Markers of Metabolic Phenotype. *Journal of Clinical Endocrinology and Metabolism, 94*(3), 827–832. <https://doi.org/10.1210/jc.2008-1422>
- Porges, S. W. (1991). Vagal tone: An autonomic mediator of affect. In *The Development of Emotion Regulation and Dysregulation* (pp. 111–128). Cambridge University Press. <https://doi.org/10.1017/cbo9780511663963.007>
- Porges, S. W. (2001). The polyvagal theory: phylogenetic substrates of a social nervous system. In *International Journal of Psychophysiology* (Vol. 42).
- Porges, S. W. (2007). The Polyvagal Perspective. In *Biol Psychol* (Vol. 74, Issue 2).
- Proeve, M., Anton, R., & Kenny, M. (2018). Effects of mindfulness-based cognitive therapy on shame, self-compassion and psychological distress in anxious and depressed patients: A pilot study. *Psychology and Psychotherapy: Theory, Research and Practice, 91*(4), 434–449. <https://doi.org/10.1111/papt.12170>
- Pruessner, J. C., Kirschbaum, C., Meinlschmid, G., & Hellhammer, D. H. (2003). Two formulas for computation of the area under the curve represent measures of total hormone concentration versus time-dependent change. *Psychoneuroendocrinology, 28*(7), 916–931. [https://doi.org/10.1016/S0306-4530\(02\)00108-7](https://doi.org/10.1016/S0306-4530(02)00108-7)
- Prunty, A., Clark, M. K., Hahn, A., Edmonds, S., & O'Shea, A. (2020). Enacted weight stigma and weight self stigma prevalence among 3821 adults. *Obesity Research and Clinical Practice, 14*(5), 421–427. <https://doi.org/10.1016/j.orcp.2020.09.003>
- Puhl, R., & Brownell, K. D. (2001). Bias, discrimination, and obesity. In *Obesity Research* (Vol. 9, Issue 12, pp. 788–805). North American Assoc. for the Study of Obesity. <https://doi.org/10.1038/oby.2001.108>
- Puhl, R., & Lessard, L. M. (2020). Weight Stigma in Youth: Prevalence, Consequences, and Considerations for Clinical Practice. *Childhood Obesity, 9*, 402–411. <https://doi.org/10.1007/s13679-020-00408-8/Published>
- Puhl, R. M., Andreyeva, T., & Brownell, K. D. (2008). Perceptions of weight discrimination: Prevalence and comparison to race and gender discrimination in America. *International Journal of Obesity, 32*(6), 992–1000. <https://doi.org/10.1038/ijo.2008.22>
- Puhl, R. M., & Brownell, K. D. (2006). Confronting and coping with weight stigma: An investigation of overweight and obese adults. *Obesity, 14*(10), 1802–1815. <https://doi.org/10.1038/oby.2006.208>

- Puhl, R. M., & Heuer, C. A. (2009). The stigma of obesity: A review and update. In *Obesity* (Vol. 17, Issue 5, pp. 941–964). <https://doi.org/10.1038/oby.2008.636>
- Puhl, R. M., & Heuer, C. A. (2010). Obesity Stigma: Important Considerations for Public Health. In *Public Health* (Vol. 100).
- Puhl, R. M., Himmelstein, M. S., & Pearl, R. L. (2020). Weight stigma as a psychosocial contributor to obesity. *The American Psychologist*, 75(2), 274–289. <https://doi.org/10.1037/amp0000538>
- Puhl, R. M., Himmelstein, M. S., & Quinn, D. M. (2018). Internalizing Weight Stigma: Prevalence and Sociodemographic Considerations in US Adults. *Obesity*, 26(1), 167–175. <https://doi.org/10.1002/oby.22029>
- Puhl, R. M., & King, K. M. (2013). Weight discrimination and bullying. In *Best Practice and Research: Clinical Endocrinology and Metabolism* (Vol. 27, Issue 2, pp. 117–127). <https://doi.org/10.1016/j.beem.2012.12.002>
- Puhl, R. M., & Latner, J. D. (2007). Stigma, Obesity, and the Health of the Nation's Children. *Psychological Bulletin*, 133(4), 557–580. <https://doi.org/10.1037/0033-2909.133.4.557>
- Puhl, R. M., Lessard, L. M., Himmelstein, M. S., & Foster, G. D. (2021). The roles of experienced and internalized weight stigma in healthcare experiences: Perspectives of adults engaged in weight management across six countries. *PLoS ONE*, 16(6 June). <https://doi.org/10.1371/journal.pone.0251566>
- Puhl, R. M., Lessard, L. M., Pearl, R. L., Himmelstein, M. S., & Foster, G. D. (2021). International comparisons of weight stigma: addressing a void in the field. *International Journal of Obesity*, 45(9), 1976–1985. <https://doi.org/10.1038/s41366-021-00860-z>
- Puhl, R. M., Luedicke, J., & Heuer, C. (2011). Weight-based victimization toward overweight adolescents: Observations and reactions of peers. *Journal of School Health*, 81(11), 696–703. <https://doi.org/10.1111/j.1746-1561.2011.00646.x>
- Puhl, R. M., Luedicke, J., & Heuer, C. A. (2013). The stigmatizing effect of visual media portrayals of obese persons on public attitudes: Does race or gender matter? *Journal of Health Communication*, 18(7), 805–826. <https://doi.org/10.1080/10810730.2012.757393>
- Puhl, R. M., Wall, M. M., Chen, C., Bryn Austin, S., Eisenberg, M. E., & Neumark-Sztainer, D. (2017). Experiences of weight teasing in adolescence and weight-related outcomes in adulthood: A 15-year longitudinal study. *Preventive Medicine*, 100, 173–179. <https://doi.org/10.1016/j.ypmed.2017.04.023>
- Puhl, R., Peterson, J. L., & Luedicke, J. (2013). Motivating or stigmatizing? Public perceptions of weight-related language used by health providers. *International Journal of Obesity*, 37(4), 612–619. <https://doi.org/10.1038/ijo.2012.110>
- Puhl, R., & Suh, Young. (2015). Health Consequences of Weight Stigma: Implications for Obesity Prevention and Treatment. *Current Obesity Reports*, 4(2), 182–190. <https://doi.org/10.1007/s13679-015-0153-z>
- Pullmer, R., Coelho, J. S., & Zaitsoff, S. L. (2019). Kindness begins with yourself: The role of self-compassion in adolescent body satisfaction and eating pathology. *International Journal of Eating Disorders*, 52(7), 809–816. <https://doi.org/10.1002/eat.23081>
- Pullmer, R., Kerrigan, S. G., Grilo, C. M., & Lydecker, J. A. (2021). Supplemental Material for Factors Linking Perceived Discrimination and Weight Bias Internalization to Body Appreciation and Eating Pathology: A Moderated Mediation Analysis of Self-Compassion and Psychological Distress. *Stigma and Health*. <https://doi.org/10.1037/sah0000334.supp>
- Rasgon, N. L., & Kenna, H. A. (2005). Insulin resistance in depressive disorders and Alzheimer's disease: Revisiting the missing link hypothesis. *Neurobiology of Aging*, 26(SUPPL.), 103–107. <https://doi.org/10.1016/j.neurobiolaging.2005.09.004>

- Ratcliffe, D., & Ellison, N. (2015). Obesity and internalized weight stigma: A formulation model for an emerging psychological problem. *Behavioural and Cognitive Psychotherapy*, 43(2), 239–252. <https://doi.org/10.1017/S1352465813000763>
- Rees, T. D. (1998). Drugs and oral disorders. *Periodontology 2000*, 18(1), 21–36. <https://doi.org/10.1111/j.1600-0757.1998.tb00136.x>
- Richman, L. S., & Jonassaint, C. (2008). The effects of race-related stress on cortisol reactivity in the laboratory: Implications of the duke lacrosse scandal. *Annals of Behavioral Medicine*, 35(1), 105–110. <https://doi.org/10.1007/s12160-007-9013-8>
- Rimmele, U., Seiler, R., Marti, B., Wirtz, P. H., Ehler, U., & Heinrichs, M. (2009). The level of physical activity affects adrenal and cardiovascular reactivity to psychosocial stress. *Psychoneuroendocrinology*, 34(2), 190–198. <https://doi.org/10.1016/j.psyneuen.2008.08.023>
- Rockliff, H., Gilbert, P., & Mcewan, K. (2008). A pilot exploration of heart rate variability and salivary Cortisol responses to compassion-focused imagery. *Clinical Neuropsychiatry*, 5(3), 132–139. <https://www.researchgate.net/publication/228642817>
- Roehling, M. V., Roehling, P. V., & Pichler, S. (2007). The relationship between body weight and perceived weight-related employment discrimination: The role of sex and race. *Journal of Vocational Behavior*, 71(2), 300–318. <https://doi.org/10.1016/j.jvb.2007.04.008>
- Rohleder, N., Beulen, S. E., Chen, E., Wolf, J. M., & Kirschbaum, C. (2007). Stress on the dance floor: The cortisol stress response to social-evaluative threat in competitive ballroom dancers. *Personality and Social Psychology Bulletin*, 33(1), 69–84. <https://doi.org/10.1177/0146167206293986>
- Rohrmann, S., Hennig, J., & Netter, P. N. (1999). Changing psychobiological stress reactions by manipulating cognitive processes. *International Journal of Psychophysiology*, 33, 149–161.
- Röthlin, P., Horvath, S., Messerli, T., Krieger, T., Berger, T., & Birrer, D. (2023). Associations of self-compassion with shame, guilt, and training motivation after sport-specific daily stress—a smartphone study. *International Journal of Sport and Exercise Psychology*, 21(1), 90–101. <https://doi.org/10.1080/1612197X.2021.2025134>
- Rubino, F., Puhl, R. M., Cummings, D. E., Eckel, R. H., Ryan, D. H., Mechanick, J. I., Nadglowski, J., Ramos Salas, X., Schauer, P. R., Twenefour, D., Apovian, C. M., Aronne, L. J., Batterham, R. L., Berthoud, H. R., Boza, C., Busetto, L., Dicker, D., De Groot, M., Eisenberg, D., ... Dixon, J. B. (2020). Joint international consensus statement for ending stigma of obesity. *Nature Medicine*, 26(4), 485–497. <https://doi.org/10.1038/s41591-020-0803-x>
- Sabin, J. A., Marini, M., & Nosek, B. A. (2012). Implicit and Explicit Anti-Fat Bias among a Large Sample of Medical Doctors by BMI, Race/Ethnicity and Gender. *PLoS ONE*, 7(11). <https://doi.org/10.1371/journal.pone.0048448>
- Sabiston, C. M., Pila, E., & Gilchrist, J. D. (2020). Self-conscious emotions in sport and exercise. In G. Tenenbaum & R. Eklund (Eds.), *Handbook of sport psychology* (pp. 299–219). John Wiley & Sons, Inc. <https://doi.org/10.1002/9781119568124.ch14>
- Sabiston, C. M., Pila, E., Pinsonnault-Bilodeau, G., & Cox, A. E. (2014). Social physique anxiety experiences in physical activity: a comprehensive synthesis of research studies focused on measurement, theory, and predictors and outcomes. *International Review of Sport and Exercise Psychology*, 7(1), 158–183. <https://doi.org/10.1080/1750984X.2014.904392>
- Saguy, A. C., & Gruys, K. (2010). Morality and health: News media constructions of overweight and eating disorders. *Social Problems*, 57(2), 231–250. <https://doi.org/10.1525/sp.2010.57.2.231>
- Salimetrics. (2023). *Calculating Inter- and Intra-Assay Coefficients of Variability*.

