WEIGHT STIGMA AND ACCULTURATION IN RELATION TO HAIR CORTISOL AND BINGE EATING IN ASIAN AMERICANS WITH OVERWEIGHT AND OBESITY

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A dissertation submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Nursing.

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ABSTRACT

Ya-Ke (Grace) Wu: Weight Stigma and Acculturation in Relation to Hair Cortisol and Binge Eating in Asian Americans with Overweight and Obesity
(Under the direction of Diane C. Berry)

Weight stigma is a pervasive social problem in Americans, but little is known about its impact on hypothalamic-pituitary-adrenal (HPA) axis activity and binge eating behaviors among Asian Americans. The aims of the study were to 1) examine the relationship between weight stigma and hair cortisol among Asian Americans with overweight and obesity; 2) examine the relationship between weight stigma and binge eating among Asian Americans with overweight and obesity; 3) examine whether the level of acculturation moderates the relationships of weight stigma with hair cortisol and binge eating among Asian Americans with overweight and obesity. Using a cross-sectional study design, data were collected from a convenience sample of 166 Asian American adults with overweight and obesity living in North Carolina, United States (U.S.). The participants primarily identified as first generation (94%), had a mean age of 45.7 years, and a mean body mass index of 26.6 kg/m^2. A 50 milligrams hair sample, height and weight, demographic data, hair-related data, the frequency of weight stigma, binge eating, level of acculturation for Asians, perceived racial discrimination for Asians, and perceived stress was collected. Description analysis, between-groups comparison, Spearman correlation coefficients, and multiple regression analyses were used for all aims. The results demonstrated that weight stigma was negatively correlated with hair cortisol and positively correlated with binge eating. After adjusting for age, perceived racism and perceived stress, weight stigma demonstrated a negative association with hair cortisol, but this result was not statistically significant. After adjusting for age, BMI, years lived in the U.S., perceived racism and perceived stress, weight stigma was significantly associated with binge eating. The level of acculturation did not significantly moderate the relationships of weight stigma with hair cortisol and binge eating after adjusting for age, BMI, years lived in the U.S., perceived racism and perceived stress. The findings highlighted the importance of alerting the public regarding the negative effects of weight stigma and including Asian American communities as targets of anti-weight bias interventions to decrease bullying and stigmatization toward Asian Americans with overweight and obesity.

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LIST OF ABBREVIATIONS

ACTH	Adrenocorticotropin Hormone
APA	American Psychiatric Association
BES	Binge Eating Scale
BMI	Body Mass Index
CBG	Cortisol Binding Globulin
CCMC	Chinese Christian Mission Church
CI	Confidence Interval
cm	Centimeter
CRH	Corticotropin-Releasing Hormone
DST	Dexamethasone Suppression Test
EFCNC	Evangelical Formosan Church of North Carolina
EIA	High-Sensitivity Enzyme Immunoassay
ELISA	Enzyme Linked Immunosorbent Assay
FACSS	Friendship Association of Chinese Students and Scholars Association
kg	Kilogram
HPA	Hypothalamic-Pituitary-Adrenocortical Axis
HPLC	High Performance Liquid Chromatography
IA	Immunoassays
IRB	The Institutional Review Board
M	Mean
N.C.	North Carolina
nmol/l	Nanomole/Liter
pg/mg	Picogram Per Milligram

PI	Principal Investigator
PRISMA	The Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PSS	Perceived Stress Scale
RCCC	Raleigh Chinese Christian Church
SABR-A^2	The Subtle and Blatant Racism Scale for Asian Americans
SAS	Statistical Analysis System
SD	Standard Deviation
SL-ASIA	The Suinn-Lew Asian Self-Identity Acculturation Scale
SPSS	Statistical Package for Social Sciences
SSI	The Stigmatizing Situations Inventory
SSIO	The Stigmatizing Situations Inventory from Others
SSIP	The Stigmatizing Situations Inventory from People
TAA-NC	Taiwanese Association of America -North Carolina Chapter
µg/dl	Micrograms Per Deciliter
U.K.	United Kingdom
UNC-CH	The University of North Carolina at Chapel Hill
U.S.	The United States
WHO	The World Health Organization
WSAW	Weight Stigma Awareness Week

CHAPTER 1: INTRODUCTION

Introduction

The purpose of chapter one is to examine what has been well established in the field of weight stigma research, particularly as it relates to Asian Americans, and to identify gaps in what is known. The background section addresses the problem of obesity among Asian Americans and the influence of acculturation and weight stigma. This followed an in-depth review of the relationship between weight stigma and hypothalamic-pituitary-adrenocortical axis activity, weight stigma and binge eating. The chapter ends with a statement of the study's purpose and aims, study framework, and definition of key terms.

Background

Obesity is an important public health concern for Asian Americans in the United States (U.S.; Jih et al., 2014). The number of Asian immigrants living in the U.S. was 12,176,983 in 2012 (Migration Policy Institute, 2013). The prevalence of overweight and obesity is increasing rapidly among Asian Americans living in the U.S. and ranges from 38.6 to 78.6% (Jih et al., 2014). The World Health Organization (WHO) defines overweight in Asian Americans as a body mass index (BMI) of 23.0 to 27.5 kg/m^2 and obesity as a BMI >27.5 kg/m^2 (WHO, Expert Consultation, 2004). Asian Americans include those of Filipino, Japanese, Chinese, Korean, South Asian, and Vietnamese descent, all of whom have been found to have a significantly higher BMI than foreign-born Asian Americans except South Asians (Rosas, Sanchez-Vaznaugh, & Sanchez, 2014). Asian immigrants who have been in the U.S. for less than 15 years have a lower BMI compared to those who have been in the U.S. longer than 15 years after adjusting for demographics (i.e. age, gender, marital status), socioeconomic factors (i.e. income and education), and behavioral factors (i.e. smoking, alcohol consumption, and physical activity) (Rosas et al., 2014).

The rapid increase in the number of Asian immigrants in the U.S. and the increasing prevalence of overweight and obesity raise concerns about the potential negative impact of weight stigma in this population. Weight stigma is defined as individuals with overweight and obesity experiencing negative comments, physical abuse or being treated unfairly secondary to having overweight or obesity (Puhl, Moss-Racusin, Schwartz, Brownell, 2008; Puhl & Heuer, 2009; Puhl & Heuer, 2011). Many Asian cultures foster high levels of social pressure related to body image (Stephen & Perera, 2014). Cultural values equate thinness with beauty and popularity, making overweight and obesity undesirable conditions (Stephen & Perera, 2014). A study conducted with Asians found that lower BMI and smaller body size were considered attractive by Asian men and women and concluded that media images of thinner people might affect perceptions of attractiveness (Stephen & Perera, 2014). Weight stigma research in western populations has been well established (Puhl & Heuer, 2009; Puhl & Heuer, 2011). However, little is known about its impact on Asian Americans' health outcomes.

Acculturation to U.S. culture may influence the experience of weight stigma among Asian Americans. Acculturation is a process in which members of one cultural group adopt the beliefs and behaviors of another group (Bharmal et al., 2014). When Asian immigrants transition from living an Asian lifestyle to a U.S. lifestyle, they start the process of acculturation (Bharmal, Hays, & McCarthy, 2014). The level of acculturation for Asians may be related to their body image perception (Guan, Lee, & Cole, 2012). Asian American women who more versus less strongly identify with Asian culture may focus on a thinner ideal body size (Guan et al., 2012). Despite the important influence of acculturation, limited research has examined the impact of acculturation on weight stigma issues in Asian American populations.

Weight stigma can be a very painful personal experience, and individuals with overweight or obesity may experience stigmatization repeatedly over their lifetime (Puhl et al., 2008; Puhl & Heuer, 2009; Puhl & Heuer, 2011). Although the causes of obesity are complex and may be beyond the scope of an individual's control (Butler, McGuire, & Manzardo, 2015), many people believe that weight control is just an issue of personal willpower and blame and stigmatize people with overweight and obesity (Salsman, 2012). Approximately 20.5% of individuals with overweight and obesity have reported experiencing weight stigma in the U.S. (Levy & Pilver, 2012). The experience of weight stigma may be even higher in Asian populations (Wu & Liu, 2015). More than 95% of Taiwanese adults with overweight or obesity have experienced weight stigma at least once in their lifetime (Wu & Liu, 2015).

The health impact of weight stigma has been well documented (Papadopoulos & Brennan, 2015). Individuals with overweight and obesity who experience weight stigma may have adverse psychological health consequences such as increased binge eating (Puhl et al., 2017), depressive symptoms (Najjar, 2013), anxiety disorders (Savoy, Almeida, Boxer, 2012), body image dissatisfaction (Latner, Wilson, Jackson, & Stunkard, 2009), and decreased self-esteem (Hunger & Major, 2015). Moreover, weight stigma can also contribute to adverse physiological health consequences such as the development of obesity (Jackson, Beeken, & Wardle, 2014), higher cardiovascular reactivity (Major, Eliezer, & Rieck, 2012), and high risk of developing type 2 diabetes (Tsenkova, Carr, Schoeller, & Ryff, 2011). However, little is known about the impact of weight stigma on Asian American populations' psychological and physical health.

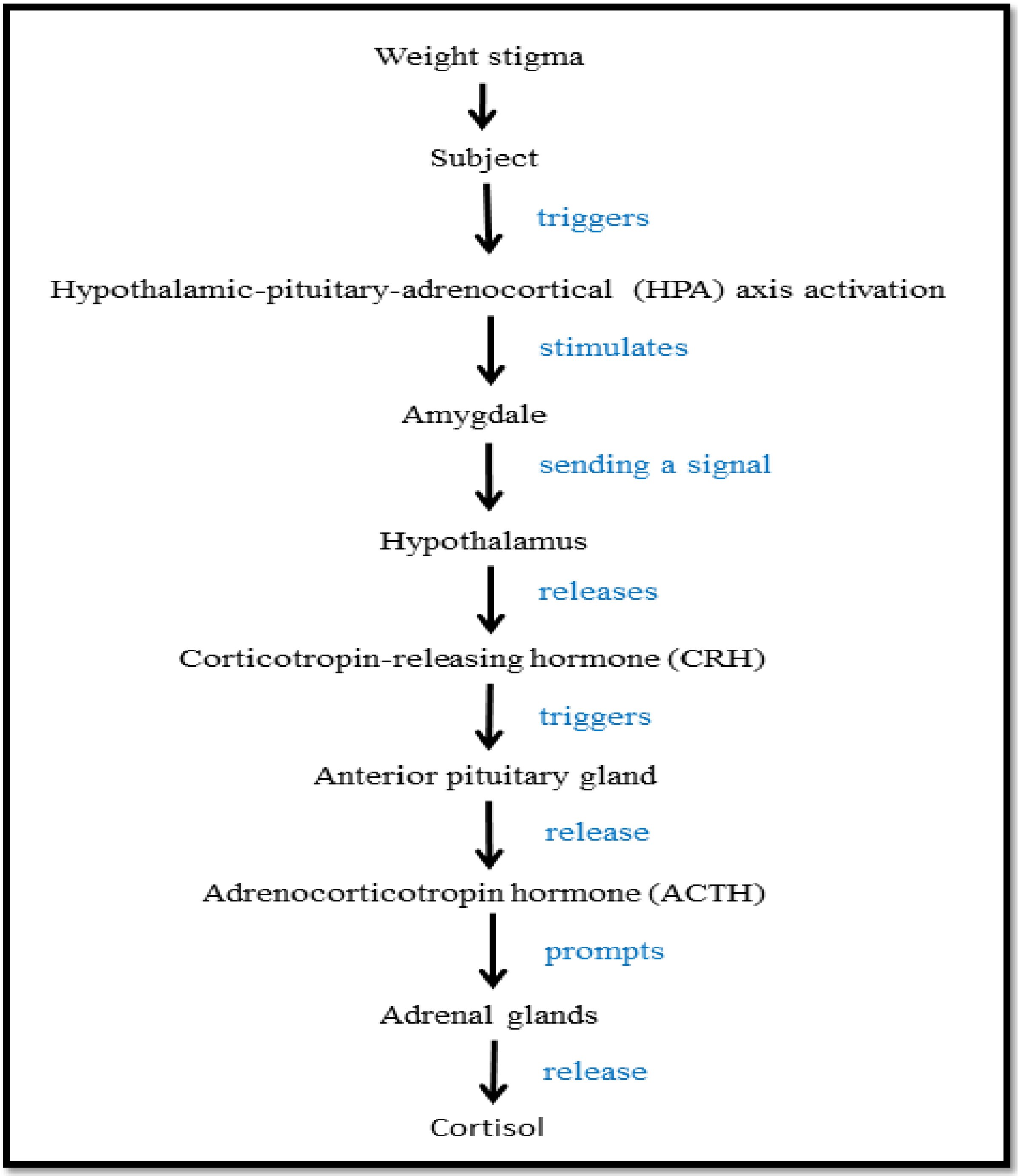
In recent studies, researchers have shown that there is a relationship between weight stigma and short-term hypothalamic-pituitary-adrenocortical (HPA) axis response by analyzing salivary cortisol samples (Himmelstein, Incollingo Belsky, & Tomiyama, 2014; Schvey, Puhl, & Brownell, 2014). The impact of weight stigma on long-term HPA axis activity also needs to be studied given the fact that weight stigma is a chronic stressor that individuals with obesity experience repeatedly over time(Levy & Pilver, 2012).

Weight Stigma and Hypothalamic-Pituitary-Adrenocortical Axis Activity

Weight stigma may be considered a stressor that causes cortisol levels to increase by triggering HPA axis activation (See Figure 1.1; Dickerson & Kemeny, 2004), which can lead to adverse health outcomes such as a high risk for developing type 2 diabetes and poor glycemic control (Tsenkova et al., 2011) or damaged neurons in the hippocampus resulting in impaired memory (Kolb & Whishaw, 2006). Cortisol is a stress hormone and the end product of the HPA axis activity (Elder, Wetherell, Barclay, & Ellis, 2014). When a human experiences stress from weight stigma, stress triggers HPA axis activation and stimulates the amygdala to send a signal to the hypothalamus (Ranabir & Reetu, 2011). The hypothalamus releases corticotropin-releasing hormone (CRH) and triggers the release of adrenocorticotropin hormone (ACTH) from the anterior pituitary gland (Elder et al., 2014); ACTH prompts the adrenal glands to release cortisol (Ranabir & Reetu, 2011). Cortisol levels rise and break down adipose tissue into free fatty acids to support energy.