- Sarkar, P. D., Choudhury, A. B., & Choudhury, A. B. (2013). Relationships between serum osteocalcin levels versus blood glucose, insulin resistance and markers of systemic inflammation in central Indian type 2 diabetic patients. *European Review for Medical and Pharmacological Sciences*, 17, 1631–1635.
- Savoy, S., Almeida, L., & Boxer, P. (2012). The Relation of Weight Stigmatization to Psychological Adjustment. *Journal of Applied Social Psychology*, 42(9), 2285–2308. <https://doi.org/10.1111/j.1559-1816.2012.00940.x>
- Schett, G., Kiechl, S., Weger, S., Pederiva, A., Mayr, A., Petrangeli, M., Oberhollenzer, F., Lorenzini, R., Redlich, K., Axmann, R., Zwerina, J., & Willeit, J. (2006). *High-Sensitivity C-Reactive Protein and Risk of Nontraumatic Fractures in the Bruneck Study*. 166, 2495–2501. <https://jamanetwork.com/>
- Schnepper, R., Reichenberger, J., & Blechert, J. (2020). Being My Own Companion in Times of Social Isolation – A 14-Day Mobile Self-Compassion Intervention Improves Stress Levels and Eating Behavior. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.595806>
- Schvey, N. A., Puhl, R. M., & Brownell, K. D. (2014). The stress of stigma: Exploring the effect of weight stigma on cortisol reactivity. *Psychosomatic Medicine*, 76(2), 156–162. <https://doi.org/10.1097/PSY.0000000000000031>
- Schwartz, M. B., Chambliss, H. O. N., Brownell, K. D., Blair, S. N., & Billington, C. (2003). Weight Bias among Health Professionals Specializing in Obesity. *Obesity Research*, 11(9), 1033–1039. <https://doi.org/10.1038/oby.2003.142>
- Sedighimornani, N., Rimes, K. A., & Verplanken, B. (2019). Exploring the Relationships Between Mindfulness, Self-Compassion, and Shame. *SAGE Open*, 9(3). <https://doi.org/10.1177/2158244019866294>
- Shaffer, F., & Ginsberg, J. P. (2017). An Overview of Heart Rate Variability Metrics and Norms. *Frontiers in Public Health*, 5. <https://doi.org/10.3389/fpubh.2017.00258>
- Sick, K., Pila, E., Nesbitt, A., & Sabiston, C. M. (2020). Does self-compassion buffer the detrimental effect of body shame on depressive symptoms? *Body Image*, 34, 175–183. <https://doi.org/10.1016/j.bodyim.2020.05.012>
- Siegel, R. D., & Germer, C. K. (2012). *Sample Chapter: Wisdom and Compassion in Psychotherapy: Deepening Mindfulness in Clinical Practice*. www.guilford.com/p/germer3
- Sikorski, C., Luppia, M., Luck, T., & Riedel-Heller, S. G. (2015). Weight stigma “gets under the skin” - Evidence for an adapted psychological mediation framework - A systematic review. In *Obesity* (Vol. 23, Issue 2, pp. 266–276). <https://doi.org/10.1002/oby.20952>
- Skinner, E. A., Edge, K., Altman, J., & Sherwood, H. (2003). Searching for the Structure of Coping: A Review and Critique of Category Systems for Classifying Ways of Coping. In *Psychological Bulletin* (Vol. 129, Issue 2, pp. 216–269). <https://doi.org/10.1037/0033-2909.129.2.216>
- Skinta, M. D., Lezama, M., Wells, G., Francisco, S., & Dilley, J. W. (2014). *Acceptance and Compassion-Based Group Therapy to Reduce HIV Stigma*. www.elsevier.com/locate/cabp
- Smyth, A. P. J., Gammage, K. L., Lamarche, L., & Muir, C. (2020). Examining University Men’s Psychobiological and Behavioral Response-Recovery Profile From a Social-Evaluative Body Image Threat. *American Journal of Men’s Health*, 14(2). <https://doi.org/10.1177/1557988320910831>
- Smyth, N., Hucklebridge, F., Thorn, L., Evans, P., & Clow, A. (2013). Salivary cortisol as a biomarker in social science research. *Social and Personality Psychology Compass*, 7(9), 605–625. <https://doi.org/10.1111/spc3.12057>

- Spahlholz, J., Baer, N., König, H. H., Riedel-Heller, S. G., & Luck-Sikorski, C. (2016). Obesity and discrimination - a systematic review and meta-analysis of observational studies. In *Obesity Reviews* (Vol. 17, Issue 1, pp. 43–55). Blackwell Publishing Ltd. <https://doi.org/10.1111/obr.12343>
- Steele, C. M. (1997). *A Threat in the Air How Stereotypes Shape Intellectual Identity and Performance*.
- Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In *Advances in experimental social psychology* (Vol. 34, pp. 379–440). Academic Press. [https://doi.org/https://doi.org/10.1016/S0065-2601\(02\)80009-0](https://doi.org/https://doi.org/10.1016/S0065-2601(02)80009-0)
- Stefanaki, C., Pervanidou, P., Boschiero, D., & Chrousos, G. P. (2018). Chronic stress and body composition disorders: implications for health and disease. In *Hormones* (Vol. 17, Issue 1, pp. 33–43). Springer. <https://doi.org/10.1007/s42000-018-0023-7>
- Steffen, P. R., Foxx, J., Cattani, K., Alldredge, C., Austin, T., & Burlingame, G. M. (2021). Impact of a 12-Week Group-Based Compassion Focused Therapy Intervention on Heart Rate Variability. *Applied Psychophysiology Biofeedback*, 46(1), 61–68. <https://doi.org/10.1007/s10484-020-09487-8>
- Stellar, J. E., Cohen, A., Oveis, C., & Keltner, D. (2015). Affective and physiological responses to the suffering of others: Compassion and vagal activity. *Journal of Personality and Social Psychology*, 108(4), 572–585. <https://doi.org/10.1037/pspi0000010>
- Stevens, S. D., Herbozo, S., Morrell, H. E. R., Schaefer, L. M., & Thompson, J. K. (2017). Adult and childhood weight influence body image and depression through weight stigmatization. *Journal of Health Psychology*, 22(8), 1084–1093. <https://doi.org/10.1177/1359105315624749>
- Stutts, L. A., Leary, M. R., Zeveney, A. S., & Hufnagle, A. S. (2018). A longitudinal analysis of the relationship between self-compassion and the psychological effects of perceived stress. *Self and Identity*, 17(6), 609–626. <https://doi.org/10.1080/15298868.2017.1422537>
- Sugaya, N., Izawa, S., Kimura, K., Ogawa, N., Yamada, K. C., Shiotsuki, K., Mikami, I., Hirata, K., Nagano, Y., Nomura, S., & Shimada, H. (2012). Adrenal hormone response and psychophysiological correlates under psychosocial stress in individuals with irritable bowel syndrome. *International Journal of Psychophysiology*, 84(1), 39–44. <https://doi.org/10.1016/j.ijpsycho.2012.01.006>
- Sutin, A. R., Stephan, Y., & Terracciano, A. (2015a). Weight Discrimination and Risk of Mortality. *Psychological Science*, 26(11), 1803–1811. <https://doi.org/10.1177/0956797615601103>
- Sutin, A. R., Stephan, Y., & Terracciano, A. (2015b). Weight Discrimination and Risk of Mortality. *Psychological Science*, 26(11), 1803–1811. <https://doi.org/10.1177/0956797615601103>
- Tangney, J. P., & Tracy, J. L. (2012). Self-Conscious Emotions. In M. Leary & J. P. Tagney (Eds.), *Handbook of Self and Identity* (2nd ed, Vol. 2, pp. 446–478). Guilford Press.
- Teachman, B. A., & Brownell, K. D. (2001). Implicit anti-fat bias among health professionals: is anyone immune? *International Journal of Obesity*, 25, 1525–1531.
- Terry, M. L., Leary, M. R., & Mehta, S. (2013). Self-compassion as a Buffer against Homesickness, Depression, and Dissatisfaction in the Transition to College. *Self and Identity*, 12(3), 278–290. <https://doi.org/10.1080/15298868.2012.667913>
- Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., Robson, R., Thabane, M., Giangregorio, L., & Goldsmith, C. H. (2010). *A tutorial on pilot studies: the what, why and how*. http://www.nsf.gov/pubs/2005/nsf0531/nsf0531_6.pdf

- Thayer, J. F., & Lane, R. D. (2000). A model of neurovisceral integration in emotion regulation and dysregulation. In *Journal of Affective Disorders* (Vol. 61). www.elsevier.com/locate/jad
- Thayer, J. F., & Lane, R. D. (2007). The role of vagal function in the risk for cardiovascular disease and mortality. *Biological Psychology*, 74(2), 224–242.
<https://doi.org/10.1016/j.biopsycho.2005.11.013>
- Tomiyama, A. J. (2014). Weight stigma is stressful. A review of evidence for the cyclic Obesity/weight-based stigma model. In *Appetite* (Vol. 82, pp. 8–15). Academic Press.
<https://doi.org/10.1016/j.appet.2014.06.108>
- Tomiyama, A. J., Carr, D., Granberg, E. M., Major, B., Robinson, E., Sutin, A. R., & Brewis, A. (2018). How and why weight stigma drives the obesity “epidemic” and harms health. *BMC Medicine*, 16(1). <https://doi.org/10.1186/s12916-018-1116-5>
- Tomiyama, J. A., Epel, E. S., McClatchey, T. M., Poelke, G., Kemeny, M. E., McCoy, S., & Daubenmier, J. (2014). Associations of Weight Stigma With Cortisol and Oxidative Stress Independent of Adiposity. *Health Psychology*, 33(8), 862–867.
<https://doi.org/10.1037/hea0000107.supp>
- Trompetter, H. R., de Kleine, E., & Bohlmeijer, E. T. (2017). Why Does Positive Mental Health Buffer Against Psychopathology? An Exploratory Study on Self-Compassion as a Resilience Mechanism and Adaptive Emotion Regulation Strategy. *Cognitive Therapy and Research*, 41(3), 459–468. <https://doi.org/10.1007/s10608-016-9774-0>
- Tylka, T. L., Annunziato, R. A., Burgard, D., Daníelsdóttir, S., Shuman, E., Davis, C., & Calogero, R. M. (2014). The Weight-Inclusive versus Weight-Normative Approach to Health: Evaluating the Evidence for Prioritizing Well-Being over Weight Loss. In *Journal of Obesity* (Vol. 2014). Hindawi Limited. <https://doi.org/10.1155/2014/983495>
- Ulrich-Lai, Y. M., & Herman, J. P. (2009). Neural regulation of endocrine and autonomic stress responses. In *Nature Reviews Neuroscience* (Vol. 10, Issue 6, pp. 397–409).
<https://doi.org/10.1038/nrn2647>
- Van den Bos, E., de Rooij, M., Miers, A. C., Bokhorst, C. L., & Westenberg, P. M. (2014). Adolescents’ Increasing Stress Response to Social Evaluation: Pubertal Effects on Cortisol and Alpha-Amylase During Public Speaking. *Child Development*, 85(1), 220–236.
<https://doi.org/10.1111/cdev.12118>
- Vartanian, L. R., & Novak, S. A. (2011). Internalized societal attitudes moderate the impact of weight stigma on avoidance of exercise. *Obesity*, 19(4), 757–762.
<https://doi.org/10.1038/oby.2010.234>
- Vartanian, L. R., Pinkus, R. T., & Smyth, J. M. (2018). Experiences of weight stigma in everyday life: Implications for health motivation. *Stigma and Health*, 3(2), 85–92.
<https://doi.org/10.1037/sah0000077>
- Vartanian, L. R., & Porter, A. M. (2016). Weight stigma and eating behavior: A review of the literature. *Appetite*, 102, 3–14. <https://doi.org/10.1016/j.appet.2016.01.034>
- Vartanian, L. R., & Shaprow, J. G. (2008). Effects of weight stigma on exercise motivation and behavior: A preliminary investigation among college-aged females. *Journal of Health Psychology*, 13(1), 131–138. <https://doi.org/10.1177/1359105307084318>
- Vartanian, L. R., & Smyth, J. M. (2013). Primum Non Nocere: Obesity Stigma and Public Health. *Journal of Bioethical Inquiry*, 10(1), 49–57. <https://doi.org/10.1007/s11673-012-9412-9>
- von Dawans, B., Kirschbaum, C., & Heinrichs, M. (2011). The Trier Social Stress Test for Groups (TSST-G): A new research tool for controlled simultaneous social stress exposure in a group format. *Psychoneuroendocrinology*, 36(4), 514–522.
<https://doi.org/10.1016/j.psyneuen.2010.08.004>

- Wakelin, K. E., Perman, G., & Simonds, L. M. (2022). Effectiveness of self-compassion-related interventions for reducing self-criticism: A systematic review and meta-analysis. In *Clinical Psychology and Psychotherapy* (Vol. 29, Issue 1, pp. 1–25). John Wiley and Sons Ltd. <https://doi.org/10.1002/cpp.2586>
- Walton, C. C., Baranoff, J., Gilbert, P., & Kirby, J. (2020). Self-compassion, social rank, and psychological distress in athletes of varying competitive levels. *Psychology of Sport and Exercise*, 50, 101733. <https://doi.org/10.1016/J.PSYCHSPORT.2020.101733>
- Wang, Z., Dang, J., Zhang, X., Moore, J. B., & Li, R. (2021). Assessing the relationship between weight stigma, stress, depression, and sleep in Chinese adolescents. *Quality of Life Research*, 30(1), 229–238. <https://doi.org/10.1007/s11136-020-02620-4>
- Warnick, J. L., Darling, K. E., West, C. E., Jones, L., & Jelalian, E. (2022). Weight Stigma and Mental Health in Youth: A Systematic Review and Meta-Analysis. In *Journal of Pediatric Psychology* (Vol. 47, Issue 3, pp. 237–255). Oxford University Press. <https://doi.org/10.1093/jpepsy/jsab110>
- Weng, H. Y., Fox, A. S., Shackman, A. J., Stodola, D. E., Caldwell, J. Z. K., Olson, M. C., Rogers, G. M., & Davidson, R. J. (2013). Compassion Training Alters Altruism and Neural Responses to Suffering. *Psychological Science*, 24(7), 1171–1180. <https://doi.org/10.1177/0956797612469537>
- Whitehead, R., Bates, G., Elphinstone, B., & Yang, Y. (2021). The relative benefits of nonattachment to self and self-compassion for psychological distress and psychological well-being for those with and without symptoms of depression. *Psychology and Psychotherapy: Theory, Research and Practice*, 94(3), 573–586. <https://doi.org/10.1111/papt.12333>
- Woerner, J., Lucas, T., Pierce, J., Riis, J. L., & Granger, D. A. (2019). Salivary uric acid: Associations with resting and reactive blood pressure response to social evaluative stress in healthy African Americans. *Psychoneuroendocrinology*, 101, 19–26. <https://doi.org/10.1016/j.psyneuen.2018.10.025>
- Wolpe, J. (1969). Subjective Units of Distress Scale (SUDS) . *APA PsycTests*.
- Wu, Q., Magnus, J. H., Liu, J., Bencaz, A. F., & Hentz, J. G. (2009). Depression and low bone mineral density: A meta-analysis of epidemiologic studies. In *Osteoporosis International* (Vol. 20, Issue 8, pp. 1309–1320). <https://doi.org/10.1007/s00198-009-0918-x>
- Wu, Y. K., & Berry, D. C. (2018). Impact of weight stigma on physiological and psychological health outcomes for overweight and obese adults: A systematic review. In *Journal of Advanced Nursing* (Vol. 74, Issue 5, pp. 1030–1042). Blackwell Publishing Ltd. <https://doi.org/10.1111/jan.13511>
- Wu, Y. K., & Liu, Y. (2015). Weight-related stigmatization and binge eating among overweight adults in Southern Taiwan. *Asia Pacific Journal of Clinical Nutrition*, 24(1), 118–127. <https://doi.org/10.6133/apjcn.2015.24.1.05>
- Yasuma, F. (2004). *Respiratory Sinus Arrhythmia* Why Does the Heartbeat Synchronize With Respiratory Rhythm?* www.chestjournal.org
- Zacher, H., & von Hippel, C. (2022). Weight-based stereotype threat in the workplace: consequences for employees with overweight or obesity. *International Journal of Obesity*, 46(4), 767–773. <https://doi.org/10.1038/s41366-021-01052-5>
- Zessin, U., Dickh€uf, O., & Garbade, S. (2015). The relationship between self-compassion and well-being: A meta-analysis. *Applied Psychology: Health and Well-Being*, 7(3), 340–364. <https://doi.org/10.1111/aphw.12051>
- Zhang, H., Carr, E. R., Garcia-Williams, A. G., Siegelman, A. E., Berke, D., Niles-Carnes, L. V., Patterson, B., Watson-Singleton, N. N., & Kaslow, N. J. (2018). Shame and Depressive

Symptoms: Self-compassion and Contingent Self-worth as Mediators? *Journal of Clinical Psychology in Medical Settings*, 25(4), 408–419. <https://doi.org/10.1007/s10880-018-9548-9>

Zoch, M. L., Clemens, T. L., & Riddle, R. C. (2016). New insights into the biology of osteocalcin. In *Bone* (Vol. 82, pp. 42–49). Elsevier Inc. <https://doi.org/10.1016/j.bone.2015.05.046>

Appendices

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



Date: 11 January 2023

To: Dr Eva Pila

Project ID: 118074

Review Reference: 2023-118074-74788

Study Title: Investigating hormones and cardiovascular function in young women

Application Type: HSREB Amendment Form

Review Type: Delegated

Full Board Reporting Date: 24/Jan/2023

Date Approval Issued: 11/Jan/2023 08:11

REB Approval Expiry Date: 28/Jul/2023

Dear Dr Eva Pila ,

The Western University Health Sciences Research Ethics Board (HSREB) has reviewed and approved the WREM application form for the amendment, as of the date noted above.

Documents Approved:

Document Name	Document Type	Document Date
psychobio social eval_protocol_2022-12-14	Protocol	14/Dec/2022
psychobio social eval-telephone pre-screen loic	Other Materials	14/Dec/2022
psychobio social eval-participant pre-lab instructions	Other Materials	14/Dec/2022
psychobio social eval-debrief letter	Other Materials	09/Jan/2023
psychobio social eval-telephone prescreen eligibility reconfirmation	Interview Guide	09/Jan/2023
psychobio social eval-loic	Consent Form	09/Jan/2023
psychobio social eval-email communication	Recruitment Materials	09/Jan/2023

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.

Electronically signed by:

Karen Gopaul , Ethics Officer on behalf of Dr. Philip Jones, HSREB Chair, 11/Jan/2023 08:11

Reason: I am approving this document.

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

Appendix B: Pre-Registration

Clinical Trials: “Psychobiological Processes in Social Evaluation”

Psychobiological Processes in Social Evaluation

The safety and scientific validity of this study is the responsibility of the study sponsor and investigators. Listing a study does not mean it has been evaluated by the U.S. Federal Government. Read our [disclaimer](#) for details.

ClinicalTrials.gov Identifier: NCT05107609

Recruitment Status ⓘ : Active, not recruiting
First Posted ⓘ : November 4, 2021
Last Update Posted ⓘ : April 25, 2023

[View this study on the modernized ClinicalTrials.gov](#)

Sponsor:
Western University, Canada

Information provided by (Responsible Party):
Dr. Eva Pila, Western University, Canada

- Study Details
- Tabular View
- No Results Posted
- Disclaimer
- How to Read a Study Record

Tracking Information	
First Submitted Date ⓘ	August 20, 2021
First Posted Date ⓘ	November 4, 2021
Last Update Posted Date	April 25, 2023

ACTIVE, NOT RECRUITING ⓘ

Psychobiological Processes in Social Evaluation

ClinicalTrials.gov ID ⓘ NCT05107609

Sponsor ⓘ Western University, Canada

Information provided by ⓘ Dr. Eva Pila, Western University, Canada (Responsible Party)

Last Update Posted ⓘ 2023-04-25

Study Overview

Brief Summary:

Higher-weight individuals face pervasive weight-related stigma and discrimination in their daily lives. There is conceptual and empirical evidence to suggest that weight stigma contributes to worse physical and psychological health outcomes, mediated by the deleterious psychobiological responses to psychosocial stress. Activating self-soothing emotional states (such as self-compassion) may protect against this psychobiological cascade, conferring resilience to negative social evaluation (such as weight stigma). This proof-of-concept study aims to establish the feasibility of an experimental protocol testing whether an acute self-compassion intervention can attenuate the psychobiological stress response to induced weight-based social-evaluative threat. Participants will be randomized into either self-compassion intervention or rest control groups. A standard body composition assessment will be used to induce weight stigma among young women who self-identify as "higher-weight." Stress-sensitive biomarkers (i.e., salivary cortisol and heart-rate variability) along with psychological indices of self-conscious emotions will be used to quantify the psychobiological stress response. This novel pilot study will contribute to efforts to understand the psychobiological processes by which self-compassion facilitates adaptive responding to acute stress, and will help inform future tests of interventions focused on mitigating the harmful health effects of social stigma.

[— Show less](#)

STUDY START (ACTUAL) ⓘ
2021-11-01
PRIMARY COMPLETION (ACTUAL) ⓘ
2023-02-01
STUDY COMPLETION (ESTIMATED) ⓘ
2023-12-01
ENROLLMENT (ACTUAL) ⓘ
37
STUDY TYPE ⓘ
Interventional

Appendix C: Recruitment Email / Online Community Group Post

Subject: MASS EMAIL: RESEARCH PARTICIPANTS NEEDED

Hello,

You are invited to participate in a research study titled: “Investigating hormones and cardiovascular function in young women.”

This study takes place at Western University.

You may be eligible if you are:

- A cis-gender woman aged 18-34
- Not currently smoking, pregnant, breastfeeding, or taking prescription medication for chronic health conditions.

Voluntary participation consists of:

- A 15-minute telephone pre-screening interview to confirm eligibility.
- A 20-minute lab visit to learn more about the study and fill out surveys.
- A subsequent 1.75 hour visit to the lab to provide saliva samples, heart rate and other physiological measurements, and online surveys.

Participants may be compensated for their time spent participating in the study.

If you are interested or would like more information about the study, please reach out to the researchers using the contact information listed below.

Best regards,

Eva Pila, PhD, Principal Investigator
Assistant Professor, School of Kinesiology
Faculty of Health Sciences, Western University

Appendix D: Recruitment Poster

PARTICIPATE IN RESEARCH STUDY

Slide1.jpeg

Study title: Hormones and Cardiovascular Function

Who can participate?

- Cis-gender women aged 18-34
- Participants must be able to read and communicate in English


Participants cannot currently be smoking, pregnant, breastfeeding, or taking prescription medication for chronic health conditions.

Voluntary participation consists of:


- A 15-minute telephone pre-screen to confirm eligibility.
- A 20-minute lab visit to learn more about the study and fill out surveys.
- A subsequent 1.75 hour visit to the lab to provide saliva samples, heart-rate and other physiological measurements, and online surveys.

[You may be compensated for time spent participating in the study.](#)

For more info, please contact



Body Image & Health Research


Western

School of Kinesiology

Principal Investigator: Eva Pila, PhD

Appendix E: Pre-Screen Letter of Information and Consent

Project Title: Investigating hormones and cardiovascular function in young women: Pre-Screen

Principal Investigator: Eva Pila, PhD

1. Invitation to Participate

We are sending you this letter of information because you have expressed your interest to participate in the advertised study on hormones and heart function. We invite you to participate in a telephone interview to determine whether you are eligible to participate in this study.

2. Why is this study being done?

The purpose of this voluntary pre-screening interview is to identify potential participants for a research study that will investigate hormones and heart function in healthy young women.

3. What are the study procedures?

This study is a project conducted under the direction of Dr. Eva Pila. The study procedures will be supported by student researchers. The first part of this study is a telephone pre-screening session to determine eligibility. If eligible, participants will be invited to two laboratory sessions where they will provide saliva samples, wear a heart-rate monitor, assess body composition, and answer psychological surveys so researchers can learn more about hormones and cardiovascular function.

We are asking your permission to participate in a telephone pre-screening survey. This telephone survey will assess whether you meet the eligibility requirements to participate in the next parts of the study.

You will be called by a student researcher who will ask for your name and contact information. The researcher will ask for your permission to ask you questions and collect your responses. If you provide verbal consent, you will be given a random participant ID number, to protect the confidentiality of your data. The researcher will ask you questions about your age, self-identified sex and gender, health history (including medications you take), and lifestyle behaviours. This interview should take no longer than 15 minutes. We will use the information you provide to determine whether you are eligible to participate in the rest of the study.

Once the interview is complete, we will let you know whether you are invited to participate in the next part of the study. You may or may not be invited back, but we are asking for your permission to use the interview responses you provide for research purposes, regardless of whether you participate in the second session. If you are invited back, you are under no obligation to return to the study if you no longer wish to participate. If you are not eligible, the decision to allow the researchers to use your initial interview responses is completely voluntary.