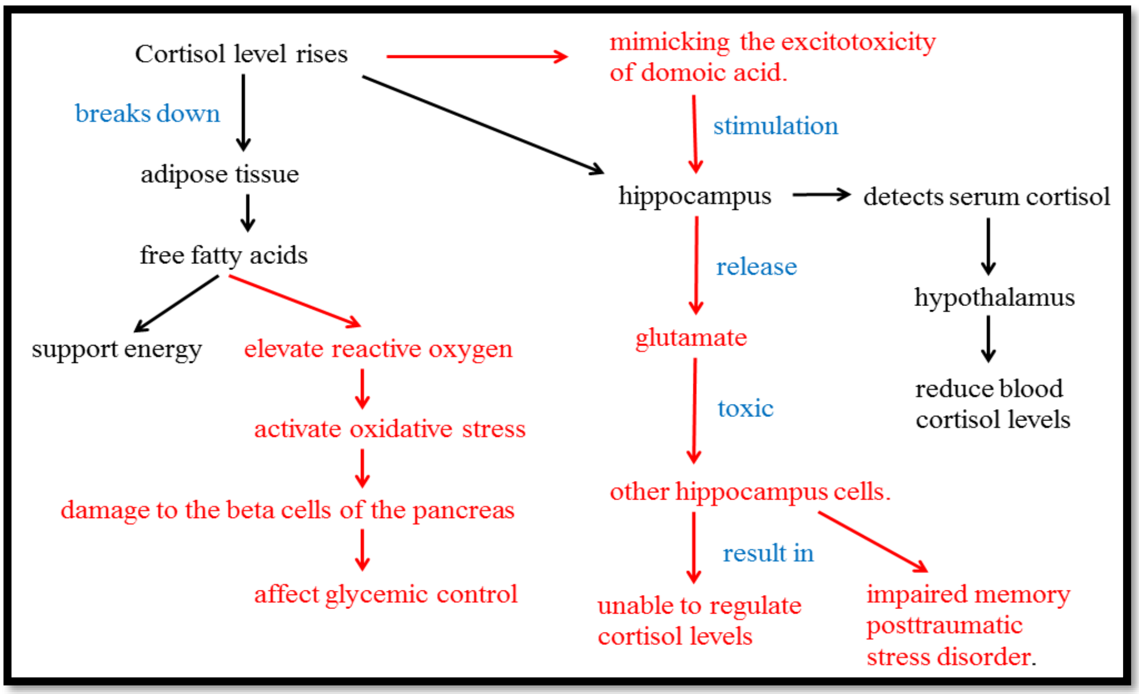
However, free fatty acids may also elevate reactive oxygen and activate oxidative stress causing damage to the beta cells of the pancreas (Figure 1.2) (Sapolsky, 2000). If the stimulus is sustained or its intensity enhanced, the cortisol reaction repeatedly returns, leading to prolonged high cortisol levels (Ranabir & Reetu, 2011). High cortisol levels produced by unrelieved stress may also damage neurons in the hippocampus (Buckingham, Gillies, & Cowell, 1997). The hippocampus contains a high density of cortisol receptors and detects

Figure 1.1. Weight Stigma Triggers the Hypothalamic-Pituitary-Adrenocortical Axis Activation and Releases Cortisol



cortisol in the blood to instruct the hypothalamus to reduce blood cortisol levels (Kolb & Whishaw, 2006). During chronic stress, prolonged high cortisol and glutamate are released and damage hippocampus cells, which results in the inability to regulate cortisol levels (Kolb & Whishaw, 2006).

Figure 1.2. The Results of Prolonged High Cortisol Levels



Cortisol levels may reflect an association between weight stigma and HPA axis activation. One study reported that higher weight stigma resulted in higher morning serum cortisol levels (Tomiyama, Epel, McClatchey, Poelke, Kemeny, McCoy, & Daubenmier, 2014). Two other studies found that exposure to weight stigma led to sustained salivary cortisol elevation after controlling for baseline cortisol levels (Himmelstein, Incollingo, Tomiyama, 2015; Schvey, Puhl, Brownell, 2014). However, the relationship between weight stigma and HPA axis activity has not been well established among Asian Americans with overweight and obesity.

Weight Stigma and Binge Eating

Multiple studies have found that the experience of weight stigma was significantly positively associated with either binge eating or emotional eating (Ashmore, Friedman, Reichmann, & Musante, 2008; Farrow & Tarrant, 2009; Friedman, Ashmore, & Applegate, 2008; Najjar, 2013; Savoy, 2010; Wott & Carels, 2010; Wu & Liu, 2015). Binge eating can be defined as the consumption of a larger amount of food in two hours than most people would eat in a similar amount of time under similar circumstances (American Psychiatric Association ([APA], 2013). During binge eating, patients feel that they cannot stop eating or control the amount of food they ingest (APA, 2013). Unlike patients with bulimia nervosa, patients with binge eating normally do not use compensatory behaviors such as purging or laxatives to balance the behaviors of overeating (APA, 2013). The diagnosis of a binge eating disorder requires at least three of the following: (1) eating more rapidly than normal, (2) eating until feeling uncomfortably full, (3) eating large amounts of food when not feeling physically hungry, (4) eating alone because of embarrassment by the amount of food consumed, and (5) feeling disgusted with oneself, depressed, or guilty after overeating (APA, 2013). The current level of severity for binge eating disorder is based upon the number of binge eating episodes per week from mild level (1 to 3 episodes per week) to an extreme level (14 or more episodes per week) (APA, 2013).

Binge eating has been examined as an ineffective coping strategy to escape the stress caused by weight stigma experiences (Friedman et al., 2008). People with obesity who have experienced weight stigma were 3.3 times more likely to be diagnosed with a binge eating disorder (Ashmore et al., 2008). Individuals with obesity and overweight who also binge eat may have negative health consequences such as an increased BMI or development of metabolic syndrome due to excessive weight gain (Udo et al., 2014). Compared to those without binge eating, individuals with obesity who reported binge eating are at increased risk for developing type 2 diabetes (Odds Ratio [OR] =2.4, 95% confident intervals [95% CI]:1.5-3.7), hypertension (OR = 1.8, 95% CI:1.3-2.4), and ulcers (OR = 1.2, 95% CI:0.7-1.9) (Kessler et al., 2013). Moreover, patients with obesity and a binge eating disorder may also have impaired mental health-related quality of life. Seventy-nine percent of patients with a binge eating disorder meet criteria for mood disorders, anxiety, disruptive behaviors, and substance abuse in community surveys across 14 countries (Kessler et al., 2013), indicating that patients with obesity and a binge eating disorder may be a vulnerable population for other mental health issues. Despite a high number of studies in binge eating areas, little research has examined the link between weight stigma and binge eating in non-white women and men.

Purpose and Aims of the Study

The purpose of this study was to examine the relationship among weight stigma experiences, level of acculturation, hair cortisol levels, and binge eating among Asian-Americans adults (≥ 21 years of age) with overweight and obesity living in North Carolina, U.S. using a cross-sectional study design. The specific aims were:

Aim 1: To examine the relationship between the experience of weight stigma and hair cortisol levels among Asian Americans with overweight and obesity.

Aim 2: To examine the relationship between the experience of weight stigma and binge eating among Asian Americans with overweight and obesity.

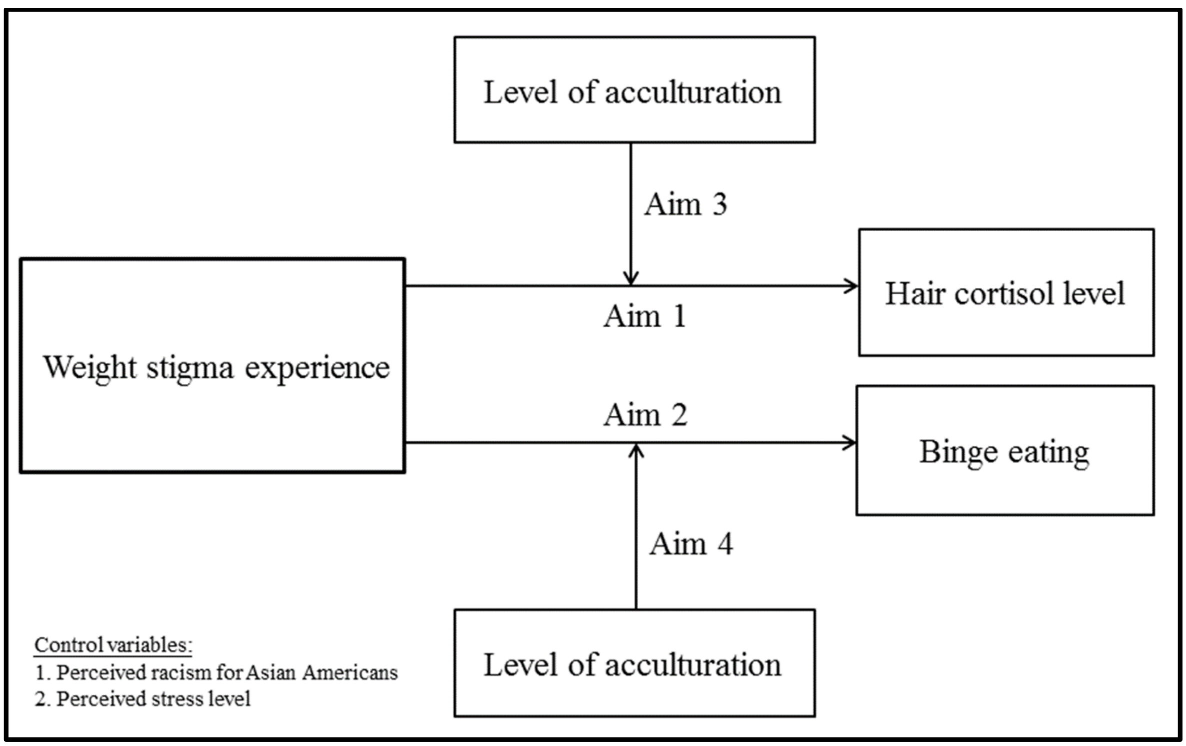
Aim 3: To examine whether the level of acculturation moderates the relationship between the experience of weight stigma and hair cortisol levels among Asian Americans with overweight and obesity.

Aim 4: To examine whether the level of acculturation moderates the relationship between the experience of weight stigma and binge eating among Asian Americans with overweight and obesity.

Study Framework

The framework for this study contained one independent (i.e., weight stigma experience) and two dependent (i.e., hair cortisol level and binge eating) variables (Figure 1.3). The level of acculturation served as a moderator for the relationships between the independent and dependent variables. Perceived racism for Asian Americans and perceived stress level served as controlling variables for all aims.

Figure 1.3. Study Framework



Definition of Key Terms

Weight stigma experience, hair cortisol level, binge eating, and acculturation level have been defined in Table 1.1.

Table 1.1. Definition of Key Terms

Variable	Conceptual Definition	Operational Definition	Reference
Weight stigma experience	Individuals with overweight and obesity and their perception of fat-related negative attitudes (i.e. stigma, discrimination, prejudice, and stereotypes) or inappropriate behaviors (i.e. teasing, bullying, verbal and physical attacks) from other people towards them.	• The participant's weight stigma experience was measured using the Stigmatizing Situations Inventory. • Average scores range from 0 to 3 with higher scores indicating higher weight stigma experiences.	(Puhl et al., 2008; Puhl & Heuer, 2009; Puhl & Heuer, 2011)
Hair cortisol level	Hair cortisol is an indicator or biomarker of stress-response pathogenic processes (i.e. HPA axis activity) and could be used to monitor the clinical and physical response to the weight stigma experience.	• Hair cortisol was analyzed by a high-sensitivity enzyme immunoassay (EIA) kit. • The normal range of hair cortisol is 5.9 - 22.6 pg/mg.	(Albar et al.,2013; Himmelstein et al., 2014; Zhai, Chen, Zhu, & Lu, 2015)
Binge eating	Individuals consume a larger amount of food in a discrete period of time that is definitely larger than what most people would eat in a similar amount of time under similar circumstances without using inappropriate compensatory behaviors (i.e. fasting, purging, using laxatives, or excessive exercise) to balance the behaviors of binge eating as are seen in bulimia nervosa.	• Binge eating was measured using the Binge Eating Scale. • The overall Binge Eating Scale Scores range is from 0 to 46 . A score < 17 represents non-binge eating; 18 to 26 represents moderate binge eating, and > 27 represents severe binge eating.	(APA, 2013; Gormally et al., 1982)
Acculturation level	Acculturation is a process in which members of one cultural group adopt the beliefs and behaviors of another group.	• The level of acculturation for Asian person was measured using the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA).	(Bharmal, Hays, & McCarthy, 2014; Suinn et al., 1992).

Variable	Conceptual Definition	Operational Definition	Reference
		• The overall scores ranges from a low of 1.00, indicative of high Asian identity to a high of 5.00, indicative of high Western identity.	

Summary of Chapter One

The importance of examining the associations between weight stigma experiences and health outcomes were introduced in this chapter. Weight stigma experiences are prevalent in not only Americans but also the Asian population. In this study, the weight stigma experience was defined as the perception of weight-related negative attitudes or inappropriate behaviors from other people towards them by individuals with overweight and obesity. Weight stigma experiences may affect cortisol levels by HPA axis activation and may result in binge eating. The level of acculturation for Asian Americans may influence the relationships between weight stigma experiences and cortisol levels and binge eating. The purpose of this study was to explore the relationships among weight stigma experiences, the level of acculturation, hair cortisol, and binge eating among Asian Americans with overweight and obesity in North Carolina. The results from this study may help to build a theory-based intervention to decrease the effect of weight stigma on Asian American communities and to improve the lives of Asian Americans with overweight and obesity.

Chapter 2 examines the literature on weight stigma, stress responses, and hair cortisol testing and the framework underpinning the study.

CHAPTER 2: REVIEW OF LITERATURE

Introduction

The review of the literature in Chapter 2 is divided into two sections, which includes a review of the associations between weight stigma and physiological and psychological health outcomes and a review of stress responses, cortisol, and hair cortisol measurement.

Review of Associations between Weight Stigma and Physiological and Psychological Health Outcomes

In this section, a quantitative systematic review was conducted to summarize the associations between weight stigma and the physiological and psychological health outcomes for adults with overweight and obesity.

Background of Weight Stigma

Several formats of weight stigma have been observed and measured, such as the experience of weight stigma situations (Myers & Rosen, 1999), implicit weight bias (Rudolph & Hilbert, 2015), explicit weight bias (Puhl, Schwartz, & Brownell, 2005), and internalized weight stigma (Durso & Latner, 2008). However, little is known about the association between the different measures of weight stigma and physical and psychological health outcomes for people with overweight and obesity.

The definitions of different measures of weight stigma are summarized as follows. The experience of a weight stigma situation can be defined as a person with overweight or obesity and their perception of negative attitudes (e.g., stigma, discrimination, prejudice, stereotypes) or inappropriate behaviors (e.g., teasing, bullying, verbal and physical attacks, and being treated unfairly) directed toward them because of their weight (Myers & Rosen, 1999; Puhl & Heuer, 2009). The experience of weight stigma can be quantified by using a self-report frequency measure, such as the Stigmatizing Situations Inventory (Myers & Rosen, 1999).

The relationships between weight stigma experiences, implicit weight bias, and explicit weight bias are related (Myers & Rosen, 1999; Puhl et al., 2005; Rudolph & Hilbert, 2015). Implicit bias can be defined as attitudes or stereotypes that affect an individual's understanding and actions in an unconscious manner (Dovidio, Kawakami, & Gaertner, 2002; Rudolph & Hilbert, 2015). Implicit weight bias represents the weight bias evaluations that people are unwilling to report and can be measured using performance-based measures, such as the Implicit Associations Test (Greenwald, McGhee, & Schwartz, 1998; Schwartz, Vartanian, Nosek, & Brownell, 2006).

Explicit bias can be defined as intentional and conscious (Puhl et al., 2005; Wilson, Lindsey, & Schooler, 2000). Explicit weight bias is a consciously stereotypical attitude, often represented by discrimination and prejudice, against the overweight and obese (Puhl et al., 2005; Wilson et al., 2000). Explicit weight bias can be obtained using self-report measures, such as the Obese Persons Trait Survey, but results may be affected by social desirability concerns (Puhl et al., 2005; Schwartz et al., 2006).

Internalized weight stigma is different from body image and is a measure of an individual's belief in stereotypes relating to negative self-evaluations (Durso & Latner, 2008). Internalized weight stigma is also a type of self-stigma among individuals with overweight and obesity, and it can be ascertained using self-report measures, such as the Weight Bias Internalization Scale (Durso & Latner, 2008).

The influence of weight stigma on the physical health of individuals with overweight or obesity has been previously reviewed as follows. Papadopoulos and Brennan (2015) found that relationships were noted between weight stigma, body mass index (BMI), and difficulty losing weight in adults. Also, weight stigma was related to poor medication adherence and weight and health-related quality of life (Papadopoulos & Brennan, 2015). Several reviews also documented that adults and children experiencing weight stigma exercised less, were less motivated to exercise, had lower self-efficacy, and tended to overeat (Papadopoulos & Brennan, 2015; Vartanian & Smyth, 2013). The effects of weight stigma on psychological health have also been reviewed. Across reviews, weight stigma has been associated with anxiety, depression, low self-esteem, substance abuse, binge eating disorders, bulimia nervosa, and anorexia nervosa (Papadopoulos & Brennan, 2015; Puhl & Suh, 2015a; Puhl & Suh, 2015b).

These reviews provided information about the problem of weight stigma in individuals with overweight or obesity but lacked a clear focus on the associations between different measures of weight stigma and its physical and psychological effects. Therefore, the purpose of this review was to summarize the current literature with a quality appraisal of studies selected for associations between different measures of weight stigma and measures of physical and psychological health in adults with overweight and obesity.

Design

The Cochrane Handbook (version 5.1.0) (Higgins & Green, 2011) was followed to define the review questions and to develop criteria for including studies, and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA Statement Guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009) were used to present the search processes. We modified a Summary of Findings Table from the Cochrane Effective Practice and Organisation of Care worksheets to present a summary of our findings (Cochrane Effective Practice and Organisation of Care, 2017b).

Search Methods

PubMed, MEDLINE, PsycINFO, and CINAHL were searched to identify studies published in English from January 1, 2008, through July 30, 2016 (Table 2.1). The following search terms were used: social stigma, discrimination, social discrimination, prejudice, bias, weight, body weight, overweight, obesity, weight stigma, stigma, and stigmatization.

Table 2.1. Search Strategy

Database	Search Strategies
PubMed & MEDLINE	#1. (("Social Stigma"[Mesh]) OR ("Discrimination (Psychology)"[Mesh]) OR ("Social Discrimination"[Mesh]) OR "Prejudice"[Mesh])) #2. (("Body Weight"[Mesh]) OR ("Obesity"[Mesh]) OR "Overweight"[Mesh])). #3. #1 and #2 AND ("2008/1/1"[Date - Publication]: "2016/7/31"[Date – Publication]) Filters: English
PsycInfo & CINAHL	S1. TI weight OR TI obesity OR TI overweight S2. TI weight stigma OR TI stigma OR TI stigmatization OR TI bias OR TI discrimination OR TI prejudice S3. DT 2008/01/01-2016/07/31 S4. S1 AND S2 AND S3 S5. S1 AND S2 AND S3. Search Options: Narrow by Language: - English

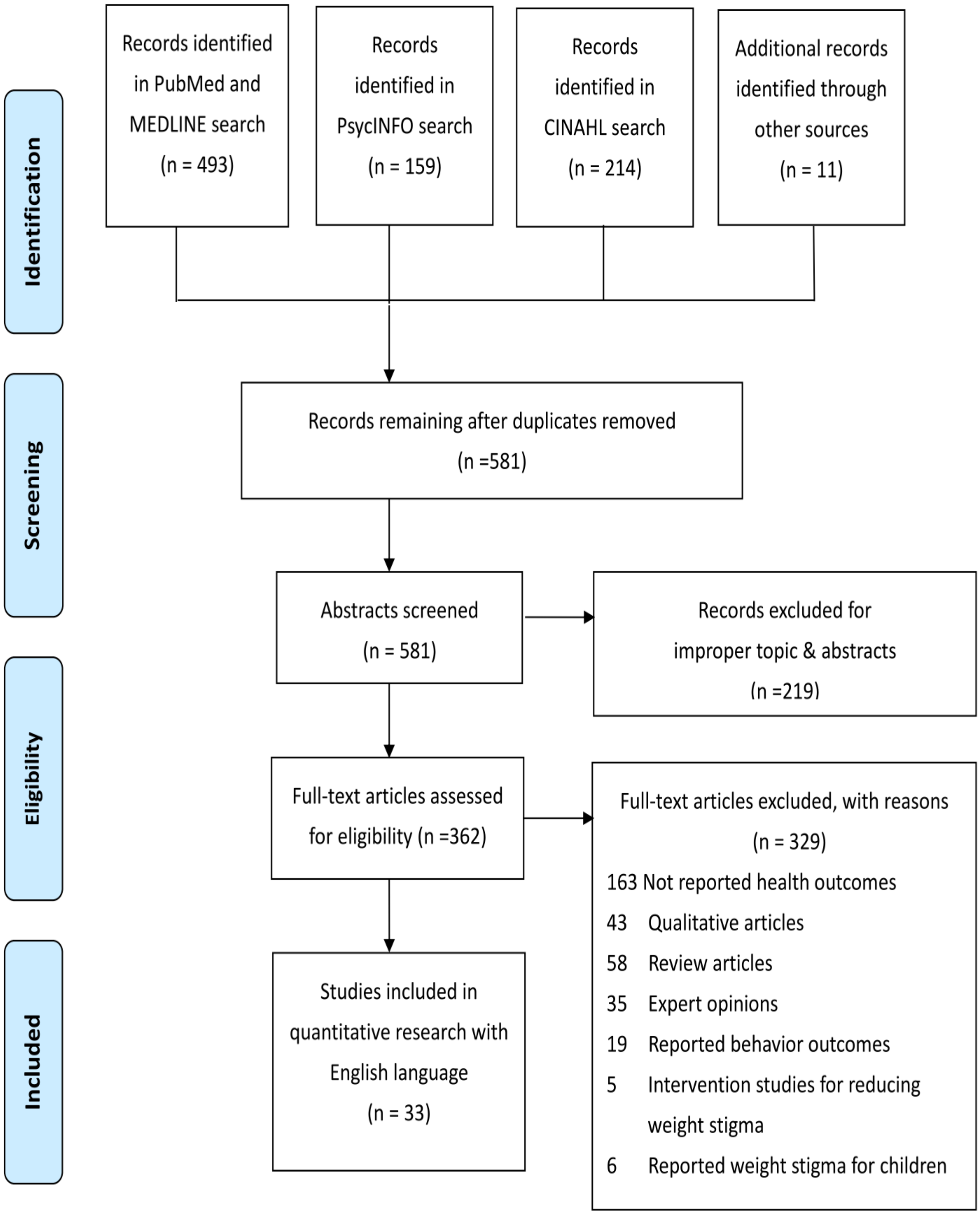
Reference lists of the studies were also searched to ensure a complete collection of study results. Inclusion criteria consisted of quantitative studies that examined the associations between weight stigma and physiological and psychological health outcomes for adults (18 years and older) with overweight (BMI > 25kg/m^2) or obesity (BMI > 30kg/m^2). No upper age limit was stipulated in the review because weight stigma could happen in all age groups. Qualitative research, literature reviews, expert opinions, editorials, reports on weight stigma without health outcomes or with behavioral outcomes, such as exercise avoidance, and intervention studies for reducing weight stigma were excluded because the focus of those articles did not include examining the relationships between weight stigma and physiological and psychological health outcomes.

Before the full-text review, two researchers worked independently and undertook duplicate screening of title-abstract records. Based on the inclusion and exclusion criteria, titles and abstracts were screened to identify studies of likely relevance, and the screening excluded articles with improper topics and abstracts. Full-text articles were then screened by the two independent reviewers.

Search Outcome

Figure 2.1 displays the PRISMA flowchart showing the search procedure for identification of the databases, screening studies, assessing for eligibility, and the final studies that met the selection criteria. The search of the present review yielded 877 studies with 296 duplicate studies; 581 studies remained after duplicates were removed. After screening titles and abstracts, 219 studies were excluded, and 362 studies remained. The full texts of the remaining 362 studies were reviewed, after which 329 were excluded, leaving 33 studies in the final analysis.

Figure 2.1. Flowchart of Search Processes in a PRISMA Diagram



Quality Appraisal

The quality of all included articles was assessed by two independent researchers. The studies included in this review were either observational and cross-sectional studies or pre-post studies with no control group. Therefore, two quality assessment tools from the National Heart, Lung, and Blood Institute were used for observational cohort and cross-sectional studies (National Heart, Lung, and Blood Institute, 2014a) and for before-after (pre-post) studies with no control group (National Heart, Lung, and Blood Institute, 2014b) to present the assessment of risk of bias because the Cochrane Handbook assessment of risk of bias guideline was more suitable for use in interventional studies with a control group and interrupted time series studies (Cochrane Effective Practice and Organisation of Care, 2017a).

Quality appraisal of each article included study questions, study population, study participants representation, sample size, exposure measures for the observational studies, intervention, outcome measures, blinding of outcome assessors, loss of follow-up rate, and statistical analysis. Overall quality rating (i.e., good, fair, or poor) was based on the critical appraisal of the risk of potential for selection bias, information bias, measurement bias, or confounding. Any disagreement was resolved by consensus.

Data Extraction

The following information was first extracted to organize the data and prepare for analysis: publication year, location of study, study design, sample and sample size, participants' ages, BMI, measures of weight stigma and instruments, measures of health outcomes, response rate for cross-sectional survey studies, attrition rate for intervention and longitudinal studies, and study results. Second, descriptive statistics were used to obtain the sum, mean, standard deviation, range, percentage of study, and sample characteristics for the included studies. All data were analyzed using Statistical Package for Social Sciences (SPSS) 3.0 software (SPSS, 2014). Third, study results related to different measures of weight stigma were extracted in more detail to summarize the associations between the experiences of weight stigma, internalized weight stigma, implicit weight bias, and explicit weight bias and health outcomes in the included studies. The process of data abstraction and synthesis was completed independently by the two reviewers, and any disagreement was resolved by consensus.

Results

Measures of Weight Stigma

Six studies (18.2%) in this review observed weight stigma by more than one measure (Table 2.2). The most common measure for weight stigma were experiences of weight stigma (54.5%, 18 studies). The most common tool for measuring the experiences of weight stigma was the Stigmatizing Situations Inventory (43.6%, 8 studies).

The second most common measure of weight stigma was internalized weight stigma, measured by the Weight Bias Internalization Scale (27.3%, 9 studies). The third most common measure for weight stigma was implicit weight bias (12.1%, 4 studies), measured by the Implicit Associations Test (3 studies) and Self-Discrimination Implicit Association Test (1 study). The fourth most common measure for weight stigma was explicit weight bias, measured by the Obese Persons Trait Survey (9.1%, 3 studies).

Table 2.2. Brief Description of Included 33 Studies

Author/s (year)	Location	Study Design	N	Weight Stigma Measure Used/ Manipulated Weight Stigma
1.Ashmore et al. (2008)	U. S.	Cross-sectional	93	• Stigmatizing Situations Inventory
2.Friedman et al. (2008)	U. S.	Cross-sectional	94	• Stigmatizing Situations Inventory
3.Carels et al. (2009)	U. S.	1-Group pretest/ posttest	42	• Obese Persons Trait Survey • Implicit Associations Test
4.Farrow and Tarrant (2009)	U.K.	Cross-sectional	197	• Experience of Weight-based Discrimination Scale
5.Hatzenbuehler et al. (2009)	U. S.	Cross-sectional with secondary database analysis	31,558	• Perceived Weight Discrimination Scale
6.Latner et al. (2009)	U. S.	1-Group pretest/ posttest	185	• Stigmatizing Situations Inventory
7.Carels et al. (2010)	U. S.	2-Group pretest/ posttest	49	• Implicit Associations Test • Weight Bias Internalization Scale • Obese Persons Trait Survey
8.Wott and Carels (2010)	U. S.	2-Group pretest/ posttest	49	• Stigmatizing Situations Inventory
9.Savoy (2010)	U. S.	Cross-sectional	123	• Weight-based Stigmatization Experience Scale
10.Carels et al. (2011)	U. S.	1-Group pretest/ posttest	53	• Implicit Association Test
11.Tsenkova et al. (2011)	U. S.	Cross-sectional with secondary database analysis	938	• Perceived Weight Discrimination Scale
12.Robinson (2011)	U. S.	Cross-sectional	955	• Perception of Teasing Scale • Gatehouse Bullying Scale
13.Durso, Latner, & Hayashi (2012)	U. S.	Cross-sectional	381	• Weight Bias Internalization Scale
14.Durso et al. (2012)	U. S.	Cross-sectional	100	• Weight Bias Internalization Scale
15.Durso (2012)	U. S.	2-Group pretest/ posttest	75	• Weight Bias Internalization Scale
16.Fettich and Chen (2012)	U. S.	Cross-sectional	234	• Stigmatizing Situations Inventory