Refusing to participate or withdrawing from this voluntary research study has no penalty and will not affect your academic standing.

4. What are the inclusion criteria?

Participants must identify as a cis-gender woman, be between the ages of 18-34 inclusive, and be fluent in English.

5. What are the exclusion criteria?

Participants cannot currently smoke, be taking prescription medications for chronic health conditions, or be pregnant or currently breastfeeding.

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

The possible risks and harms that may result from participation in pre-screening survey involve psychological discomfort associated with answering questions about your health history and lifestyle behaviours. If you do not feel comfortable answering a question, you may decline to answer.

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

There are no direct benefits for choosing to participate in this study.

8. Can participants choose to leave the study?

Yes. Participation in research is completely voluntary. Please email the researchers if you wish to withdraw. You may also withdraw from the study at any point and for any reason, at no penalty.

The only exception is that your data cannot be withdrawn after the study results have been published.

If you choose to withdraw your participation and your data has already been collected, we will be able to remove it prior to publication. If the data has already been analyzed and published, we will not be able to remove your data from the study. However, all published participant data will be reported in aggregate.

9. How will participants' information be kept confidential?

There is a risk of loss of confidentiality if your information or your identity is obtained by someone other than the investigators, but precautions will be taken to prevent this from happening. The confidentiality of electronic data created by you or by the researchers will be maintained as required by applicable law and to the degree permitted by the technology used. Absolute confidentiality cannot be guaranteed.

The confidentiality of the data that is collected will be protected. You will not be identified by your name on any study data collection documents or samples, rendering all collected survey and biomarker data de-identified. You will be assigned a random number that will be your identification for the study which will be accessible only through study investigators on a password-protected file. Your unique participant identification number will be used to track survey and biomarker data. Any saliva samples you provide will be labeled only with your anonymous participant ID number and a number indicating the time of collection. The principal investigators and the research assistants working on this project will be the only people with access to the data collected in this study.

Efforts will be made to limit the use and sharing of your personal research information to people who have a need to review this information. Personal identifiers we will need to collect from you include your email address, telephone number, sex/gender, race/ethnicity, and age. Researchers will keep the identified data on a secure Western University sanctioned drive. This data file will be stored in a safe area on a password protected computer in a locked room. Your data will be stored for 7 years as per Western University's policy. Reasonable efforts will be made to keep the personal information in your research record private. However, absolute confidentiality cannot be guaranteed.

All data resulting from this research that is 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.

We may use your research information for future research studies or may share your information with other investigators here or at other institutions for future research without your additional informed consent. Future research may be similar to this study or completely different. Before we use or share your information or samples we will remove any information that shows your identity. The information that may be shared includes any survey responses and biomarker data.

Delegated institutional representatives of Western University and its Research Ethics Boards (REBs) may require access to your study-related records to monitor the conduct of the research in accordance with regulatory requirements.

10. Are participants compensated to be in this study?

There is no compensation for participating in this telephone pre-screening.

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 at a later date, there will be no penalty or loss of benefits to which you are entitled.

- Participants who choose to prematurely withdraw from the study will still be compensated for their time.

You do not waive any legal rights by consenting to this study. Withdrawing from this study will not have any impact on your academic standing. If you wish to withdraw your data, please contact the research assistant named below.

12. Whom do participants contact for questions?

Please contact the research lab or principal investigator, Dr. Eva Pila if you:

- Have questions, complaints or concerns about the research, including questions about compensation.
- 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 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.

Appendix F: Telephone Pre-Screening Interview – Researcher Script

Hello, this is _____ from Western University. I am contacting you because you have previously participated in the pre-screen for the Hormones and Cardiovascular Function study that is being conducted in the School of Kinesiology at Western University. Your eligibility was re-evaluated due to revisions to the study's protocol, and you may be considered eligible for participation. Is now a good time for me to describe our study and ask you some questions?

IF NO: Is there a better time for me to call back and explain this study to you?

IF YES: You were sent an email with a Letter of Information describing the procedures for today's telephone screening session. First, I'll review the information provided in the letter, give you a chance to ask questions, and then I'll ask your permission to go through the pre-screening interview.

Dr. Eva Pila and her colleagues are conducting a study to learn more about hormones and cardiovascular function in healthy young women. This is a multi-part study starting with today's telephone pre-screening. This telephone survey will assess whether you meet the eligibility requirements to participate in the next parts of the study. We will ask you questions about your age, self-identified sex and gender, health history (including medications you take), and lifestyle behaviours. This interview should take no longer than 15 minutes. You may or may not be invited to participate in the rest of the study, but we are asking for your permission to use the interview responses you provide for research purposes, regardless of whether you participate in the next sessions or not. Your decision to allow us to use your interview responses for research purposes is

completely voluntary and you may withdraw your permission at any point prior to the publication of the data.

If you are eligible, you will be invited to come to the lab for two sessions, where you will provide saliva samples, wear a heart-rate monitor, and answer psychological surveys so we can learn more about hormones and cardiovascular function. If you are invited back, you are under no obligation to return to the study if you no longer wish to participate.

Do you think you might be interested in participating in our study?

IF YES: Great. I'll now ask your permission to perform the pre-screening interview. I'll remind you of your random, anonymous participant ID number. I'll ask you to write down this number and keep it in a safe place, because you'll use it to identify yourself during the rest of the study to protect the confidentiality of your data.

Please be assured that we are taking precautions to ensure your information remains strictly confidential. Only myself and other authorized research personnel running this study will have access to your personal information, which will be kept in password-protected files.

Taking part in this research is completely voluntary. You are free to decline to answer any question I ask you, and you are free to withdraw your participation at any point and for any reason.

Do I have your permission to ask you the pre-screening questions? YES NO

[document verbal consent]

I'll now provide you with an anonymized participant ID number. Please write this number down because you will be asked for it if you participate in any other parts of this study. Here is your participant ID number [insert ID].

[Record all of the following pre-screen responses in telephone pre-screen Excel file]

Record participant ID number _____

1. Are you able to read and write in English? (yes/no)	If "No" → [INEGILIBLE]
2. How old are you in years?	If outside 18 – 34 (inclusive) → [INEGILIBLE]
3. How would you describe yourself? <ul style="list-style-type: none"> ○ Cisgender Woman ○ Transgender Woman ○ Cisgender Man ○ Transgender Man ○ Non-binary ○ Two Spirit ○ Self-identify 	If not cisgender woman → [INEGILIBLE]
4. Are you currently pregnant or breastfeeding? (yes/no)	If yes → [INEGILIBLE]
5. Please rate yourself on the following on the following scale: <ul style="list-style-type: none"> ○ very thin ○ moderately thin ○ slightly thin ○ average ○ slightly heavy ○ moderately heavy ○ very heavy 	If "very thin," "moderately thin," or "slightly thin" is selected → [INEGILIBLE]
6. Do you currently smoke cigarettes? Currently refers to	If yes → [INEGILIBLE]

regular use within the last month. (yes/no)	
7. Do you currently use other nicotine or tobacco products now? Currently refers to regular use within the last month. (yes/no)	If yes → [INEGILIBLE]
8. Do you identify as a current regular user of cannabis products? Currently refers to regular use within the last month. (yes/no)	If yes → [INEGILIBLE]
9. Do you identify as a current regular user of other recreational drugs? Currently refers to regular use within the last month. (yes/no)	If yes → [INEGILIBLE]
10. Are you currently taking prescribed medications for a chronic medical condition? (yes/no)	If yes → [INEGILIBLE]
11. Do you use any steroid-based medications, products or supplements (e.g., steroid creams, anabolic steroids, hormone therapies, etc.) (yes/no)	If yes → [INEGILIBLE]
12. Have you ever participated in self-compassion training or other forms of compassion training and/or therapy? (yes/no)	If yes → [INEGILIBLE]
13. Have you ever participated in organized meditation training, specific mindfulness training, or other mindfulness/meditation-based practices or therapies (for example, mindfulness-based stress-reduction therapy, mindfulness-based cognitive therapy, etc.)? (yes/no)	If yes → [INEGILIBLE]
14. Have you ever been diagnosed with a mental illness or psychiatric condition by a licensed healthcare provider? (yes/no)	If yes → [INEGILIBLE]
15. Have you ever been diagnosed with a substance-use disorder? (yes/no)	If yes → [INEGILIBLE]
16. Have you ever been diagnosed with an eating disorder, or thought that you may have an eating disorder? (yes/no)	If yes → [INEGILIBLE]

17. Has your doctor ever said that you have a heart condition or high blood pressure? (yes/no)	If yes → [INEGILIBLE]
18. Has your doctor that you have any health disorders that may affect the neuroendocrine system (e.g., neuroendocrine disorders, autoimmune disease, diabetes, thyroid problems, cardiovascular disease, respiratory conditions, depression, etc.)? (yes/no)	If yes → [INEGILIBLE]
19. Do you have any known oral health problems including untreated cavities, gum disease, gingivitis or periodontitis? (yes/no)	If yes → [INEGILIBLE]
20. Do you have a salivary gland disease or disorder? (yes/no)	If yes → [INEGILIBLE]
21. Do you have any other chronic health condition? (yes/no). If yes, please specify.	If chronic health condition other than “obesity” is specified → [INEGILIBLE]

If “[INEGILIBLE]”

[continue collecting responses to all questions as even ineligible participants’ data can be used for feasibility assessment]

Thank you for your interest in our research study and participating in the pre-screen. However, it appears that based on the updated information you provided, you are not eligible for this particular study.

We can still use the updated information you provided today for research purposes. However, we would like to remind you of the opportunity to remove the data we collected today from you today from the pre-screen should you not wish to participate. Do we have your permission to use your data for research?

IF YES: Great, thank you so much for your time and participation!

IF NO: No problem, we will delete your data now and it will not be included in our study. Thank you for your time and participation!

If ELIGIBLE

Thanks for answering the survey questions. Based on what you have told me, it sounds like you are a good candidate to continue participating in the study. Now, we can schedule two visits to the laboratory that are at least 24 hours apart.

The first visit will be approximately 20 minutes long and can be at any time. You will be provided more information about study procedures and will be asked to provide written informed consent for your participation. Then, we will ask you to fill out a brief computerized survey on an iPad, and we will go over instructions for your next visit.

The second visit will be 1.75 hours long and needs to be scheduled after the first visit, sometime between 1pm and 5pm. During this visit, you will be asked to provide saliva samples, wear a heart-rate monitor, assess body composition, and answer more surveys. You will be asked to make some minor modifications to your lifestyle in the 24 hours prior to coming in for this second visit. These modifications will include avoiding taking any non-prescription medications, consuming alcohol or recreational drugs, or engaging in intense physical exercise for 24 hours prior to the second lab session. We request that you follow these instructions because these factors can influence the hormones and cardiovascular indices we will be measuring.

We will go over these instructions in more detail when you come into the lab. I will email you a copy of these instructions after our phone call, so you can review them and plan ahead. I will also email you a Letter of Information and Consent that provides more information about the study procedures for you to review. Please look over these documents before you come into the lab, so we can answer any questions you might have. When you come into the lab, you will be asked to sign a copy of the Letter of Information and Consent before beginning any study procedures.

Can I schedule your lab sessions now?

IF NO: Address any concerns and offer the opportunity to speak with the Principal Investigator.

Ask the caller if she needs more time to decide whether or not to participate. If so, ask if and when she would like to be re-contacted. If the participant does not wish to be contacted again, leave the study telephone number and ask her to call back if she changes her mind.

IF YES: Great, let's go ahead and schedule your lab visits.

[Work together to find a convenient date and time for the first visit. Provide directions to Western and the EHPL.]

I will send you a follow-up email confirming these appointments and providing the Letter of Information and Consent and Pre-Lab Instructions that I mentioned earlier. Please review these documents before you come into the lab and make note of any questions or concerns you have.

In the meantime, don't hesitate to reach out if you have any questions or if you need to reschedule your visits.

Thank you for your time and participation!

Appendix G: Experimental Session Letter of Information and Consent

Project Title: Investigating hormones and cardiovascular function in young women

Principal Investigator: Eva Pila, PhD

1. Invitation to Participate

You are here because you identified yourself as a cis-gender woman between the ages of 18-34, who is not smoking, taking prescription medication for chronic health conditions, pregnant, or breastfeeding. You can read and communicate in English.