Author/s (year)	Location	Study Design	N	Weight Stigma Measure Used/ Manipulated Weight Stigma
17.Levy and Pilver (2012)	U. S.	Cross-sectional with secondary database analysis	20,649	• Experiences of Discrimination Scale
18.Savoy et al. (2012)	U. S.	Cross-sectional	CP:99 SP:100	• Stigmatizing Situations Inventory
19.Carels et al. (2013)	U. S.	Cross-sectional	62	• Obese Persons Trait Survey • Weight Bias Internalization Scale
20.Sutin and Terracciano (2013)	U. S.	Longitudinal with secondary database analysis	6,157	• Experience of Everyday Discrimination Scale
21.Burmeister and Carels (2014)	U. S.	Cross-sectional	116	• Weight Bias Internalization Scale
22.Hilbert et al. (2014)	Germany	Cross-sectional	1,158	• Weight Bias Internalization Scale
23.Himmelstein et al. (2014)	U. S.	2-Group pretest/ posttest	110	• Experimentally manipulated weight stigma in a clothes shopping scenario
24.Hunger and Major (2014)	U. S.	Cross-sectional	SO:171 ST:194	• Modified version of Perceived Racial Discrimination • Modified version of Other Forms of Stigma Concerns
25.Jackson et al. (2014)	U. S.	Longitudinal with secondary database analysis	2,944	• Perceived Discrimination Questionnaire
26.Lee et al. (2014)	U. S. Australia	Cross-sectional	USP:215 AP:264	• Modified versions of the Attitudes to Mental Illness Questionnaire and the General Social Survey
27.Pearl et al. (2014a)	U. S.	Cross-sectional	245	• Weight Bias Internalization Scale
28.Pearl et al. (2014b)	U. S.	Cross-sectional	255	• Weight Bias Internalization Scale
29.Sutin et al. (2014)	U. S.	Cross-sectional with secondary database analysis	7,394	• Single-item measures from Perceived Discrimination Scale
30.Rudolph and Hilbert (2014)	Germany	Cross-sectional	78	• Self- Discrimination Implicit Association Test

Author/s (year)	Location	Study Design	N	Weight Stigma Measure Used/ Manipulated Weight Stigma
31.Schvey et al. (2014)	U. S.	2-Group pretest/ posttest	123	• 10-minute weight stigmatizing video
32.Tomiyama et al. (2014)	U. S.	Cross-sectional survey with repeat measure of salivary cortisol	47	• Stigmatizing Situations Inventory • Modified version of the Stigma Consciousness Scale
33.Wu and Liu (2015)	Taiwan	Cross-sectional	141	• Stigmatizing Situations Inventory

Note. Year = published year; N = number of participants; U.S.= United States; U.K.= United Kingdom; CP = participants from clinical; SP: participants who are student; SO = study one; ST = study two; USP = participants from United States; AP = participants from Australia

Characteristics and Quality of Included Studies

Overall, the quality ratings for all 33 studies were fair to good (Tables 2.3 and 2.4). They included a total of 75,599 participants, and individual sample sizes ranged from 42 to 31,558. The majority of participants across the studies were Caucasian (mean [M] = 69.6% ± standard deviation [SD] 26.9%). The mean age of participants across the studies was 44.6 ± 12.7 years, and the mean BMI of participants was 33.6 ± 7.6 kg/m^2. The majority of the studies were conducted in the U.S. (84.8%, 28 studies) and used a cross-sectional design (69.7%, 23 studies) and a convenience sample (60.6%, 20 studies). Six studies in this review used secondary databases. Only two studies reported power analysis for sample size justification (Robinson, 2011; Wu & Liu, 2015), which made it difficult to determine whether the sample size was sufficiently large enough for the majority of the studies.

Twenty studies in this review reported sample sizes of less than 200, which may have affected the results. The mean response rate for cross-sectional design studies was 93.3 ± 11.6 %, and the mean attrition rate for intervention studies was 11.3 ± 11.2 %. Two intervention studies in this review reported that participants lost to follow-up exceeded 20% (Carels et al., 2009; Durso, 2012). None of the studies in this review reported outcome assessors blinded to the participants' exposure or intervention, which may have altered the results.

Table 2.3. Quality Assessment for both the Observational Cohort and the Cross-Sectional Studies

Criteria	Article Number (based on Table 2.2)											
	1	2	4	5	9	11	12	13	14	16	17	18
1. Was the research question or objective in this paper clearly stated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Was the study population clearly specified and defined?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Was the participation rate of eligible persons at least 50%?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Were all the subjects selected or recruited from the same o r similar populations (including the same time period)?Were inclusion and exclusion criteria for being in the study prespe cified and applied uniformly to all participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Was a sample size justification, power description, or vari ance and effect estimates provided?	No	No	No	No	No	No	Yes	No	No	No	No	No
6. For the analyses in this paper, were the exposure(s) of inte rest measured prior to the outcome(s) being measured?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9. Were the exposure measures (independent variables) clearl y defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10. Was the exposure(s) assessed more than once over time?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. Were the outcome assessors blinded to the exposure statu s of participants?	No	NR	No	NR	NR	NR	No	No	NR	No	No	No
13. Was loss to follow-up after baseline 20% or less?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Quality Rating (Good, Fair, or Poor)	Fair	Fair	Fair	Good	Fair	Good	Good	Good	Fair	Good	Good	Fair

Note. CD = cannot determine; NA = not applicable; NR = not reported.

Criteria	Article Number (based on Table 2.2)												
	19	20	21	22	24	25	26	27	28	29	30	32	33
1. Was the research question or objective in this paper clearly stated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Was the study population clearly specified and defined?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Was the participation rate of eligible persons at least 50% ?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)?We re inclusion and exclusion criteria for being in the study pre specified and applied uniformly to all participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Was a sample size justification, power description, or var iance and effect estimates provided?	No	No	No	No	No	No	No	No	No	No	No	No	Yes
6. For the analyses in this paper, were the exposure(s) of int erest measured prior to the outcome(s) being measured?	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	Yes	NA
7. Was the timeframe sufficient so that one could reasonabl y expect to see an association between exposure and outcome if it existed?	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	Yes	NA
8. For exposures that can vary in amount or level, did the st udy examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
9. Were the exposure measures (independent variables) clea rly defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10. Was the exposure(s) assessed more than once over time ?	NA	Yes	NA	NA	NA	Yes	NA	NA	NA	NA	NA	NA	NA
11. Were the outcome measures (dependent variables) clearl y defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. Were the outcome assessors blinded to the exposure stat us of participants?	No	NR	No	No	No	NR	No	NR	NR	NR	No	NR	No
13. Was loss to follow-up after baseline 20% or less?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yes	NA
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Quality Rating (Good, Fair, or Poor)	Fair	Good	Fair	Fair	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Fair

Note. CD = cannot determine; NA = not applicable; NR = not reported.

Table 2.4. Quality Assessment for the Before and -After (Pre-Post) Studies with No Control Group

Criteria	Article Number (based on Table 2.2)							
	3	6	7	8	10	15	23	31
1. Was the study question or objective clearly stated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Were eligibility/selection criteria for the study population prespecified and clearly described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Were the participants in the study representative of thos e who would be eligible for the test/service/intervention in the general or clinical population of interest?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Were all eligible participants that met the prespecified e ntry criteria enrolled?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Was the sample size sufficiently large to provide confide nce in the findings?	NR	NR	NR	NR	NR	NR	NR	NR
6. Was the test/service/intervention clearly described and d elivered consistently across the study population?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Were the outcome measures prespecified, clearly define d, valid, reliable, and assessed consistently across all study participants?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8. Were the people assessing the outcomes blinded to the p articipants' exposures/interventions?	NR	No	NR	NR	NR	NR	NR	NR
9. Was the loss to follow-up after baseline 20% or less? W ere those lost to follow-up accounted for in the analysis?	No (25%)	Yes (17.4%)	Yes (9.3%)	Yes (10.9%)	Yes (0%)	No (29.2%)	Yes (0.9%)	Yes (6.8%)
10. Did the statistical methods examine changes in outcom e measures from before to after the intervention? Were statistical tests done that provided p-values for the pre-to-post changes?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
11. Were outcome measures of interest taken multiple time s before the intervention and multiple times after the intervention (i.e., did they use an interrupted time-series design)?	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12. If the intervention was conducted at a group level (e.g., a whole hospital, a community, etc.) did the statistical analysis take into account the use of individual-level data to determine effects at the group level?	NA	NA	NA	NA	NA	NA	NA	NA
Quality Rating (Good, Fair, or Poor)	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair

Note. CD = cannot determine; NA = not applicable; NR = not reported.

Most of the psychological health outcomes were self-reported by the participants. Four studies in this review used doctoral-level diagnostic interviews for binge eating disorder but did not report whether the interviewers were blinded to the participants' exposures (Friedman, Ashmore, & Applegate, 2008; Durso et al., 2012; Pearl, White, & Grilo, 2014a; Pearl, White, & Grilo, 2014b). Finally, 18 of 25 longitudinal and cross-sectional studies measured and adjusted statistically for the impact of confounding variables on the relationship between weight stigma and health outcomes. Seven of eight intervention studies reported the pre-to-post health outcomes changes.

In summary, the main limitations of the included studies consisted of small convenience samples without sample size justification, self-reported psychological health outcomes, and lack of confounding variables in the studies.

Summary of Findings across Included Studies

Table 2.5 presents a modified summary of findings table from the Cochrane Effective Practice and Organisation of Care worksheets to synthesize the results across all included studies. The in-depth detail for each study is presented in Appendix 2.1.

Table 2.5. A Modified Summary of Findings Table

Associations between weight stigma and physiological and psychological health for overweight or obese adults.			
People: Individual adults who are overweight or obese **Settings:** Primarily the United States of America (USA) **Intervention:** none **Comparison:** none			
Outcomes	**Impact**	**Number of Studies**†	**Overall Quality Rating***
Weight change	Some researchers reported the higher the weight stigma, the lower percentage of weight loss. Others reported no statistically significant association between weight stigma and weight change.	7	Fair
Obesity and diabetes risk	Higher weight stigma is associated with higher glycated hemoglobin (HbA1c) levels, which may increase the risk for developing type 2 diabetes mellitus. Higher weight stigma also increased the risk to be obese or remain obese.	3	Good
Biomarkers	The greater the weight stigma, the higher the cortisol, oxidative stress, and C-reactive protein levels, meaning that weight stigma is linked to hypothalamic–pituitary–adrenal axis reactivity and systemic inflammation and may contribute to adverse health outcomes like cardiovascular disease and diabetes.	4	Fair
Eating disturbances	Higher weight stigma was significantly associated with higher eating disturbances like binge eating and emotional eating and result in weight gain.	14	Fair
Depressive symptoms	The higher the weight stigma, the greater the depressive symptoms.	17	Fair
Anxiety	The more frequently weight stigma was experienced, the higher the anxiety levels reported.	7	Fair
Self-esteem	Higher weight stigma was significantly associated with lower self-esteem.	7	Fair
Body image	Higher weight stigma was significantly associated with higher body image dissatisfaction.	9	Fair

Other psychological distress	Higher weight stigma was significantly associated with higher psychological distress such as social isolation, suspiciousness, hostility, and nicotine, alcohol, and drug dependence.	10	Fair

* National Heart, Lung, and Blood Institute quality assessment guideline
Good = Low risk of bias of the included studies. The outcome results reported in the studies can truly be attributed to the intervention or exposure being evaluated, and not to biases, measurement errors, or other confounding factors that may result from flaws in the design or conduct of the studies.
Fair = Some risk of bias of the included studies. The outcome results reported in the studies were attributed to the intervention or exposure being evaluated but the studies may contain some risk of bias.

Poor = High risk of bias of the included studies such as potential for selection bias, information bias, measurement bias, or confounding (the mixture of exposures that one cannot tease out from each other). The outcome results reported in the studies cannot be attributed to the intervention or exposure being evaluated.

[†] Twenty of the 33 studies reported more than one type of health outcomes.

Associations between Weight Stigma and Physiological Health Outcomes

The results of associations between weight stigma and weight change, obesity and diabetes risk, cortisol, oxidative stress, and C-reactive protein levels were summarized below.

Weight change. A previous study showed that greater weight-related stigmatizing experience is associated with greater weight loss in obesity treatment ($r = .23$, $p < .005$) (Latner, Wilson, Jackson, & Stunkard, 2009); however, Wott and Carels (2010) found no significant association. Jackson, Beeken, and Wardle (2014) compared participants who did not report experiences of weight discrimination to those who did and found that those who reported having experienced weight stigma gained a mean (M) = 1.66 kilograms (standard deviation [SD] ± 0.42, $p < 0.001$) over four years.

Greater implicit weight bias was significantly associated with a lower percentage of weight loss ($r = –.33$, $p = .04$) (Carels et al., 2011), but no statistically significant associations were found between implicit weight bias and weight change in the other two studies (Carels et al., 2009; Carels et al., 2010)

Participants with obesity who lost at least 2.5% of their baseline weight reported less explicit weight bias (Carels et al., 2009); however, another study reported no statistically significant association between explicit weight bias and weight change (Carels et al., 2010).

Participants with low levels of internalized weight stigma lost twice as much weight as participants with higher levels of internalized weight stigma (Durso, 2012). In contrast, Carels et al. (2010) reported no significant difference between internalized weight stigma and weight change.

Obesity and diabetes risk. The experience of weight stigma moderated the effects of waist-to-hip ratio on glycated hemoglobin (HbA1c) after controlling for selected socio-demographic, health, and psychosocial variables (Tsenkova, Carr, Schoeller, & Ryff, 2011). Participants who experienced a higher frequency of weight stigma had higher HbA1c levels and a higher risk of developing type 2 diabetes mellitus (Tsenkova et al., 2011). Controlling for baseline BMI, participants who experienced weight stigma were more likely to have obesity than those who did not (Jackson et al., 2014; Sutin & Terracciano, 2013) and were also more likely to remain obese at four-year follow-up: (Odds Ratio [OR] = 3.20, 95% confidence interval [CI] [95% CI] = 2.06-4.97) (Sutin & Terracciano, 2013).

Cortisol, oxidative stress, and C-reactive protein levels. Two of these studies examined weight stigma using weight stigma scenarios and weight stigma videos, respectively (Himmelstein, Incollingo, & Tomiyama, 2014, Schvey, Puhl, & Brownell, 2014). Himmelstein, Incollingo, and Tomiyama (2014) set up a shopping area in a lab and invited participants with underweight, overweight, and obesity to shop without telling them the true purpose of the study.

Each participant was randomized to either the control (i.e., did not do the shopping activity) or the stigmatizing condition (shopping with a clerk making comments like “your size and shape just aren’t ideal for this style”) condition and, they examined salivary cortisol responses. Schvey, Puhl, and Brownell (2014) randomized participants with underweight, overweight and obesity to either a 10-minute stigmatizing video or a neutral video and examined salivary cortisol responses. The two studies found that participants who experienced the weight-stigmatizing condition had an elevation in salivary cortisol levels controlling for baseline cortisol (Himmelstein et al., 2014; Schvey et al., 2014).

F_2-isoprostane levels represent oxidative stress levels, a pathogenic mechanism of the stress response that causes physical damage, such as disrupting the activity of antioxidant enzymes (Tomiyama et al., 2014). Researchers found that the greater the weight stigma, the higher the morning serum cortisol and F_2-isoprostane levels (Tomiyama et al., 2014).

Finally, one study examined the association between the experience of everyday discrimination secondary to excessive weight and the level of C-reactive protein in participants with overweight found that having experienced weight discrimination was associated with higher levels of C-reactive protein among the participants with a BMI of 25-30 kg/m^2 (Sutin, Stephan, Luchetti, & Terracciano, 2014).

Associations between Weight Stigma and Psychological Health Outcomes

Associations between weight stigma and eating disturbances, depressive symptoms, anxiety, self-esteem, body image, other psychological distress are summarized below.

Eating disturbances. The experience of weight stigma was significantly positively associated with either binge eating behaviors or emotional eating (r = .21-0.45, all $p < .05$) (Ashmore, Friedman, Reichmann, & Musante, 2008; Farrow & Tarrant, 2009; Friedman et al., 2008; Savoy, 2010; Wott & Carels, 2010; Wu & Liu, 2015).

For implicit and explicit weight bias, Carels et al. (2010) reported a significant positive association between implicit weight bias and binge eating behaviors ($r = .36$, $p < .05$). In a later study, Carels et al. (2013) reported no significant associations between explicit weight bias and binge eating behaviors among adults; however, they found that more negative self-ratings of explicit weight bias were associated with greater binge eating behaviors ($r = .55$, $p < .001$).

In terms of internalized weight stigma, four studies reported a significant positive association between internalized weight stigma and binge eating behaviors ($r = .43$-$.58$, all $p < .05$) (Burmeister & Carels, 2014; Carels et al., 2010; Carels et al., 2013; Pearl et al., 2014b). Also, Durso, Latner, and Hayashi (2012) found that internalized weight stigma partially mediated the association between perceived discrimination and eating disturbances.

As it relates to the other measures of weight stigma, such as weight-based stigma toward a fictional character, perceived weight-related teasing, and fat stereotypes, Lee, Hall, Lucke, Forlini, and Carter (2014) found no significant associations between weight-based stigma toward a fictional character and a diagnosis of food addiction among adults. No significant association between implicit self-discrimination and eating disorders has been reported among adults (Rudolph & Hilbert, 2015).

Depressive symptoms. The more frequent the experience of weight stigma, the greater the depressive symptoms ($r = .31$-0.51, all $p < .05$) (Ashmore et al., 2008; Friedman et al., 2008; Hatzenbuehler, Keyes, & Hasin, 2009; Wott & Carels, 2010; Fettich & Chen, 2012; Savoy, Almeida, & Boxer, 2012). Also, the experience of weight stigma mediated the relationship between weight status and depressive disorders (Levy & Pilver, 2012) and between BMI and depressive symptoms (Hunger & Major, 2015).

Related to implicit and explicit weight bias, one study reported that neither implicit nor explicit weight bias was significantly associated with depressive symptoms (Carels et al., 2010); however, another study reported that explicit weight bias was significantly associated ($r = .419$, $p = .001$) (Carels et al., 2013).

Internalized weight stigma was positively associated with depressive symptoms ($r = .43$-$.66$, all $p < .05$) (Burmeister & Carels, 2014; Carels et al., 2013; Durso, 2012; Durso et al., 2012), however, one study reported no significant association (Carels et al., 2010). In addition, Hilbert, Braehler, Haeuser, and Zenger (2014) found that self-evaluation (i.e., an essential evaluation of an individual's worthiness, effectiveness, and capability as a person) mediated the relationship between internalized weight stigma and depressive symptoms. Pearl et al. (2014b) found that depressive symptoms mediated the relationship between internalized weight stigma and self-reported psychological and physiological health.

Perceived weight-related teasing, weight-related victimization, and implicit self-discrimination were significantly positively associated with depressive symptoms among adults ($r = .28$-$.53$, all $p < .05$) (Robinson, 2011; Rudolph & Hilbert, 2015). Perceived weight-related teasing of adults mediated the effect of BMI on depressive symptoms (Hunger & Major, 2015).

Anxiety. The increased frequency of the experience of weight stigma was associated with higher anxiety levels ($r = .33$-0.39, all $p < .05$) (Ashmore et al., 2008; Friedman et al., 2008; Hatzenbuehler et al., 2009; Savoy et al., 2012). The experience of weight stigma also mediated the association between weight status and anxiety among adults (Levy & Pilver, 2012).

Self-evaluation mediated the relationship between internalized weight stigma and anxiety among adults (Hilbert et al., 2014). However, another study demonstrated no significant association between internalized weight stigma and anxiety among adults (Durso, 2012). No studies in this review examined associations between implicit or explicit weight bias and anxiety.

Self-esteem. Higher frequency of experienced weight stigma was significantly related to lower self-esteem among adults ($\beta = 0.23$, $p < .02$) (Friedman et al., 2008); however, another study reported no significant associations with self-esteem (Latner et al., 2009). Still another study indicated that the experiences of weight stigma mediated the relationship between BMI and self-esteem among adults (Hunger & Major, 2015).

Higher internalized weight stigma was significantly associated with lower self-esteem among adults ($r = -.41\sim -.68$, all $p < .05$) (Durso, 2012; Durso et al., 2012; Pearl et al., 2014a). Overvaluation of shape and weight mediated the relationship between internalized weight stigma and self-esteem (Pearl et al., 2014a).

For the other measures of weight stigma, a higher implicit self-discrimination level was significantly associated with lower self-esteem among adults ($r = -.39$, $p < .001$) (Rudolph & Hilbert, 2015) and an individual's weight stigma concerns mediated the relationship between BMI and self-esteem among adults (Hunger & Major, 2015). No studies in this review reported associations between implicit or explicit weight bias and self-esteem.

Body image. Higher frequency of experienced weight stigma was significantly associated with higher body image dissatisfaction among adults ($r = .25$-$.41$, all $p < .05$) (Farrow & Tarrant, 2009; Friedman et al., 2008; Latner et al., 2009) and was significantly associated with concerns regarding body shape ($r = .44$, $p < .015$) (Savoy, 2010). Higher implicit weight bias was associated with higher investments in personal appearance ($r = .27$, $p < .05$), but explicit weight bias was not significantly associated with body image (Carels et al., 2010).

Higher internalized weight stigma was significantly associated with higher body image dissatisfaction ($r = .60$, $p < .01$) (Durso, 2012), lower appearance evaluation ratings ($r = -.63$, $p < .01$) (Carels et al., 2010), and lower body satisfaction ($r = -.51$, $p < .01$) (Burmeister & Carels, 2014).

For the other measures of weight stigma, Robinson (2011) reported that greater perceived weight-related teasing was associated with higher body image dissatisfaction ($r = .42$, $p < .01$)

Other psychological distress. The experiences of weight stigma were significantly positively associated with interpersonal sensitivity (Ashmore et al., 2008), social isolation and social phobia (Ashmore et al., 2008; Hatzenbuehler et al., 2009), suspiciousness (Ashmore et al., 2008), hostility (Ashmore et al., 2008), phobic anxiety (Friedman et al., 2008), perceived stress and dysthymia (Hatzenbuehler et al., 2009), nicotine, alcohol, and drug dependence (Hatzenbuehler et al., 2009), manic or hypomanic episodes (Hatzenbuehler et al., 2009), panic and post-traumatic stress disorder (Hatzenbuehler et al., 2009), fear of fat and weight gain (Latner et al., 2009), antisocial behavior (Savoy et al., 2012), and negative association with the "in group" social consensus ($r = -.20$, $p < .01$) (Farrow & Tarrant, 2009). No studies in this review looked at associations between implicit or explicit weight bias and other types of psychological distress.

Discussion

Overall, the majority of the studies established the associations between weight stigma and health outcomes in the western population. Little research has examined the impact of weight stigma in the non-western population such as Asians in this review. Future researchers should investigate intersectionality in weight stigma and health-related outcomes to stigmatizing experiences across racial groups.

The frequency of experiencing weight stigma, internalized weight stigma, implicit weight bias, and explicit weight bias are four types of measures that were found in the current literature for measuring weight stigma in adults with overweight and obesity. The majority of the studies focused on the impact of the frequency of experiencing weight stigma by using self-report frequency tools. However, whether the frequency of experienced weight stigma was equal to the level of stress a person perceived may require further discussion. The personal perception of weight stigma for individuals may lead to different stress levels and, therefore, may result in different health outcomes.

Overall, the greater the weight stigma, the worse the physiological health status of adults with overweight and obesity, regardless of the measures of weight stigma. Obesity and diabetes risk, cortisol, oxidative stress, and C-reactive protein levels were all positively related to experiences of weight stigma, but the association between different measures of weight stigma and weight change demonstrated mixed results. Only a few studies reported physiological health outcomes. One reason might be the difficulty of separating the physiological impact of weight stigma from the physiological impact of having overweight or obesity. Individuals with overweight or obesity have been found to have a significantly greater physiological vulnerability than individuals with normal weight (Tsenkova et al., 2011). For example, the higher the frequency of weight stigma an individual experience may increase that individuals HbA1c by activating the hypothalamic-pituitary-adrenal (HPA) axis (Tsenkova et al., 2011). However, it is difficult to determine whether an increased HbA1c is due to weight stigma using an observational study design. One solution to this problem in study design is to use a weight stigma intervention. Two studies in our review employed weight stigma scenarios and videos and measured cortisol at baseline and 30 minutes after the intervention (Himmelstein et al., 2014;

Schvey et al., 2014). However, the long-term impact of weight stigma on cortisol levels remains unclear. Longitudinal studies with larger samples of adults with overweight and obesity are needed.

The review also found that the greater the weight stigma experienced resulted in increased eating disturbances, depressive symptoms, anxiety, and body image dissatisfaction. Also, individuals with overweight or obesity who experienced weight stigma were found to have lower self-esteem. Weight stigma is considered a significant stressor in individuals with overweight or obesity. Overeating has been found to be a comfort-seeking behavior and may help individuals with overweight or obesity manage the stress caused by weight stigma (Tomiyama, 2014). Also, when individuals with overweight or obesity experience negative judgments related to their weight, they may feel blamed or accused of failing to be healthy and thin. Therefore, they may feel dissatisfied with their body image and have a sense of shame, which, in turn, may increase depression and anxiety (Kemeny, Gruenewald, & Dickerson, 2004; Tomiyama, 2014).

This review provided important information on measurement of weight stigma and its association with health outcomes for individuals with overweight or obesity. There is a need for further research on weight stigma experiences with physiological stress biomarkers and stress-related health outcomes. Longitudinal studies measuring personal perception of weight stigma are needed to further examine the long-term impact of weight stigma on physiological, psychological, and behavioral aspects for adults, adolescents, and children, especially non-western populations.

Review of Stress Responses, Cortisol, and Hair Cortisol Measurement

This section provides a literature review of stress responses, an introduction of cortisol, and a review of hair cortisol measurement.

Stress Responses

"Stress" is a term from engineering to describe a process of an agent exerting a force on an object (Kolb & Whishaw, 2006). When applying this concept to humans, a stressor represents a stimulus that challenges the body's homeostasis and triggers arousal (Kolb & Whishaw, 2006). Weight stigma is an unpleasant and painful personal experience; such experience may create negative emotion and make one feeling stressful, and should be considered as a psychological stressor for individuals with overweight and obesity (Puhl & Heuer, 2011). Stress responses are not only physiological but also behavioral and include both arousal and attempts to reduce stress (Kolb & Whishaw, 2006). Physical stressors (e.g., severe diseases, chronic pain, extreme exercise, and starvation) and psychological stressors (e.g., major life events) can induce a biological stress response in the human body (Wester & van Rossum, 2015).

The biological stress response consists of two pathways, one is a fast response, and the other is a slow response (Kolb & Whishaw, 2006). In the fast response, the hypothalamus sends a neural message through the spinal cord (Kolb & Whishaw, 2006). The sympathetic division of the autonomic nervous system is activated to stimulate the medulla of the adrenal gland to release epinephrine into the circulatory system (i.e., brain, body cell, and endocrine glands) (Kolb & Whishaw, 2006). The epinephrine surge (i.e., adrenaline surge) prepares the body for a sudden burst of activity and stimulates cell metabolism so that the body is ready for action (Kolb & Whishaw, 2006). In short, the fast response primes the body immediately for fight or flight (Kolb & Whishaw, 2006).

In the slow response, a hormone called steroid cortisol controls the response (Kolb & Whishaw, 2006). The HPA axis is responsible for the production of the cortisol by the adrenal cortex, and the HPA axis is readily activated by cognitive and non-cognitive stressful stimuli

(Tomiyama, 2014). In the brain, the hypothalamus releases corticotropin-releasing hormone (CRH) into the pituitary gland. The pituitary gland releases adrenocorticotropin hormone (ACTH), and ACTH acts on the cortex of the adrenal gland (Kolb & Whishaw, 2006). The adrenal cortex releases cortisol into the circulatory system (Kolb & Whishaw, 2006). Once in the circulation, approximately 95% of cortisol is bound to the specific carrier protein, cortisol binding globulin (CBG) and albumin (Turpeinen & Hamalainen, 2013). Approximately 5% of cortisol is in its unbound form in the blood and the majority of the unbound cortisol is in saliva and the rest of the unbound cortisol is in hair, urine or fingernails (Turpeinen & Hamalainen, 2013). The cortisol pathway acts from minutes to hours (Kolb & Whishaw, 2006). The function of cortisol is to adjust the body system to deal with stressors such as turning off insulin release so the liver can release glucose to increase the energy supply (Kolb & Whishaw, 2006). In short, the slow response both mobilizes the body's resources to deal with a stressor and repairs stress-related damage (Kolb & Whishaw, 2006).

Prolonged stress results in increased cortisol secretion, destruction of hippocampal neurons and decreased ability to shut off cortisol secretion, and mediates many health conditions such as hypertension and cardiovascular disease and drives eating behavior and fat storage (Tomiyama, 2014). If the stress response is not shut down, the body may continue to mobilize energy and growth hormone may be inhibited so the body decreases growth (Kolb & Whishaw, 2006). Also, protein may be used up, and muscle fatigue ensues, and the gastrointestinal system may shut down to reduce the process of food (Kolb & Whishaw, 2006).