2. Why is this study being done?

The purpose of this voluntary research study is to learn about hormones and heart function in healthy young women. Specifically, we are measuring cortisol, (the body's stress hormone), salivary osteocalcin (a bone-derived hormone), salivary uric acid (a metabolic product), and heart-rate variability (a measure of nervous system input to the heart).

3. What are the study procedures?

This study is a project conducted under the direction of Dr. Eva Pila. The study procedures will be supported by student research assistants. This is a three-part study consisting of a telephone screen and 2 lab visits. You already completed the telephone pre-screening interview. The next part of the study is an in-lab baseline assessment which is what you are here to complete today. Today's session should take about 20 minutes. You will be asked to answer demographic questions about yourself and to fill out some psychological surveys on an iPad. Please be assured that we are taking precautions to ensure your information remains strictly confidential. The survey will ask you to input the random participant ID number you were provided during the phone screen, and

only authorized research personnel running this study will have access to your personal information. You are free to select “prefer not to answer” or skip any questions you do not feel comfortable answering, and if you no longer wish to participate, you may stop filling out the surveys at any point for any reason.

This is the first of two lab sessions. If you would like to continue your participation, you will be asked to return to the lab for the second session you booked previously. This second part of the study will last about 1.75 hours and involves collecting saliva samples to measure hormones and products of metabolism, wearing a heart-rate monitor, taking body measurements, and answering survey questions on a computer. You are under obligation to return to the lab if you no longer wish to participate. However, we are requesting your permission to use the survey responses you provide today for research purposes, regardless of whether you participate in the next part of the study or not.

The experimental portion of the study will last at least 1.75 hours. You will be asked to provide saliva samples using a SalivaBio oral swab (exclusively from Salimetrics, Carlsbad, CA). You will hold the synthetic swab under your tongue for 90 seconds to saturate it. Then you will deposit your swab into a storage tube. Your saliva samples will be labeled only with your anonymous participant ID number and a number indicating the time of collection. This will allow us to measure your salivary cortisol, osteocalcin and uric acid levels. You will also be asked to wear a chest-strap heart-rate monitor to measure your heart-rate variability for the entire duration of the experiment.

During the lab session, we will collect five saliva samples: one at baseline, one after ~1 hour, and then at each of the time points 10, 20 and 35 minutes after that. In between samples you will be asked to complete computerized psychological surveys, and participate in guided activities (potentially including mindfulness exercises) and body measurements. We are asking you to bring a sports bra and spandex shorts to the lab so we can take body measurements. If you do not have a suitable athletic outfit, we will have sports bras and spandex shorts available in a range of sizes for you to wear. We are asking for your permission to use your saliva samples, cardiac (ECG) data, and survey responses for research purposes.

We also ask that you follow some minor dietary, sleep and activity adjustments to your lifestyle starting the day before the experiment. We ask that you refrain from drinking alcohol, taking drugs/non-prescription medications, and very intense physical exercise (such as running, weight lifting, circuit training or sports) in the 24 hours prior to your experiment. We request that you try to adhere to your regular sleep schedule the night before, and that you record the time you go to bed and wake up. The day of the experiment, we ask that you refrain from exercise and consuming caffeine for 3 hours prior to arriving at the lab, and that you avoid eating or drinking anything except for water for 1 hour prior to arriving at the lab. We ask you to follow these instructions because diet, physical activity, sleep and medications can all affect the physiological measures we are taking.

4. What are the inclusion criteria?

Participants must identify as a cis-gender woman, be between the ages of 18-34 inclusive, and be fluent in English.

5. What are the exclusion criteria?

Participants cannot smoke, be taking prescription medications for chronic health conditions, or be pregnant or currently breastfeeding.

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

The possible risks and harms that may result from participation in this study include psychological stress, distress and/or discomfort associated with answering survey questions and undergoing bodily measurements. If these changes in your feelings occur, they are expected to be temporary and not any greater than those caused by other stressful experiences in everyday life. The protocols and survey questions used in this study have been previously used in research studies all over the world with no reports of adverse effects on participants.

Responding to multiple survey questions takes time, effort and may cause some discomfort. Survey questions assess your thoughts and emotions, and some participants may experience negative feelings or anxiety when answering these questions. If you do experience distress from any survey question and/or do not wish to answer it, you may select “prefer not to answer” or skip the question. If you are still experiencing distress upon completion of the study, you may access a variety of community-level resources that will be provided in the debriefing form.

You are free to withdraw from the study at any time and for any reason. Refusing to participate or withdrawing from the study has no penalty and will not affect your academic standing.

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

There are no direct benefits for choosing to participate in this study. However, the results of this research may help scientists to better cardiovascular and hormone function in young women.

8. Can participants choose to leave the study?

Yes. Participation in research is completely voluntary. Please email the researchers if you wish to withdraw. You may also withdraw from the study at any point during the laboratory sessions for any reason, at no penalty.

If you choose to withdraw your participation and your data has already been collected, we will be able to remove it prior to publication. Your saliva samples can be withdrawn and discarded according to local regulations up until they are sent to Salimetrics. If the data has already been analyzed and published, we will not be able to remove your data from the study. However, all published participant data will be reported in aggregate.

9. How will participants' information be kept confidential?

There is a risk of loss of confidentiality if your information or your identity is obtained by someone other than the investigators, but precautions will be taken to prevent this from happening. The confidentiality of electronic data created by you or by the researchers will be maintained as required by applicable law and to the degree permitted by the technology used. Absolute confidentiality cannot be guaranteed. Saliva samples will be sent to the Salimetrics lab, then disposed according to local regulations.

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 servers.

The confidentiality of the data that is collected will be protected. You will not be identified by your name on any study data collection documents or samples aside from this written informed consent form, rendering all collected survey and biomarker data de-identified. You will be assigned a random number that will be your identification for the study which will be accessible only through a password-protected file. Your unique participant identification number will be used to track survey and biomarker data. Hard copies of the consent forms will be stored in a locked file cabinet. The principal investigators and the research assistants working on this project will be the only people with access to the data collected in this study.

Efforts will be made to limit the use and sharing of your personal research information to people who have a need to review this information. Personal identifiers we will need to collect from you include your email address, telephone number, sex/gender, race/ethnicity, and age. Researchers will keep the identified data on a secure Western University sanctioned drive. This data file will be stored in a safe area on a password protected computer in a locked room. Your data will be stored for 7 years as per Western University's policy. Reasonable efforts will be made to keep the personal information in your research record private. However, absolute confidentiality cannot be guaranteed.

All data resulting from this research that is 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.

We may use your research information for future research studies or may share your information with other investigators here or at other institutions for future research without your additional informed consent. Future research may be similar to this study or completely different. Before we use or share your information or samples we will remove any information that shows your identity. The information that may be shared includes any survey responses and biomarker data.

Delegated institutional representatives of Western University and its Research Ethics Boards (REBs) may require access to your study-related records to monitor the conduct of the research in accordance with regulatory requirements.

10. Are participants compensated to be in this study?

Participants will be compensated \$10 CAD cash for participating in the first laboratory session, and \$40 CAD cash for participating in the second laboratory session. Participants who complete the first lab session will be compensated \$10 CAD cash regardless of whether or not they choose to complete the second lab session.

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 at a later date, there will be no penalty or loss of benefits to which you are entitled.

- Participants who choose to prematurely withdraw from the study will still be compensated for their time.

You do not waive any legal rights by consenting to this study. Withdrawing from this study will not have any impact on your academic standing. If you wish to withdraw your data, please contact the research assistant named below.

12. Whom do participants contact for questions?

Please contact the research assistants [emails] or principal investigator, Dr. Eva Pila if you:

- Have questions, complaints or concerns about the research, including questions about compensation.
- 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 if you:

- Have questions regarding your rights as a person in a research study.
- Have concerns, complaints, or general questions about the research.
- You may also call this number if you cannot reach the research team or wish to offer input or to talk to someone else about any concerns related to the research.

13. What does providing consent mean?

- You understand the information given to you on this document.
- You have been able to ask the researcher questions and state any concerns you have.
- The researcher has responded to your questions and concerns.

- You believe you understand the research study and the potential benefits and risks that are involved.

Statement of Consent

I give my voluntary consent to take part in this study. I may request a copy of this consent document for my records.

Consent Form*Hormones and Cardiovascular Function*

This study has been explained to me and any questions I had have been answered.

I know that I may leave the study at any time. I agree to take part in this study.

Print Participant Name

Participant Number

Signature

Date (*DD-MMM-YYYY*)

My signature means that I have explained the study to the participant named above. I have answered all questions.

Print Name of Person Obtaining Consent

Signature

Date (*DD-MMM-YYYY*)

Appendix H: Participant Pre-Study Preparation Checklist

Thank you for participating in this study.

Your lab visit is scheduled for the following date and time: _____

- For the 24 hours prior to the start of your lab session, please avoid taking any drugs or medication (except contraceptives), consuming any alcohol, or engaging in intense physical exercise (such as running, weight-lifting, circuit training or sports).
- Please try to adhere to your regular sleep routine the night before your lab session, and record your bedtime and wake time.
- Please avoid drinking caffeinated beverages or engaging in any exercise in the 3 hours prior to your lab session.
- Please avoid eating any food or drinking any beverage except for water in the 1 hour prior to the start of your lab session. Please also avoid brushing your teeth in the 1 hour prior to arriving at the lab.
- Please bring a sports bra and spandex shorts for the body measurements. If you do not have a suitable outfit or prefer not to bring your own, researchers will have sports bras and shorts in a range of sizes available for use at the lab.
- You may also bring quiet, non-electronic individual activities (i.e., readings, homework, books, magazines) because you may be asked to rest quietly for some portions of the lab session.
- If you are not able to adhere to these instructions prior to your lab session, please contact the investigators and we will be happy to rebook your session.

Please contact us if you have any questions or concerns.

Eva Pila, PhD

Appendix I: Psychological Baseline & Demographic Survey Measures

Demographics:

How would you describe your race?

Race refers to a socially constructed category based on a person's physical characteristics (e.g., White, Black, Asian, Latinx). You may provide more than one race.

How would you describe your ethnicity?

Ethnicity refers to a shared cultural heritage that distinguishes one group of people from another, including ancestry, a sense of history, language, religion, foods, and clothing (e.g., Japanese, Eastern European, Nigerian, Greek, Canadian). You may provide more than one ethnicity.

What is the highest degree or level of school you have completed? (If you're currently enrolled in school, please indicate the highest degree you have received).

- Less than a high school diploma
- High school diploma or equivalent (e.g., GED)
- College diploma

- Associate degree (e.g., AA, AS)
- Bachelor's degree (e.g., BA, BS)
- Master's degree (e.g., MA, MS, MEd)
- Professional degree (e.g., MD, DDS, DVM, LLB, JD)
- Doctorate (e.g., PhD, EdD)
- Prefer not to say

How would you describe your household income? If you are a student and/or a dependent, you may indicate your parents'/family's household income.

- Less than \$20,000
- \$20,000 to \$34,999
- \$35,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- Over \$100,000
- Prefer not to say

In the past year, on average, approximately how often did you consume 4 or more standard drinks on the same occasion? (A standard drink is equivalent to a 12-oz bottle of 5% alcohol beer, cider or cooler, a 5-oz glass of 12% alcohol wine, or a 1.5-oz shot of hard liquor).

- Never
- Once during the year
- Twice during the year
- Once every few months

- Approximately once a month
- Approximately 2-3 times per month
- Approximately once a week
- More than once a week
- Prefer not to say

Do you have experience with any of the following practices?

- Yoga
- Tai Chi
- Qigong
- Other mindfulness practice
- prefer not to say)

(for each selected, indicate if they currently practice, and if yes, indicate frequency: daily, 4-6 times a week, 3 or 4 times a week, once a week or less, never).

Self-Compassion Scale (SCS)

HOW I TYPICALLY ACT TOWARDS MYSELF IN DIFFICULT TIMES

Please read each statement carefully before answering. For each item, indicate how often you behave in the stated manner, using the following 1-5 scale. Please answer according to what really reflects your experience rather than what you think your experience should be.