Introduction of Cortisol

Background

Cortisol is the main glucocorticoid hormone produced by the adrenal cortex and the end product of HPA axis activity (Zhai, Chen, Zhu, & Lu, 2015). Cortisol also serves as a biomarker and reflects HPA axis activity (Zhai et al., 2015). Cortisol is a type of biochemical biomarker (Tahara, Huang, Kiritoshi, Onodera, & Toko, 2014). Biochemical biomarkers can be defined as a characteristic that is objectively measured and evaluated as indication of normal biologic processes or pathogenic processes (Aronson, 2005). In this study, cortisol will be defined as an indicator of stress-response pathogenic processes (i.e., HPA axis activity) and could be used to monitor the clinical and physical response to the weight stigma experience (Himmelstein et al., 2014).

Cortisol levels may fluctuate rapidly over the course of the day in response to multiple daily-life experiences as well as circadian rhythms (Hoffman, Karban, Benitez, Goodteacher, & Laudenslager, 2014). In a typical day, levels of cortisol start to rapidly increase in the first hour after awakening by 38% to 75%, peaking approximately 30 minutes after awakening, followed by a steep decline over the next three hours (Elder, Wetherell, Barclay, & Ellis, 2014). Levels then follow a gradual decline over the remainder of the day, reaching the lowest point during the first half of the sleep period (Elder et al., 2014). During sleep, cortisol levels remain low and then start to rise again in the morning upon awakening (Elder et al., 2014). High cortisol levels are found in acute stress responses, psychiatric diseases, obesity, diabetes, alcoholism, pregnancy and Cushing's syndrome (Turpeinen & Hamalainen, 2013). Low cortisol levels are seen in patients with rare adrenal enzyme defects and after long-lasting stress (Turpeinen & Hamalainen, 2013).

Common Cortisol Analyses

Common cortisol analytical methods in clinical laboratories are immunoassays (IA) and enzyme immunoassays (EIA), luminescence and fluorescence assays (Turpeinen & Hamalainen, 2013). Those methods are available in many commercial kits and on automated platforms (Turpeinen & Hamalainen, 2013). The most widely used method is the EIA kit (Turpeinen &

Hamalainen, 2013). The EIA kit uses several strategies to measure free cortisol (i.e., unbound to protein) (Salimetrics, 2014). A microtitre plate is coated with monoclonal antibodies to cortisol (Salimetrics, 2014). Cortisol in standards and unknowns competes with cortisol linked to the horseradish peroxidase for the antibody binding sites (Salimetrics, 2014). After incubation, unbound components are washed away (Salimetrics, 2014). Bound cortisol peroxidase is measured by the reaction of the peroxidase enzyme on the substrate tetramethylbenzidine (Salimetrics, 2014). This reaction produces a blue color, and a yellow color is formed after stopping the reaction with sulfuric acid (Salimetrics, 2014). Optical density is read on a standard plate reader at 450 nanometers (Salimetrics, 2014). The amount of cortisol peroxidase detected, as measured by the intensity of color, is inversely proportional to the amount of cortisol present (Salimetrics, 2014). In an immunometric assay, the color generated is directly proportional to the amount of analyte present (Salimetrics, 2014).

Cortisol levels can be measured by blood (Haleem, Inam, Haider, Perveen, & Haleem, 2015), saliva (Umeanuka, Saheeb, Uguru, & Chukwuneke, 2015), urine (Suzuki et al., 2015), hair (Steudte-Schmiedgen et al., 2015), feces (He et al., 2014), and fingernails (Izawa et al., 2015). The following section introduces four most common measurements of cortisol: blood, saliva, urine, and hair.

Blood Cortisol

Blood cortisol testing is the most invasive of all of the approaches, secondary to the pain and discomfort caused by venipuncture. Erroneous test results may also be noted due to the elevation in cortisol levels caused by the participant's fear of venipuncture (Weckesser et al., 2014). Collecting blood may create a stressful situation that falsely elevates cortisol levels (Tahara et al., 2014). Non-invasive methods such as collecting cortisol in saliva, urine, or hair offer the opportunity to collect the samples stress-free in many different environments

(Umeanuka et al., 2015; Suzuki et al., 2015; Steudte-Schmiedgen et al., 2015). Also, the process of collecting salivary, urine or hair cortisol is easier than serum cortisol and does not require professional medical personnel (Turpeinen & Hamalainen, 2013).

Salivary Cortisol

Salivary cortisol testing is a non-invasive method to test cortisol levels (Desai & Mathews, 2014). Salivary cortisol concentrations are known to increase within 5 minutes of increases in serum cortisol levels (Desai & Mathews, 2014). The proportion of salivary cortisol to serum total cortisol is about 1-2% in the lower range, but about 8-9% in the upper range (Hellhammer, Wust, & Kudielka, 2009). Salivary cortisol could be determined by a high sensitivity enzyme immune assay kit (EIA kit) because in saliva the majority of cortisol remains unbound to protein and EIA kit uses antibodies to capture unbound cortisol in saliva (Nalla, Thomsen, Knudsen, & Frokjaer, 2015). Salivary cortisol levels are unaffected by salivary flow rate or salivary enzymes (Nalla, Thomsen, Knudsen, & Frokjaer, 2015). For adults, the morning range of salivary cortisol levels ranges from 0.094 to 1.551 grams per deciLiter (g/dL) and the evening range is from not detected to 0.359 g/dL (Aardal & Holm, 1995).

Salivary cortisol levels have to be interpreted with caution. Salivary cortisol levels do not reflect a linear adrenocortical response to ACTH or adrenergic stimulation (Hellhammer et al., 2009). For example, an increase of salivary cortisol of only 5 nanomoles per liter (nmol/l) would be detected if serum total cortisol levels increased from 200 to 400 nmol/l (Hellhammer et al., 2009). The same serum total cortisol increase of 200 nmol/l from 500 to 700 nmol/l would result in a threefold higher increase of about 15 nmol/l cortisol in saliva (Hellhammer et al., 2009). The non-linearity problem between the cortisol levels in blood and saliva may only appear in situations of high salivary cortisol levels (Hellhammer et al., 2009).

Urine Cortisol

Only about 1% of free blood cortisol (i.e., unbound to protein) is excreted in urine (Raff, Auchus, Findling, & Nieman, 2015). Urine free cortisol is commonly used to diagnose Cushing's syndrome (Raff et al., 2015). The extraction method for urine cortisol concentration values requires a 24 hours urine collection to provide integrative HPA axis measures over larger time periods (Raff et al., 2015). In many laboratories, the mean of two to three 24-hour urine collections is used for reliable estimation of the average daily cortisol excretion to avoid the issue of inaccurate urine collection by subjects (Turpeinen & Hamalainen, 2013). A urinary cortisol sample represents the production of cortisol over a fixed time period and urine excretion may, therefore, better reflect cortisol production than a single serum sample (Turpeinen & Hamalainen, 2013). Poor compliance or non-adherence of repeated overnight or 24-hour urine collections is a major problem when analyzing cortisol in the urine (Russell, Koren, Rieder, & Van Uum, 2012). Also, urinary cortisol levels may be affected by renal conditions, so researchers have to evaluate creatinine clearance to adjust for urinary cortisol levels (Hellhammer et al., 2009). The reduction in urinary output commonly seen in older adults and chronic renal insufficiency and failure can erroneously affect urinary cortisol results (Russell et al., 2012).

Long-Term Cortisol Level and Hair Cortisol

Blood, saliva, or urine cortisol collection represents the acute status of the HPA axis instead of chronic HPA activation (Russell et al., 2012). If researchers want to examine the long-term cortisol level such as chronic stress response of HPA activity, researchers need to use repeated measures of saliva, urine, and blood to measure long-term cortisol characterizations (Wright, Hickman, & Laudenslager, 2015). However, providing repeated measures of saliva, urine, or blood increases burden and discomfort for study participants (Wright et al., 2015). For instance, study participants will need to collect four saliva or blood samples a day at four standardized time points (immediately on waking, 30 min post-awakening, 3 hours post-awakening, and 12 hours post-awakening) for a month in order to properly capture the long-term characterizations of cortisol (Elder et al., 2014). The repeated measures of saliva and urine may induce participant error in collection or non-compliance with collection protocols (Hoffman et al., 2014).

Hair cortisol analysis may offer another approach to measuring the HPA axis activity in response to chronic stressors with a one-time non-invasive collection (Wright et al., 2015). The cortisol hair collection process does not cause physical discomfort to participants (Wright et al., 2015). Hair specimens are easy to ship and can be stored at room temperature, unlike other specimens such as saliva, urine, and blood, which have to be stored under certain conditions (Rocky Mountain Analytical, 2015; Wright et al., 2015).

Hair cortisol can serve as a biomarker of long-term or chronic stress with minimum cost (Gerber et al., 2012). The average cost of blood, salivary, or urinary cortisol analysis is approximately $20 U.S. dollars for each sample (Wright et al., 2015). Cortisol secretion fluctuates based on a marked circadian pattern (Elder et al., 2014), subjects need to collect four blood or saliva samples at four standardized time points in order to capture the dynamic range of cortisol properly. The cost is $80 per day per subject for multiple samples (Wright et al., 2015). However, hair cortisol analysis may require only one sample every 3 months for approximately $50 U.S. dollars per sample because hair cortisol concentrations are assumed to provide a retrospective reflection of integrated cortisol secretion over periods of several months (Stalder & Kirschbaum, 2012; Wright et al., 2015).

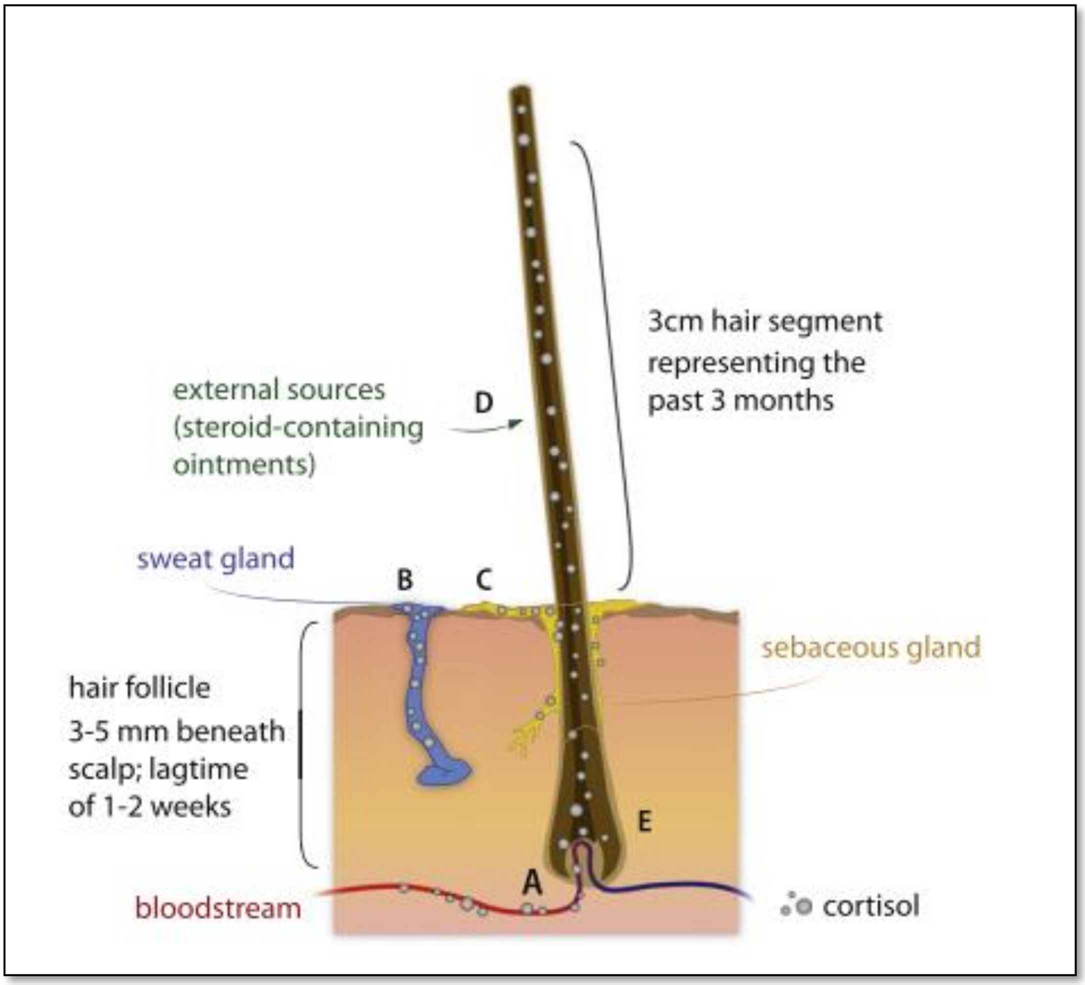
Hair Cortisol Measurement

Hair cortisol measurements can create a retrospective timeline of cortisol exposure (Wester & van Rossum, 2015). Hair cortisol is assumed to provide a retrospective reflection of integrated cortisol secretion over a period of several months (Stalder, & Kirschbaum, 2012). Evidence has shown that hair cortisol sensitively reflects cumulative cortisol secretion over a total period of 3-9 months (Stalder, & Kirschbaum, 2012). Hair cortisol is a unique marker that provides researchers with information about participant's HPA activity before recruitment into a study from the historical information contained in their hair (Wright et al., 2015). Hair cortisol allows researchers to examine cortisol production retrospectively and provides a baseline cortisol assessment for a period during, before and after a stressful event (Russell et al., 2015). Measures of the HPA axis such as saliva, urine, and serum cortisol only cover a brief time period, but hair cortisol could capture long-term cortisol secretion (Gerber et al., 2012). Weight stigma may be a source of chronic stress since individuals with overweight or obesity may experience weight stigma over time and repeatedly (Wu & Liu, 2015).

Cortisol obtained from scalp hair is a lipophilic substance that originates from the vascular supply which nourishes the hair shaft follicular cells (Wright et al., 2015). After the adrenal cortex releases cortisol into the circulatory system, free cortisol (i.e., unbound active form) is released from the circulation into the medullary region in the core of the hair shaft (Wright et al., 2015). It is assumed that cortisol enters the hair shaft through passive diffusion and that the hair cortisol concentration represents cumulative free circulating cortisol levels (Wester & van Rossum, 2015). Sources of cortisol on the surface of the hair include both sweat and sebaceous glands (Wright et al., 2015). The standard procedure of hair cortisol testing usually includes the steps of washing, grinding, and extracting (Wright et al., 2015). Cortisol on the surface of the hair is eliminated by washing (Wright et al., 2015).

Hair growth rate is approximately 1-centimeter per month (Figure 2.2) so the analysis of a 3-centimeter hair segment reflects integrated cortisol secretion over a three-month period (Stalder, & Kirschbaum, 2012). Ideally, the 1-centimeter segment of hair most proximal to the scalp represents the cortisol level of the last month and the second most proximal 1-centimeter segment of hair represents the level of the previous month (Stalder, & Kirschbaum, 2012). Intervention studies could collect hair samples once to examine the effects of intervention in pre- and post-test by using a different segment of the hair sample (Wright et al., 2015). However, it is worth noting that hair cortisol concentrations show a significant decline from proximal to more distal hair segments (F (1.225, 20.831) = 5.195, p = .027) (Steudte et al., 2011). Hair cortisol concentration has been shown to decrease as one moves distally from the scalp due to exposure to water, sunlight and other elements (Wosu, Valdimarsdottir, Shields, Williams, & Williams, 2013).

Figure 2.2. Anatomy of Hair (Stalder & Kirschbaum, 2012)



Hair cortisol analysis has been used in adults with depression (Wei et al., 2015), post-traumatic stress symptoms (Wang et al., 2015), Pituitary-Adrenal Disease (Staufenbiel et al., 2015), and metabolic syndrome (Langerak et al., 2015). It also has been used in caregivers' chronic stress (Chen et al., 2015), the synergies of obesity and psychosocial stress in young adults (Keenan-Devlin, 2015), children (Veldhorst et al., 2014), and long-term cortisol levels in adults with obesity (Wester et al., 2014).

Regardless of the psychological effects of weight stigma, obesity itself may have a certain physiologic effect on hair cortisol concentration. A positive association between participants with obesity and hair cortisol levels has been observed in previous studies (Stalder et al., 2013; Veldhorst et al., 2014; Wester et al., 2014). Adults with obesity had significantly higher ($p < 0.001$) hair cortisol concentrations than adults with normal weight and overweight; however, hair cortisol concentrations did not significantly (post hoc comparison, $p = .96$) differ between adults with normal weight and overweight (Wester et al., 2014). The association between increased weight and long-term cortisol may only appear in a more extreme phenotype of adiposity (Wester et al., 2014). Similarly, hair cortisol concentrations were higher in children with obesity than in children with normal weight (median [interquartile range], 25 [95% CI 17-32] vs 17 [95% CI 13-21] picogram per milligram; $p < .05$) (Veldhorst et al., 2014). The correlations between hair cortisol concentrations and BMI ($r = .407$; $p < .01$) and between hair cortisol concentrations and waist circumference in children ($r = .430$; $p < .01$) were statistically significant (Veldhorst et al., 2014). High hair cortisol concentrations suggest long-term activation of the HPA axis in children with obesity (Veldhorst et al., 2014). Although the reasons for high hair cortisol concentrations in individuals with obesity remain unclear, experiencing high psychological stress from society due to excess body weight may be one of the reasons for this observation (Veldhorst et al., 2014).

Analysis Procedure

Enzyme-Linked Immunosorbent Assay (ELISA) is often used to measure hair cortisol levels (Albar, Russell Evan, Koren, Rieder, & van Umm, 2013). ELISA is a highly sensitive technique for detecting and measuring cortisol in a solution. The solution is run over a surface to which immobilized antibodies specific to cortisol have been attached, and if cortisol is present, it will bind to the antibody layer, and its presence will be varied and visualized with an application of antibodies that have been tagged (Albar et al., 2013). The steps of the ELISA results in a colored end product which correlates to the amount of cortisol present in the original sample (Albar et al., 2013).

There are several steps that have to be considered in the analysis procedure of hair cortisol. While the analysis procedure of hair cortisol is similar between different laboratories, the detail of each step such as the weight of hair mass or the dosage of isopropanol show relatively wide variability between laboratories (Albar et al., 2013). The steps of the procedure include: collecting the hair (10-15 milligrams [mg] or 25-50 mg); washing the hair (2.5-3.0 milliliters [ml] of isopropanol), pulverization (surgical scissors or Retsch ball mill), extraction solvent (1-1.5 ml methanol), duration of extraction and temperature, centrifugation during extraction, solvent evaporation (nitrogen), reconstituting solvent (250-400 microliter [μl] of phosphate buffered saline), duration of vortexing (15 seconds to 1 minute), ELISA used and cross reactivity, centrifugation during ELISA (100-500 revolutions per minute [rpm]), and wavelength while measuring cortisol (at 450 nanometer) (Albar et al., 2013).

Data Interpretation

The normal range of hair cortisol is 5.9 - 22.6 picogram per milligram (pg/mg), this represents normal HPA axis function in the absence of significant patient history or symptoms (Rocky Mountain Analytical, 2015). Below normal hair cortisol levels indicate that cortisol levels are chronically depressed or blunted (Rocky Mountain Analytical, 2015). Duration of stressors affects HPA axis activity (Woda, Picard, & Dutheil, 2016). Stressors activate the HPA system, and the adrenal cortex produces high levels of cortisol to mobilize energy. Therefore, high cortisol levels can be observed at the beginning of a stressful situation. Then, cortisol levels are reduced by an auto-regulated feedback system. However, long-term exposure to stressful situations may lead the HPA axis from hyperactivity (i.e. high cortisol level) to hypoactivity (i.e., low cortisol level) (Maripuu, Wikgren, Karling, Adolfsson, & Norrback, 2016). Low hair cortisol levels may be a consequence of decreased cortisol output due to chronic and prolonged stress (Rocky Mountain Analytical, 2015).

Potential Confounding Influences

Hair cortisol concentration may be affected by ultraviolet sun exposure and hair growth rate (Li et al., 2012; Wright et al., 2015). The most common location to take a hair sample for cortisol analysis is the posterior vertex, because hair cortisol may be decreased by long-term ultraviolet sun exposure (Li et al., 2012). Cortisol levels after ultraviolet light were found to be significantly lower than hair without exposure to ultraviolet light (t (11) = -3.392, p<.01) (Li et al., 2012). After 9 hours of ultraviolet light, the average hair cortisol loss ratio was 26.5± 20.9% (Li et al., 2012). The bleaching effect of ultraviolet light may be one reason why hair cortisol was reduced (Li et al., 2012). Therefore, cortisol obtained from the posterior vertex is more likely to accurately reflect HPA activity (Li et al., 2012). Another reason for obtaining hair cortisol from this location is because of the stable growth rate (Wright et al., 2015). However, if participants have an issue with hair loss or thinning hair, they may be reluctant to provide a hair sample (Wright et al., 2015). Participants with hair loss cannot use other sites such as the arms or legs for hair collection because the growth rates differ and cortisol collected from those sites may not reflect the same cortisol levels collected from the posterior vertex (Wright et al., 2015).

Hair cortisol concentration increases with age (Wester & van Rossum, 2015). Compared to younger participants, older participants were found to have higher hair cortisol levels (Feller et al., 2014). The difference between older and younger participants is that hair grows faster in younger participants (Wright et al., 2015). Slower growing hair in the posterior vertex will have higher levels of cortisol concentration than faster-growing hair because the hair has more time to accumulate cortisol (Wright et al., 2015). However, there is minimal research examining the influence of different hair growth rates among participants (Wright et al., 2015).

Different racial and ethnic groups may have different levels of cortisol concentration in their hair samples (Wright et al., 2015). Analyses by race and ethnicity showed a significantly higher median hair cortisol concentration in non-Hispanic Blacks (12.5 [95% CI 6.9-29.3]) pg/mg), followed by Hispanics (10.7 [95% CI 5.8-14.9] pg/mg), non-Hispanic Whites (5.0 [95% CI 3.8-10.8] pg/mg), and then other participants (4.2 [95% CI 3.3-15.7] pg/mg), $p<.01$ (Wosu et al., 2015). A trend toward elevated mean cortisol levels in unprocessed hair was also observed in the hair of African Americans (mean± SD: 36.85±46.0 pg/mg) and Native Americans (mean ±SD: 40.5±32.2 pg/mg) (Hoffman et al., 2014).

Hair cortisol concentration levels are not affected by natural hair color (e.g., gray, black, blonde), hair curvature or waves; however, cosmetic hair treatments may affect the concentration (Hoffman et al., 2014; Wosu et al., 2013). Cosmetic hair treatments such as bleaching and permanent wave solution may involve chemical like persulfates and peroxides that alter the hair shaft (Hoffman et al., 2014). Compared to unprocessed hair from the same individual, hair treated with bleach (p = .0005) and permanent wave solution (p = .007) significantly decreased hair cortisol levels (Hoffman et al., 2014). After adjusting for age and sex, hair cortisol level concentration was 0.72 pg/mg lower in dyed hair compared with hair that was not dyed (β = -0.72, SD = 0.30, 95% CI: -1.29 to -0.15, p = .02) (Wosu et al., 2015). The cortex of hair is exposed during chemical hair processing, and the hair cortex surrounds the hair shaft medulla where cortisol is thought to enter hair from the blood (Hoffman et al., 2014). Bleached, permanent wave solution and dyed hair may affect cortisol within the medullary region in the hair shaft causing erroneous results (Hoffman et al., 2014).

Hair cortisol is also significantly affected by repeated shampooing and hot water (Hoffman et al., 2014). Compared to unprocessed hair from the same individuals, hair shampooed in a laboratory 15 times (p = .04) and 30 times (p = .02) demonstrated a significant reduction in hair cortisol levels (Hoffman et al., 2014). Hair cortisol levels were also decreased after 4 hours of immersion in a 10% shampoo solution (i.e., shampoo concentration was 10% by weight in water) at room temperature with the average cortisol loss ratio at 75.5±27.4% (Li et al., 2012). Professional salon care often involves repeat shampooing. It is unclear why repeat shampooing reduces hair cortisol levels; however, after repeat shampooing the condition of the hair changes from healthy and shiny to dry and easily broken (Hoffman et al., 2014). Also, hot water may also affect hair cortisol levels (Li et al., 2012). The hair shaft swells in an aqueous medium, which may also contribute to the loss of cortisol from the interior of the hair shaft (Li et al., 2012). Hair cortisol level was decreased when immersed at 40 Celsius (p<.001), 65 Celsius (p<.001) and 80 Celsius (p<.001) hot water for eight hours (Li et al., 2012).

Smoking and shift work may both affect hair cortisol concentration levels as well (Manenschijn, van Kruysbergen, de Jong, Koper, & van Rossum, 2011; Wosu et al., 2015). Current smokers had significantly higher median hair cortisol level concentrations (11.7 [95% CI 8.8-18.9] pg/mg) compared with former smokers (4.6 [95% CI 3.5-14.6] pg/mg) and those who had never smoked (6.9 [95% CI 4.7-12.8] pg/mg, p = .04) (Wosu et al., 2015).

Chronic shiftwork may alter the circadian rhythm of cortisol production leading to HPA dysfunction (Wosu et al., 2013). Mean hair cortisol levels were significantly higher in individuals who worked the evening and night shift compared to those who worked the day shift (47.32 pg/mg [95% CI 38.37-58.21] vs. 29.72 pg/mg [95% CI 26.18-33.73], p< .001) (Manenschijn et al., 2011). After adjustment for age, BMI, and frequency of hair washing, the differences between hair cortisol level concentrations of individuals who did evening and night shift work compared to day shift remained significant (p<.01) (Manenschijn et al., 2011).

Summary of Chapter Two

Chapter 2 reviewed the published evidence on the associations between weight stigma and physiological and psychological health outcomes. It also reviewed stress response, cortisol, and hair cortisol measurement. Overall, the greater the weight stigma, the worse the physiological and psychological health of adults with overweight and obesity, regardless of the measures of weight stigma. Also, there is a need to examine the relationship between weight stigma and stress biomarkers and stress-related health outcomes, especially in non-western populations.

In the review of stress responses, cortisol, and hair cortisol measurement, the stress response included fast and slow responses. Cortisol is a type of biochemical biomarker and can be an indicator of HPA axis activity. Measures of the HPA axis such as saliva, urine, and serum cortisol only cover a brief time period of stress response, but hair cortisol provides a retrospective reflection of integrated cortisol secretion over periods of several months, which allows researchers to examine the impact of chronic stress such as weight stigma. Hair cortisol concentration levels may be affected by ultraviolet sun exposure, hair growth rate, age, racial and ethnic status, cosmetic hair treatment, repeated shampooing, hot water, and certain lifestyles such as smoking and shift work. In Chapter 3, the study procedures used in the present cross-sectional study were discussed.

CHAPTER 3: METHODS

Introduction

This chapter describes the procedures used in this cross-sectional study. The research aims, research design, study setting, subjects, sample size, ethical considerations, measurements, recruitment procedures, procedures, retention plan, data management, data analysis and a summary of chapter three are described in this chapter.

Aims

The purpose of this study was to examine the relationships among weight stigma experiences, acculturation, hair cortisol, and binge eating among Asian American adults (≥ 21 years of age) with overweight and obesity living in North Carolina (N.C.), United States (U.S.). The specific aims were: (1) to examine the relationship between the experience of weight stigma and hair cortisol levels; (2) to examine the relationship between the experience of weight stigma and binge eating; (3) to examine whether the level of acculturation moderates the relationship between the experience of weight stigma and hair cortisol levels; and (4) to examine whether the level of acculturation moderates the relationship between the experience of weight stigma and binge eating among Asian Americans with overweight and obesity.

Research Design

The purpose of this descriptive, cross-sectional design study using a convenience sample was to gain an initial understanding of the relationship between the experience of weight stigma, level of acculturation, hair cortisol levels and binge eating, after statistically controlling for the level of perceived racism and perceived stress as covariates, among Asian American adults with overweight and obesity in N.C. The rationale for the research design was driven by the previous understanding of weight stigma in Asian Americans in N.C. and the research questions that emerged. The experimental design examined the potential cause-effect (i.e., causal) relationships between the primary independent (weight stigma experience) and dependent (hair cortisol levels and binge eating) variables (Polit & Beck, 2008). However, there have been no studies conducted to date that explain the relationships among these variables in Asian Americans with overweight and obesity. Therefore, the purpose of this study was to use a cross-sectional design to gain an initial understanding of the links between these variables at a single point in time (Polit & Beck, 2008).

This was the first study designed to understand weight stigma in the Asian American population using the Stigmatizing Situations Inventory (Myers & Rosen, 1999), Binge Eating Scale (Gormally, Black, Daston, & Rarin,1982), the Suinn-Lew Asian Self-Identity Acculturation Scale (Suinn, Ahuna, & Khoo, 1992), the Subtle and Blatant Racism Scale for Asian Americans (Yoo, Steger, & Lee, 2010), the Perceived Stress Scale (Cohen, Karmack, & Mermelstein, 1983) and hair cortisol samples using a non-invasive collection method simultaneously. In this study, perceived racism for Asian Americans and perceived stress levels were statistically controlled for in all of the aims in the analysis as covariates.