- | Almost
never | | | | | Almost
always |
|-----------------|---|---|---|---|--|
| 1 | 2 | 3 | 4 | 5 | |
| 1. | | | | | I'm disapproving and judgmental about my own flaws and inadequacies. |
| 2. | | | | | When I'm feeling down I tend to obsess and fixate on everything that's wrong. |
| 3. | | | | | When things are going badly for me, I see the difficulties as part of life that everyone goes through. |
| 4. | | | | | When I think about my inadequacies, it tends to make me feel more separate and cut off from the rest of the world. |
| 5. | | | | | I try to be loving towards myself when I'm feeling emotional pain. |
| 6. | | | | | When I fail at something important to me I become consumed by feelings of inadequacy. |
| 7. | | | | | When I'm down, I remind myself that there are lots of other people in the world feeling like I am. |
| 8. | | | | | When times are really difficult, I tend to be tough on myself. |
| 9. | | | | | When something upsets me I try to keep my emotions in balance. |
| 10. | | | | | When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people. |
| 11. | | | | | I'm intolerant and impatient towards those aspects of my personality I don't like. |
| 12. | | | | | When I'm going through a very hard time, I give myself the caring and tenderness I need. |
| 13. | | | | | When I'm feeling down, I tend to feel like most other people are probably happier than I am. |
| 14. | | | | | When something painful happens I try to take a balanced view of the situation. |
| 15. | | | | | I try to see my failings as part of the human condition. |
| 16. | | | | | When I see aspects of myself that I don't like, I get down on myself. |
| 17. | | | | | When I fail at something important to me I try to keep things in perspective. |
| 18. | | | | | When I'm really struggling, I tend to feel like other people must be having an easier time of it. |
| 19. | | | | | I'm kind to myself when I'm experiencing suffering. |
| 20. | | | | | When something upsets me I get carried away with my feelings. |
| 21. | | | | | I can be a bit cold-hearted towards myself when I'm experiencing suffering. |
| 22. | | | | | When I'm feeling down I try to approach my feelings with curiosity and openness. |
| 23. | | | | | I'm tolerant of my own flaws and inadequacies. |
| 24. | | | | | When something painful happens I tend to blow the incident out of proportion. |
| 25. | | | | | When I fail at something that's important to me, I tend to feel alone in my failure. |
| 26. | | | | | I try to be understanding and patient towards those aspects of my personality I don't like. |

Reference

[Neff, K. D. \(2003\). Development and validation of a scale to measure self-compassion. *Self and Identity*, 2, 223-250.](#)

International Personality Item Pool (Mini-IPIP; Donnellan et al., 2006)

(unrelated to bolster cover story and mask research questions)

Please indicate how accurate each phrase is for you, using the following 1-5 scale. (insert 5-point Likert-type scale)

1. I am the life of the party.
2. I sympathize with others' feelings.
3. I get chores done right away.
4. I have frequent mood swings.
5. I have a vivid imagination.
6. I don't talk a lot. (R)
7. I am not interested in other people's problems. (R)
8. I often forget to put things back in their proper place. (R)
9. I am relaxed most of the time. (R)
10. I am not interested in abstract ideas. (R)
11. I talk to a lot of different people at parties.
12. I feel others' emotions.
13. I like order.
14. I get upset easily.
15. I have difficulty understanding abstract ideas. (R)
16. I keep in the background. (R)
17. I am not really interested in others. (R)
18. I make a mess of things. (R)
19. I seldom feel blue. (R)
20. I do not have a good imagination. (R)

IPAQ, 2002 (unrelated to bolster cover story and mask research questions)

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

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

_____ **days per week**

☐

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

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

_____ **hours per day**

_____ **minutes per day**

☐

Don't know/Not sure

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

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

_____ **days per week**

☐

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

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

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

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

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

_____ **days per week**

☐ No walking → **Skip to question 7**

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

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

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

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

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

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

Pittsburgh Sleep Quality Index (unrelated to bolster cover story/mask research purpose)

Sleep Quality Assessment (PSQI)

What is PSQI, and what is it measuring?

The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument used to measure the quality and patterns of sleep in adults. It differentiates "poor" from "good" sleep quality by measuring seven areas (components): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month.

INSTRUCTIONS:

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. What time have you usually gotten up in the morning? _____
4. A. How many hours of actual sleep did you get at night? _____
B. How many hours were you in bed? _____

5. During the past month, how often have you had trouble sleeping because you	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
A. Cannot get to sleep within 30 minutes				
B. Wake up in the middle of the night or early morning				
C. Have to get up to use the bathroom				
D. Cannot breathe comfortably				
E. Cough or snore loudly				
F. Feel too cold				
G. Feel too hot				
H. Have bad dreams				
I. Have pain				
J. Other reason (s), please describe, including how often you have had trouble sleeping because of this reason (s):				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
9. During the past month, how would you rate your sleep quality overall?	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)

Perceived Stress Scale (Cohen, 1983)

PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

	0 = Never	1 = Almost Never	2 = Sometimes	3 = Fairly Often	4 = Very Often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Appendix J: In-Lab Baseline Assessment Session – Researcher Script

“Hi, **[insert the name of the potential participant here]**, welcome to the Exercise Health & Psychology Lab. My name is [researcher name] and I will be conducting the procedures during this study on cardiovascular function and hormones.

First off, I’m going to take you through the informed consent process, so you can provide your consent to participate in the study before we start. I hope you received and had the chance to review the Letter of Information and Consent you were sent by email. I’ll provide more information about what the study entails and what would be asked of you should you choose to participate. Interrupt me at any point if you need clarification or have questions.

This is a three-part study consisting of a telephone screen and 2 lab visits. You already completed the telephone pre-screening interview. The next part of the study is an in-lab baseline assessment which is what you are here to complete today. Today’s session should take about 20 minutes. You will be asked to answer demographic questions about yourself and to fill out some psychological surveys on an iPad. Please be assured that we are taking precautions to ensure your information remains strictly confidential. The survey will ask you to input the random participant ID number you were provided during the phone screen, and only myself and other authorized research personnel running this study will have access to your personal information. You are free to select “prefer not to answer” or skip any questions you do not feel comfortable answering, and if you no longer wish to participate, you may stop filling out the surveys at any point for any reason.

This is the first of two lab sessions. You are under obligation to return to the lab if you no longer wish to participate. If you would like to continue your participation, you will be asked to return to

the lab for the second session you booked previously. This second part of the study will last about 1.75 hours and involves collecting saliva samples to measure hormones and enzymes, wearing a heart-rate monitor, taking body measurements, and answering survey questions on a computer.

During the second session, we will be measuring the hormones cortisol and osteocalcin, and the metabolic product uric acid using an oral swab method to collect saliva. You will be asked to provide 1-2mL of saliva by placing an oral swab in your mouth for 90 seconds before transferring the swab to a plastic tube. We will be collecting 5 saliva samples throughout the experiment. We will also ask you to wear a heart rate monitor for the duration of the session, so we can assess your heart-rate variability. We will take some body measurements and we will ask you to fill out computerized surveys between saliva collections. You may have the opportunity to participate in listening or writing activities which will be guided by a researcher.

We will be recruiting 60 women for this study. You will use your random identification number to protect your confidentiality. There may not be any potential benefits that come from participating in this study. Some potential risks are that there may be questions that make you uncomfortable and some of the physiological measurements may cause some distress. There is a risk of loss of confidentiality, but precautions are being taken to prevent this from happening. Only the primary researchers will be able to access personally identifying information. We are asking your permission to use the information you provided in the pre-screen, today's session and in the next session for research purposes. Should you choose to participate in the next part of the study, you will be asked to adhere to some standard lifestyle instruction for the 24 hours prior to the experiment, involving minor dietary and physical activity modifications.

Involvement in the research study is completely voluntary. You can decide not to be a part of this study at any point. There will be no penalty if you choose not to take part or quit. Providing consent to participate means that you understand the information given just now and in the letter of consent that was forwarded to you. You understand the potential benefits and risks that are involved. You have asked and received any answers to questions that you have.

This information is all outlined in detail within this Letter of Information. Please take a moment to review this letter. If after reviewing this information you decide you would like to participate in the experiment, please indicate your consent by signing at the end of the letter. You will receive a copy of the signed form. If you are not sure whether you would like to participate now, you may take the letter home for further consideration, and contact us at the listed phone number/email address should you choose to participate at a later time.

[If participant provides informed, written consent]:

(if yes)

Great! Now, I'll ask you to fill out a survey on this iPad using your random participant ID number.

(if no)

No problem! Thanks for your time and have a good day.

[Administer Qualtrics baseline demographics & psychological measures on iPad.]

Thanks for answering the survey questions. I have you scheduled to return to the lab for your second session on [insert date/time].

We ask that you adhere to some minor lifestyle adjustments in the 24 hours prior to your lab appointment. All instructions are outlined here **[provide participant with paper copy of lab preparation instructions and copy of signed LOI/C]** and I will briefly go over them with you now **[review following instructions]**.

- For the 24 hours prior to the start of your lab session, please avoid taking any drugs or medication (except contraceptives), consuming any alcohol, or engaging in intense physical exercise (such as running, weight-lifting, circuit training or sports).
- Please try to adhere to your regular sleep routine the night before your lab session, and record your bedtime and wake time.
- Please avoid drinking caffeinated beverages or engaging in exercise in the 3 hours prior to your lab session.
- Please avoid eating any food or drinking any beverage except for water in the 1 hour prior to the start of your lab session. Please also avoid brushing your teeth in the 1 hour prior to arriving at the lab.
- Please bring a sports bra and spandex shorts for the body measurements. If you do not have a suitable outfit or prefer not to bring your own, researchers will have sports bras and shorts in a range of sizes available for use at the lab.
- You may also bring quiet, non-electronic individual activities (i.e., readings, homework, books, magazines) because you may be asked to rest quietly for some portions of the lab session.

- If you are not able to adhere to these instructions prior to your lab session, please contact the investigators and we will be happy to rebook your session.

Please let me know if you have any questions or concerns about these instructions, and if a question comes to mind later, don't hesitate to reach out.

Thank you for your time!

Appendix K: Experimental Lab Session – Procedures & Researcher Script

Baseline Data Collection (minutes 0-15)

[Participant arrival]

“Welcome to the lab session today! Thank you for your participation in our study.

“As we discussed during the informed consent process at the pre-screening session, this study aims to understand the relationships between hormones and cardiovascular function. We will be collecting your heart-rate data, saliva samples and survey responses. The entire session should last ~1 hour and 45 minutes.

“First, I’ll ask you some baseline questions about your recent sleep, diet, lifestyle and health. I’ll record the data into an iPad while we talk. Then, I’ll fit you with a chest-strap heart-rate monitor and start collecting heart-rate data, including a baseline measurement. We’ll take a baseline saliva sample, and then I’ll ask you to fill out a brief survey on the lab iPad. After that, we will spend 30 minutes doing some activities which may include mindfulness and writing exercises or quiet rest. I’ll ask you to fill out another brief computer survey, and then we’ll take some body measurements. Finally, we will ask you to fill out one more survey and we will collect 4 more saliva samples each spaced 10-15 minutes apart, in between which you can rest and engage in quiet activities like reading. We will be taking a total of 5 saliva samples and we will ask you to fill out three surveys.

“You are free to withdraw from the study at any time for any reason, at which point any information collected from you will be destroyed. Furthermore, should you consent to participate, all information collected from you will remain strictly confidential.

“Do you have any questions at this time?”

YES: Answer any questions they may have.

NO: “Great, if you do have any questions or concerns at any point throughout the study, don’t hesitate to let me know. Let’s get started.”

[enter private room]

“First we are going to go through some baseline questions about your lifestyle today and yesterday and your recent health. Please answer to the best of your ability. I’ll note your responses on this iPad.

[Administer experimental session baseline verbal survey]

“Great, thanks for answering those questions. Now we will fit you with a heart-rate monitor, so we can begin collecting your heart-rate data. Please follow me to this private room so I can set you up with the heart-rate monitor.”

“This is a Polar H10 Heart-Rate sensor. This strap goes around your chest, and there are two electrodes on the monitor that collect information about your heart beats using ECG. I will just dampen the electrode surface on the monitor with water using this wet cloth, and then I’ll ask you to fasten the monitor snugly around your chest, right underneath where you would wear your bra. You wear this watch to record the heart-rate data. Please let me know if you have any questions or would like help securing the heart-rate sensor.”

[participant puts on HR sensor, researcher verifies that HR sensor is recording properly]

“Great, the HR sensor is recording properly. The signals picked up by these monitors can be affected a bit by movement, so we ask that you please try to minimize unnecessary motion while sitting or standing still. I’ll ask you to stand here for several moments so I can verify that the sensor is properly recording and take a baseline measurement.

[Start Timer (At 5 min, record time/start hrv)- Start 5-min acclimatization period followed by 5-min baseline standing HRV measurement – participants unaware that baseline measurement has started. Researcher will denote precise start/stop time of baseline measurement it can be identified later in HRV data. Researcher will sit at a computer in same room as participant but facing the wall while participant waits quietly.]

“Alright, thanks for waiting. Now we will collect your first saliva sample. Please hold this swab in your mouth under your tongue, and try your best not to swallow so the swab can collect your saliva. I’ll start a timer for 90 seconds. Then, please place the swab in this plastic tube and I’ll put it in the storage rack in the fridge.”

[take baseline saliva sample]

“Now we have a brief online survey for you to fill out. Please use this iPad and answer the survey questions to the best of your ability. You are free to select “prefer not to answer” if you do not feel comfortable answering.”

[complete baseline psychological measures (state distress, state body emotions, state shame and guilt, internalized weight bias) on Qualtrics]

Acute Intervention (minutes 15-45)

[Researcher opens envelope with participant’s anonymous ID number to check randomization into condition]

“Thanks for filling out the questionnaire. Over the next 30 minutes you will be completing some activities [insert either guided activities or quiet rest, depending on condition].”

Over the next 30 minutes, participants who were randomized into the self-compassion condition will be guided through the 30-minute acute intervention. Participants randomized into the attention control condition will engage in 30 minutes of guided activities intended to maintain their attention and allow for the isolation of compassion-specific effects of the experimental condition. Participants in the no-intervention control group will be asked to sit quietly for 30

*minutes. They can read neutral magazines provided or work on pen-and-paper homework, but will be asked not to use outside electronic devices or communicate with anyone external. *Please see intervention outlines attached to application for detailed procedures for the self-compassion intervention and attention control.*

Control

Over the next 30 minutes, you will be asked to sit quietly for 30 minutes. You can read the magazines provided or work on pen-and-paper homework, but you cannot use outside electronic devices or communicate with anyone external.

Manipulation Check (minute 45)

“Great, thank you for your participation in those activities. Now, I will ask you to complete a second brief online survey on this iPad.”

[complete a measure of state self-compassion and repeat state psychological measures taken at baseline (state distress, state body emotions, state shame and guilt, internalized weight bias) on Qualtrics]

Weight Stigma Induction (minutes 45-60)

[enter research “assistant”]

“This is [research assistant name], who will be assisting me with the next part of the study. We are going to complete some body measurements.

“I will now assess your body fat with a standard body composition test – a 3-site skinfold test. For this test, I will ask you to change into your sports bra and spandex shorts. If you didn’t bring an outfit, I can provide you with a sports bra and spandex shorts in your size [show the participant(s) example of clothing]. You will be able to change privately. Once changed, I will conduct the body fat test. I am going to landmark three sites on your body – at the iliac crest or around the hip at the belly, the back of your arm at your triceps, and the mid part of your thigh. I will then pinch the fat that is underneath your skin and use the calipers [showed calipers] to get a skinfold measurement. I will also take your height and weight. I will record these measurements and use them to calculate your percent body fat using an equation on a computer program. If you would like to me to get you an outfit, give me your size for the shorts and bra, and I will get my assistant to grab the clothing.

[participant acquires change of clothing they brought/provided by researchers. Participant changes in private room, and then enters the room with the researcher and research assistant where the body measurements will take place].

“Is your heart-rate sensor still secured snugly? I can help if you need any assistance adjusting it or making sure it’s still secure.

[Verify HR monitor]

“Great, the heart-rate sensor is still recording properly. Please stand still while we take the skinfold measurements.”

Researcher takes each of the three skinfold measurements using a pair of calipers and reads each measurement aloud. Research assistant verbally repeats each value and then records it on a clipboard. Repeat same procedure for height and weight measurements. The assistant will denote the start and stop times of each component of the assessment (i.e., calipers, height, weight).

If participant challenges or objects to any part of the anthropometric assessment (e.g., asks technician not to read out values, asks if they can undergo assessment without wearing the sports bra/spandex shorts, etc.) the following response will be delivered:

“Unfortunately it is very important that we adhere to a strictly standardized protocol, so we cannot modify any aspects of this study. If you are not comfortable with this protocol, please know you may discontinue your participation at any time.”

Participants who still do not want to go through the anthropometric assessment may withdraw from the study at this point, and will be debriefed and compensated.

Outcome Measure Collection (minute 60)

“Thanks for helping us take those body measurements. Now, I’ll ask you to provide another saliva sample using the exact same procedure as before.”

[collect saliva sample]

“Thank you. Now I’ll ask you to fill out one final online questionnaire on the computer.”

[complete outcome psychological measures (state distress, state body emotions, state shame and guilt, internalized weight bias) on Qualtrics]

Recovery (minutes 60-95)

“Thank you for filling out the last questionnaire. You may now change back into your regular clothes. Please be careful to keep the heart-rate sensor attached snugly.”

[participant changes privately]

“Great, now I will ask you to sit and wait quietly. Over the next 35 minutes, we will collect 3 more saliva samples spaced 10-15 minutes apart. In between samples you may rest, read, complete pen-and-paper homework, or browse the provided magazines. We ask that you please refrain from using outside electronics until the study is complete.”

[Participant waits quietly. Saliva samples collected at 10, 20 and 35-minutes into recovery stage.]

Debriefing (minutes 95-105)

[after collecting last saliva sample]

“That was the last saliva sample we will be collecting. The experimental session is now over.

Thanks for your participation! Now, we will go through the debriefing process. I’m going to ask you a few brief questions about your perceptions of today’s study, and then I’ll explain more about the study purpose and why we had you complete today’s activities. Please let me know if you have any questions or concerns.”

Researcher ask participant open-ended funnel questions to assess participant experience and believability of cover story. Researcher will inform participants of the true purpose of the study, go over the debriefing letter, provide participant with psychological resources, and provide compensation (Please refer to debriefing procedures detailed in HSREB application for more information).

Appendix L: In-Lab Baseline Data Collection/Eligibility Confirmation – Verbal Survey

(Researcher Facing)

1. Please provide your participant ID number.

Sleep:

2. Have you been awake for at least 4 hours?
3. What time did you fall asleep last night?
4. What time did you wake up this morning?
5. On an average day, what time do you wake up in the morning?
6. On a typical day, how many hours of sleep do you get?
7. Rate your average sleep quality on a scale from 1-5.

Contraceptives:

8. What type of oral contraceptive do you take?
9. Are you currently taking the active dose of your oral contraceptive? If yes, how many days have you been on the active dose?
10. How many days has it been since your last period?

Food/drink:

11. Did you consume any caffeine today, and if so, how much?
12. Have you consumed any alcohol in the last 24 hours?
13. Have you chewed any gum within the past 1 hour?
14. List all food and drink you've consumed today (besides water) with approximate times.

Drugs/medication:

15. Have you used any recreational drugs in the past 3 days?
16. Have you taken any over-the-counter or prescription medications (other than contraceptives) in the last 48 hours? If so, please detail the name, time/date taken, dosage and reason for taking.

Activities:

17. When was the last time you exercised? What physical activities did you perform?

General Health:

18. Do you currently have an upper respiratory infection (i.e., a cold)?
19. Have you had any signs of fever in the last 3 days?
20. Have you had any surgeries using general anesthesia in the last 2 weeks?
21. Have you had a broken bone within the last 2 weeks?
22. Are you currently taking antibiotics or other medicines for any acute infection?

Oral Health:

23. Do you have any open sores or abrasions in your mouth (i.e., cuts, canker sores, cavities, etc.)?
24. Have you been to the dentist in the last 48 hours?
25. Do you have braces?
26. When you brush your teeth, do you typically see any signs of bleeding (i.e., reddish-pink colour when you spit in the sink)?
27. How many times per day do you usually brush your teeth?

28. How many times per day do you usually floss?

29. Have you brushed your teeth or flossed within the last 2 hours?

COVID-Specific Screening

- a. Do you currently have a cough?
- b. Do you have a fever and/or do you feel feverish/chills?
- c. Do you have shortness of breath?
- d. Are you experiencing any other flu-like symptoms? For example:
 - a. Sore throat
 - b. Runny or stuffy nose
 - c. Muscle/body aches
 - d. Headache
 - e. Fatigue (tiredness)
- e. Have you been in direct contact with anyone who has or is suspected of having COVID-19 in the past 14 days?
- f. Have you had close contact with anyone who has a confirmed case of COVID-19 in the past 14 days?
- g. Have you tested positive for COVID-19?

Have you travelled out of province or internationally within the last 14 days?

Appendix M: Self-Compassion Presentation Script

Researcher (R): “For the next 30 minutes, I’m going to guide you through some self-compassion activities that will involve meditation and writing. Because self-compassion may be a new concept to you, I’ll start by providing a brief overview of what self-compassion is and how being compassionate towards ourselves can help us in our lives.”

Part 1: Self-Compassion Psychoeducation (5 mins)

[Researcher will present the following brief introduction to self-compassion accompanied by the attached slides.]

Adapted from:

“Module 1: Understanding Self-Compassion” in Saulsman, L., Campbell, B., & Sng, A. (2017).

Building Self-Compassion: From Self-Criticism to Self-Kindness. Perth, Western Australia:

Centre for Clinical Interventions.

Neff, K. (2021). “Definition of Self-Compassion.” Self-Compassion.org. Retrieved from

<https://self-compassion.org/the-three-elements-of-self-compassion-2/>

R: What is self-compassion?

“To define self-compassion, we really need to start with what is compassion. The two are really one and the same. Compassion is an attitude that involves a certain set of feelings, thoughts, motives, desires, urges, and behaviours that can be directed towards any living thing.

“Leading compassion researcher Paul Gilbert defines compassion as: “a basic kindness, with a deep awareness of the suffering of oneself and of other living things, coupled with the wish and effort to relieve it” (Gilbert, 2009, p. xiii)

“Essentially, self-compassion is compassion directed towards ourselves.

[Next Slide]

“Self-compassion is comprised of three main elements.

“Firstly, it involves Self-Kindness; or being warm and understanding towards ourselves when we suffer, fail or feel inadequate, instead of ignoring our pain or criticizing ourselves.

“Secondly, self-compassion involves recognizing our Common Humanity. Instead of feeling alone when we suffer, a self-compassionate attitude recognizes that feeling pain, vulnerability and personal inadequacy is a universal part of the shared human experience that we all experience.

“Finally, self-compassion involves being Mindful. This means taking a non-judgmental, receptive mind state where we can observe and accept our thoughts and feelings for what they are, instead of trying to suppress them. At the same time, being mindful means we don’t “over-identify” with our thoughts and feelings, so we can experience pain and suffering without becoming overwhelmed by these negative emotions.

[Next Slide]

“Why is Self-Compassion Important?”

“The need to receive care and nurturing evolved as a strong need within all mammals, including humans. Being cared for from birth is vital to our survival, and without it we don’t thrive. While it is very important to receive care from other people, we can help fulfill our own needs for care and nurturing with self-compassion.

“Accordingly, self-compassion can bring great benefits for our mental health and well-being. People who are compassionate towards themselves generally experience less mental health problems, like depression, anxiety and stress. They also tend to have a better quality of life, a greater sense of well-being, and less problems in relationships. In fact, there is evidence that self-compassion can trigger the release of oxytocin, a hormone that promotes bonding, closeness and calmness.

“The reason why self-compassion might bring us such wonderful benefits is via its vital role in helping to balance our emotions. Theorists propose that our emotions are governed by three systems known as the threat, drive and soothe systems, with each playing an important role in regulating our emotions. These emotional response systems evolved to motivate us to protect ourselves, to work towards goals, and to form social bonds. But a lot of people experience over-active threat and drive systems, which can cause negative feelings like stress, anxiety, anger and depression. Self-compassion can help by activating our soothe system, which calms the threat and drive systems.

“Why is it hard to be self-compassionate?”

“Though self-compassion has all these wonderful benefits, many of us find it doesn’t come naturally to treat ourselves with compassion. Instead, we tend to be self-critical, a thinking style that involves our internal self-talk being highly negative, disparaging and berating. This activates the threat system. In fact, we often get stuck in a self-critical cycle, which keeps us stuck in and our emotional suffering.

“Self-compassion is an alternative to self-criticism. But being self-compassionate is hard for most of us for various reasons. For instance, if we didn’t experience enough care, kindness and nurturing from others while we were growing up, our soothe system can be underdeveloped and we have to learn how to be more compassionate towards ourselves later in life. Our brains can also get so stuck in threat mode that we default to seeing things negatively, which means it can take a lot of effort to overturn this automatic response and respond to ourselves with more self-compassion, especially when we are upset. Many of us may not even be aware that we are struggling, or when we are being critical towards ourselves. Or maybe we think that self-compassion sounds weak, narcissistic or self-pitying. Rest assured that is it not. Self-compassion just means you are treating yourself with kindness and caring the same as you would treat a friend, and it can improve our lives in many ways. Everyone can benefit from a bit more self-compassion.

Part 3: Compassionate Writing Activity (10 mins)

[Researcher will provide participants with a paper copy of the following instructions, along with a pen and blank paper on which to write a compassionate letter to themselves.]

Adapted from: Neff, K. (2021). "Exercise 3: Exploring self-compassion through writing." Self-Compassion.org. Retrieved from <https://self-compassion.org/exercise-3-exploring-self-compassion-writing/>

COMPASSIONATE LETTER TO MYSELF

- o Everybody has something about themselves that they don't like; something that causes them to feel shame, to feel insecure, or not "good enough." Try thinking about an issue you have that tends to make you feel inadequate or bad about yourself (physical appearance, work or relationship issues, a mistake you have made...)
- o Now think about an imaginary friend who is unconditionally loving, accepting, kind and compassionate. Imagine that this friend can see all your strengths and all your weaknesses, including aspects of yourself that you don't like. Reflect upon what this friend feels towards you, and how you are loved and accepted exactly as you are, with all your very human imperfections. This friend recognizes the limits of human nature, and is kind and forgiving towards you. In his/her great wisdom this friend understands your life history and the millions of things that have happened in your life to create you as you are in this moment. Your particular inadequacy is connected to so many things you didn't necessarily choose: your genes, your family history, life circumstances – things that were outside of your control.

- o Write a letter to yourself from the perspective of this imaginary friend – focusing on the perceived inadequacy you tend to judge yourself for. What would this friend say to you about your “flaw” from the perspective of unlimited compassion? How would this friend convey the deep compassion he/she feels for you, especially for the pain you feel when you judge yourself so harshly? What would this friend write in order to remind you that you are only human, that all people have both strengths and weaknesses? And if you think this friend would suggest possible changes you should make, how would these suggestions embody feelings of unconditional understanding and compassion? As you write to yourself from the perspective of this imaginary friend, try to infuse your letter with a strong sense of his/her acceptance, kindness, caring, and desire for your health and happiness.

Appendix O: Debriefing Open Funnel Questions

1. What are your general thoughts and reactions to participating in this study?
2. How did you feel when participating in this study?
3. What do you believe is the purpose of this study?

Additional questions to be asked after participant is debriefed and the true purpose of the study is revealed:

4. What is your reaction to learning the true purpose of the study?
5. How do you feel about your participation in the study now that you have learned the true purpose?
6. Would you participate in a study like this again? Why or why not?

Appendix P: Debriefing Letter

Project Title: Psychobiological Processes in Social Evaluation

Principal Investigator: Dr. Eva Pila

Thank you for your participation in this study.

This study is testing whether an acute self-compassion intervention can help reduce the physiological and psychological stress of a potentially weight-stigmatizing situation. This is a pilot study primarily aimed at establishing the feasibility of the experimental protocol you participated in today. Although you were told that the purpose of the study was to investigate cardiovascular function and hormones, you were not informed that the body composition assessment was intended to induce psychosocial stress related to the evaluation of your body. We could not make you aware of the true purpose of the body composition assessment ahead of time because it may have impacted your stress response.

Research suggests that weight stigma leads to physiological and psychological stress for individuals who perceive themselves as higher-weight. When experienced repeatedly over time, these stigmatizing situations are thought to contribute to negative health outcomes experienced by higher-weight people. Although body composition assessments are very common in healthcare and physical activity settings, research suggests these procedures can be distressing and stigmatizing, especially for higher-weight individuals. We used a series of questionnaires to assess the emotions (including distress and shame) you experienced in response to the body composition assessment. We also collected saliva samples and heart rate data from you to study your body's

physiological stress response by measuring the stress biomarkers cortisol, osteocalcin, uric acid and heart-rate variability.

You were invited to take part in this study because you indicated during the screening interview that you self-identified as “average” or “heavier-weight.” You participated in a standardized body composition assessment that has previously been shown to elicit feelings of shame and distress as well as biological stress. To see whether a self-compassion intervention could reduce the negative response to the body composition assessment, we randomly assigned all participants to complete either a 30-minute self-compassion intervention or 30 minutes of neutral control activities. This experimental design allows us to compare the stress responses of participants who completed different activities, to see if the self-compassion activities reduced stress during and after the body composition assessment when compared to the control activities. We expect that on average, participants who did the self-compassion activities will show lower negative emotions and lower biological stress compared with participants who did the neutral activities. It was important that you not know what the study is testing or that you were placed into an experimental condition because it could have influenced your responses to the experiment.

The protocol used to induce weight stigma was a standardized body composition assessment that is commonly used as an index of health in medical, research and physical activity contexts.

Research shows that such procedures can be stressful, stigmatizing, and do not provide much useful information about a person’s health status. We do not endorse the belief that higher-weight individuals are necessarily unhealthier or less fit than are lower-weight individuals. We are doing this research to help understand why weight stigma is harmful, and to 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 let the researchers know. You can also contact us to withdraw in the future, up until this work has been published.

Your data is fully anonymous, and all data we recorded from your participation in this study will remain confidential. 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 us 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:

Principal Investigator: Eva Pila

Student Investigator: Madeline Wood

Student Investigator: Karen Leung

Co-Investigator: Lindsay Bodell

Body Image and Health Lab

It is understandable that you may feel negative emotions after participating in this experiment. The study protocol can be distressing for individuals. If you feel this distress is difficult to manage, we recommend that you seek support from the follow-up resources provided below.

Student participants may access Western University's Student Health Services and Psychological Services. Student and community participants may access community-level mental health supports, including crisis telephone lines, which may be called at any time 24/7 whenever a person is experiencing distress. If after completing this study, you require psychological support, please do not hesitate to reach out:

Mental Health Support Resources

Health and Wellness at Western University

Monday-Friday, Daytime

Psychological Services

4th floor, Room 4100

Student Services Building

Student Health Services

UCC Room 11 (lower level)

Reach Out 24/7

<https://reachout247.ca>

24-hour phone crisis assistance

Crisis Services Canada

<https://www.crisisservicescanada.ca>

Crisis line and national network of crisis services

First Nations and Inuit Hope for Wellness Help Line

24-hour culturally relevant telephone crisis intervention counselling

Canadian Mental Health Association – Mental Health and Addictions Crisis Centre

648 Huron St., London ON

We also recommend you check out the following online resources to learn more about self-compassion and how you can practice self-compassion in your everyday life.

- <https://self-compassion.org/>
- <https://centerformsc.org/>
- <https://mindfulcompassion.com/>

If you have questions about your rights as a research participant, you should contact the Office of Human Research Ethics.

Thank you again for your time and participation. It is greatly appreciated! We will follow up with you via email in the next 24 hours. If you are experiencing any negative thoughts or feelings about the study, we encourage you to contact us.

Eva Pila, PhD

Assistant Professor, School of Kinesiology

Faculty of Health Sciences, Western University

*This survey will be repeated a total of 3 times during the experimental session: at baseline, immediately after the self-compassion intervention/control intervention, and immediately after the stressor (i.e., body composition assessment). Participants will complete this survey on an iPad.

Please provide your participant ID number _____

Subjective State Distress

(Modeled on Subjective Units of Distress Scale; Wolpe, 1990)

“How distressed do you feel right now?”

Respond on a visual analogue scale from 0-100.

Body Emotions Scale

(purpose-built for this study)

5-point scale from 1 (very slightly or not at all) to 5 (extremely)

Indicate to what extent you feel this way about your weight RIGHT NOW IN THIS VERY MOMENT.

1. I feel ashamed of my weight.
2. I feel guilty that I don't do more to improve my weight.
3. When I compare my weight to others, I feel envious.
4. I feel embarrassed about my weight.

State Shame and Guilt Scale (SSGS)

(Marschall et al., 1994)

5-point scale: 1 = I do not feel this way at all; 3 = I feel this way somewhat; 5 = I feel this way very strongly

The following are some statements which may or may not describe how you are feeling **right now**. Please rate each statement using the 5-point scale below. Remember to rate each statement based on how you are feeling **right at this moment**.

1. I feel good about myself.
2. I want to sink into the floor and disappear.
3. I feel remorse, regret.
4. I feel worthwhile, valuable.
5. I feel small.
6. I feel tension about something I have done.
7. I feel capable, useful.
8. I feel like I am a bad person.
9. I cannot stop thinking about something bad I have done.
10. I feel proud.
11. I feel humiliated, disgraced.
12. I feel like apologizing, confessing.
13. I feel pleased about something I have done.
14. I feel worthless, powerless.
15. I feel bad about something I have done.

Modified Weight Bias Internalization Scale (WBIS-M)

(Pearl & Puhl, 2014)

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

Each of the statements below refer to your perceptions of your weight. Using the scales provided, please indicate to what extent you agree or disagree with each of the statements **RIGHT NOW, IN THIS VERY MOMENT**.

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.

Name:	Karen Leung
Post-Secondary Education and Degrees:	<p>Western University London, Ontario, Canada 2017-2021 B.A. Honours Specialization in Kinesiology, Minor in Psychology</p> <p>Western University London, Ontario, Canada 2021- Present M.A. in Psychological Basis of Kinesiology</p>
Related Work Experience	<p>Research & Evaluation Intern Jack.org Jan 2022 – May 2022</p> <p>Research Assistant Body Image & Health Research Lab – Western University 2021 – 2022</p> <p>Teaching Assistant School of Kinesiology, Western University 2021 – 2023</p> <p>Student Researcher International Centre for Olympic Studies – Western University 2020 – 2021</p> <p>Practicum Intern Nourished Beginnings Sept 2020 – Dec 2020</p>
Honours and Awards:	<p>Ontario Graduate Scholarship 2022 - 2023</p> <p>Western Graduate Scholarship 2022 – 2023</p> <p>Kinesiology Graduate Travel Award 2022</p> <p>Mental Health Research Canada – Mitacs Accelerate Fellowship (2022)</p>

Western Graduate Research
Scholarship (2021-2022)

Ontario Graduate Scholarship
(2021-2022)

Undergraduate Summer Research
Internship Award (2021)

Publications

Refereed Conference Papers:

Sick, K., Gilchrist, J., Leung, K. K., & Pila, E. (2021). Do momentary body-related emotions predict movement time? Evaluating concurrent and time-lagged relations using experience sampling. *Journal of Exercise, Movement, and Sport*. 52(1).
<https://www.scapps.org/jems/index.php/1/article/view/2468>

Published Manuscripts:

Leung, K. K., Sick, K., Huellemann, K., & Pila, E. (2023). Longitudinal relations between body image flexibility and exercise motivation: A two-sample replication study. *Body Image*, 46, 212-222. <https://doi.org/10.1016/j.bodyim.2023.06.006>

Manuscripts in Preparation:

Leung, K. K., Sutton, M., Thai, M., & Pila, E. (In Preparation: *Body Image*). Exploring the #Ozempic viral trend on TikTok.

Academic Conferences and Presentations:

Leung, K. K., Huellemann, K., Sick, K., & Pila, E. (2022, May). *Longitudinal relations between body image flexibility and exercise motivation: A two-sample replication study*. Paper presented at the 2022 NASPSPA Annual Conference. Waikoloa, United States.