Study Setting

The study was conducted in Chapel Hill, Durham, Raleigh and Cary, N.C., U.S. The size of the Asian American population of N.C. has been published at 256,427 (N.C. Government, 2013). Although there are no relevant data for overweight, approximately 17.1% of Asian American adults in N.C. are categorized as obese (N.C. Government, 2013; N.C. State Center for Health Statistics, 2013). The study was conducted in partnership with the University of North Carolina at Chapel Hill (UNC-CH) School of Nursing, the UNC-CH Biobehavioral Lab, the

Duke University Greenleaf Lab, and six Asian American Associations and churches: (1) Taiwanese Association of America - North Carolina Chapter (TAA-NC), (2) Evangelical Formosan Church of North Carolina (EFCNC), (3) Friendship Association of Chinese Students and Scholars Association (FACSS), (4) Chinese Christian Mission Church(CCMC), (5) Raleigh Chinese Christian Church (RCCC), and (6) Chapel Hill Chinese school. The TAA-NC, the EFCNC and the FACSS are three large Asian American community sites in N.C. The TAA-NC was built in 1995 and serves approximately 1000 Taiwanese immigrants, the EFCNC was built in 1975 and serves approximately 500 Asian American immigrants, and FACSS was built in 1999 and serves more than 1000 Chinese students and scholars.

Subjects

Inclusion criteria included (a) U.S. born or foreign-born Asian Americans living in N.C.; (b) between 21 to 65 years of age; (c) who could read and write in English at a sixth-grade level or above (Lynn, 1989); (d) and had a body mass index (BMI) >23 kg/m^2. Exclusion criteria included participants (a) who had a mental illness such as schizophrenia or a cognitive limitation such as Alzheimer's disease or dementia, which would have made it difficult to complete the surveys (Arango , Fraguas, & Parellada, 2013; Pearman, 2013), (b) who regularly used recreational drugs such as cannabis or any other recreational drugs, secondary to the potential influence on cortisol activity (Granger, Johnson, Szanton, & Out, 2012); (c) who regularly used seizure medication, estrogen, hydrocortisone, prednisone or androgens within the past year, which may have affected the results of cortisol testing (Granger et al., 2012); and (d) who had diseases affecting cortisol activity such as Cushings disease, ectopic Cushings syndrome, tumors of the adrenal gland, Addison disease, or hypopituitarism (Granger et al., 2012), (e) worked the night shift within the past year, or had shift work within the past year which may also affect hair cortisol concentration levels (Manenschijn et al., 2011); and (f) who are pregnant. All participants were asked these questions during screening for eligibility using a telephone interview guide. Also, if potential participants fit the inclusion criteria and used hair dye within the past year, the principal investigator (PI) asked them not to dye their hair for one month to allow for new 1-cm hair growth and collected all data one month later.

Sample Size

For power analysis, G*Power 3 software (Faul, Erdfelder, Lang & Buchner, 2007) was used. Himmelstein and colleagues (2014) examined the effects of experimentally manipulated weight stigma on cortisol response in 110 female undergraduate participants and had an effect size of 0.12 (i.e., coefficient of determination [R^2] = 0.12) (Himmelstein et al., 2014). The results of the power analysis for this study indicated that 140 participants were needed to reach a power of 0.80 with the effect size of 0.12 and $\alpha = 0.05$. Attrition was projected to be 20% (Polit & Beck, 2008); Therefore, a total of 168 participants were needed to be enrolled in the study.

Ethical Considerations

The protocol for this study was approved by the Institutional Review Board (IRB) for the Protection of Human Subjects at the University of North Carolina at Chapel Hill. The Principal Investigator (PI) protected participants from harm, unnecessary risks, or mental and physical discomfort. Informed consent was obtained using a written informed consent in English. The PI fully explained the purpose of the study, the procedures, and potential benefits and harm and answered all questions. The participants were told that they could choose not to participate in the study and could freely withdraw from the study at any time without negative consequences. Once, potential participants, had all of their questions answered they were asked to sign the consent. Confidentiality procedures were maintained. Personal information, such as names and addresses, were separated from all questionnaires and hair samples. The PI assigned a confidential and sequential study identification number to each participant's study documents, questionnaires, and hair samples. The list of names and the numbers were kept confidential in two separate documents which were locked in two separate file cabinets behind a locked door where only the PI and dissertation chair had access. The Microsoft Excel file that contained the list of names and numbers was stored in a password-protected computer.

All data were entered by the PI. The hair cortisol results were entered into a Microsoft Excel format by the PI and kept in the password-protected computer in the PI's office behind a locked door. All data were double entered into Excel and SAS databases created for the study and kept on a password-protected computer in the PI's office behind a locked door. Study results were presented and published without any individually identifiable information.

Measurements

A summary of measures is presented in Table 3.1. Demographic data, height and weight, BMI, hair cortisol, the Stigmatizing Situations Inventory (SSI) (Myers & Rosen, 1999), the Binge Eating Scale (BES) (Gormally et al., 1982), the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) (Suinn, Ahuna, & Khoo, 1992), the Subtle and Blatant Racism Scale for Asian Americans (SABR-A^2) (Yoo, Steger, & Lee, 2010), and the Perceived Stress Scale (PSS) (Cohen et al., 1983) were collected in this study. Internal consistency reliability was examined using Cronbach's alpha for the SSI, BES, SL-ASIA, SABR-A^2, and the PSS. A reasonable acceptability criterion for Cronbach's alpha ranges from 0.70 to 0.95 (Tavakol & Dennick, 2011).

Table 3.1. Summary of Measures

Variable	Measurement	α^1	α^2
Demographic variables	Age, gender, education level, marital status, occupation, annual income, family country of origin, ethnicity country of birth and current residence, generation, years lived in Asia, years lived in the U.S., years in an Asian or non-Asian neighborhood, age upon beginning school in the U.S., years attending school in the U.S., previous experience with dieting in the past six months.	N/A	N/A
Hair-related variables	Frequency of hair washing per week, usual water temperature used for hair washing based on participants' own judgment, frequency of swimming per week, hair color, and weight of hair subjected to extraction (milligram).	N/A	N/A
Anthropometric measurements	Body height, body weight, BMI. BMI formula: BMI = weight(kg)/height^2(m^2)	N/A	N/A
Biochemical measurements	Hair cortisol level by the UNC-CH Biobehavioral Lab with a high-sensitivity enzyme immunoassay (EIA) kit.	N/A	N/A
Weight stigma experience	Stigmatizing Situations Inventory (SSI) (Myers & Rosen, 1999)	.82-.94	.79-.94
Binge eating behaviors	Binge Eating Scale (BES) (Gormally et al., 1982)	.73-.85	.75-.86
Acculturation for Asian Americans	The Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) (Suinn, Ahuna, & Khoo, 1992)	.91	.86
Perceived racism for Asian Americans	The Subtle and Blatant Racism Scale for Asian Americans (SABR-A^2) (Yoo, Steger, & Lee, 2010)	.72-.84	.58-.79
Perceived stress	Perceived Stress Scale (PSS) (Cohen et al., 1983)	.74-.86	.75-.89

Note. α^1 = Cronbach's alpha from previous studies; α^2 = Cronbach's alpha from the present study; N/A = not applicable

Demographic Variables

The demographic variables are presented in Appendix 3.1. Participants were asked to report their age, gender, education level (middle school and below, high school, college/university, graduate school), marital status (single, divorced, widowed, unmarried but in a relationship and do not live with your partner, unmarried but in a relationship and live with your partner, married and living with a spouse; legally married but separated). Information was also collected on occupation (reported actual occupation by participants, then the PI recoded all occupations into 10 categories: business/market/financial, computer/information technology, research/education, healthcare practitioners, self-employment, housewife/ student/ unemployment, retired, and others) and annual income (reported by actual U.S. dollar). Participants also were asked to describe their family country of origin, ethnicity, country of birth and current residence, years lived in the U.S., years in an Asian or non-Asian neighborhood, age upon beginning school in the U.S., years attending school in the U.S., and previous experience with dieting in past six months (yes/no).

Hair-Related Characteristics

The questions about hair-related characteristics are also presented in Appendix 3.1. Participants were asked to report the frequency of washing their hair per week during the last month, usual water temperature used for hair washing based on the participants' judgment, and frequency of swimming per week during in the previous month. Hair colors (i.e., black and a mix of black, gray, and white) and weight of hair subjected to extraction (milligram) were documented by the PI during the hair cortisol analysis procedure at the UNC-CH Biobehavioral Lab.

Anthropometric Measurements

Height and weight were measured by the PI. All participants were dressed in light indoor clothes, without socks and shoes. Weight was measured twice and averaged using a portable digital scale and recorded to the nearest 0.1 kilogram (kg), according to an established protocol. Height was measured twice and averaged using a portable Martin stadiometer and recorded to the nearest 0.5 centimeter (cm), according to an established protocol. BMI was calculated by entering averaged weight and height into a BMI computerized formula.

Biochemical Measurements

Hair samples were analyzed by the UNC-CH Biobehavioral Lab and the Duke University Greenleaf Lab for the cortisol levels. Only the 1-centimeter segment of hair most proximal to the scalp was analyzed. The procedure for hair analysis included (1) Sample washing and drying: hair samples were washed by the PI using a high-performance liquid chromatography (HPLC)-grade isopropanol and were dried for 2-3 days to ensure complete isopropanol evaporation; (2) Sample grinding: After the sample washing and drying procedures, the PI took the hair samples to the Duke University Greenleaf Lab, where the hair was ground using a bead beater; and the PI brought the powdered hair samples back to the UNC-CH Biobehavioral Lab for the next step; (3) Cortisol extraction: the PI extracted the cortisol by the HPLC-grade methanol; (4) Solvent evaporation and sample reconstitution: The PI dried down the methanol using a vacuum evaporator and reconstituted the cortisol extract in an appropriate volume of high-sensitivity enzyme immunoassay (EIA) assay buffer, then the assay was reconstituted immediately; (5) Cortisol assay: The PI assayed the hair extracts for cortisol using an EIA kit (Meyer, Novak, Hamel, & Rosenberg, 2014); (6) Data conversion: Because the EIA kit is designed to measure cortisol values in liquid samples such as saliva, the output was converted to amount of cortisol per unit weight of powdered hair (Meyer et al., 2014). The following formula converted assay output in micrograms per deciliter (μg/dl) to picogram (pg) cortisol per mg hair:

$$(A/B) * (C/D) * E * 10{,}000 = F$$

Where A = μg/dl from assay output

B = weight (in milligrams) of hair subjected to extraction

C = volume (in milliliters) of methanol added to the powdered hair

D = volume (in milliliters) of methanol recovered from the extract and subsequently dried down

E = volume (in milliliters) of assay buffer used to reconstitute the dried extract

F = final value of hair cortisol concentration in picogram per milligram (pg/mg)

(Meyer et al., 2014)

Weight Stigma Experiences

The participant's weight stigma experience was measured using the Stigmatizing Situations Inventory (SSI) (Myers & Rosen, 1999). The English version of the Stigmatizing Situations Inventory has been used in the U.S. for Asian populations (Tomiyama et al., 2014) and the Chinese version of the Stigmatizing Situations Inventory has been used in Taiwan for the Taiwanese population (Wu & Liu, 2015). The English version of the Stigmatizing Situations Inventory was used in this study. Appendix 3.2 presents all items of the Inventory. The original Stigmatizing Situations Inventory was developed by Myers and Rosen (1999) and has 50 items with 11 subcategories: (1) comments from children (four questions); (2) others making negative assumptions about you (three questions); (3) physical barriers (seven questions); (4) being stared at (five questions); (5) inappropriate comments from doctors (four questions); (6) nasty comments from family (seven questions); (7) nasty comments from others (11 questions); (8) being avoided, excluded, ignored (two questions); (9) loved ones embarrassed by your size (three questions); (10) job discrimination (three questions); and (11) being physically attacked (one question) (Myers & Rosen, 1999). Due to the repetitiveness of the 11 subcategories, Carissa (2010) merged the 11 subcategories into two subcategories: the Stigmatizing Situations Inventory from People (SSIP, 43 items) and Stigmatizing Situations Inventory from Others (SSIO, 7 items). The English version of the modified Stigmatizing Situations Inventory with a 4-point scale was used in this study (0 = never experienced the weight stigma situation in question; 1 = experienced one instance; 2 = experienced more than one instance; 3 = experienced multiple instances) (Puhl & Brownell, 2006). The overall score of the Stigmatizing Situations Inventory was computed by adding all of the questions and dividing by 50 to create a mean score of weight stigma experiences. Average scores range from 0 to 3 with higher scores indicating higher weight stigma experiences (Ashmore et al., 2008). In a previous study with 141 Asian participants, the Cronbach's alpha of the overall SSI, the SSIP subscales, and the SSIO subscale were .94, .94 and .82, respectively (Wu & Liu, 2015). In this study, the Cronbach's alpha for the overall SSI, the SSIP subscales, and the SSIO subscale were .94, .92, and .79, respectively.

Binge Eating

Binge eating was measured using the Binge Eating Scale (BES) (Gormally et al., 1982). The English version of the Binge Eating Scale has been used in the U.S. for Asian populations (Burmeister & Carels, 2014) and the Chinese version of the Scale has been used in Taiwan for the Taiwanese population (Wu & Liu, 2015). The English version of the Binge Eating Scale was used in this study. The Binge Eating Scale contains 16-items with two subcategories: the emotional and cognitive responses subscales (eight items) and the behavioral characteristics subscale (eight items) (Gormally et al., 1982). See Appendix 3.3 for all 16 items of the Scale. Every item has three or four statements, and each statement is independently scored from 0 to 3 or 0 to 4 (Gormally et al., 1982). Participants can only choose one statement for each item (Gormally et al., 1982). The overall Binge Eating Scale scores range from 0 to 46 (Gormally et al., 1982). Higher scores suggest a greater degree of binge eating severity (Gormally et al., 1982). The severity of binge eating is as follows: a score < 17 represents non-binge eating; 18 to 26 represents moderate binge eating, and > 27 represents severe binge eating (Gormally et al., 1982). In a previous Taiwanese study, the Cronbach's alpha of the overall BES, the emotional and cognitive responses subscale, and the behavioral characteristics subscale were .85, .75 and .73, respectively (Wu & Liu, 2015). In this study, the Cronbach's alpha for the overall BES, the emotional and cognitive responses subscale, and the behavioral characteristics subscale were .86, .77, and .75, respectively.

Level of Acculturation

The level of acculturation for Asian participants was measured using the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) (Suinn, Ahuna, & Khoo, 1992). The SL-ASIA was developed by Suinn and colleagues and modeled after the Acculturation Rating Scale for Mexican Americans (Suinn et al., 1987). Appendix 3.4 displays a letter of permission to use the scale obtained from Dr. Richard Suinn. The SL-ASIA is the most often used acculturation scale for Asian Americans (Ownbey & Horridge, 1998). The SL-ASIA has 21 multiple choice questions (See Appendix 3.5) with 6 subcategories: (1) language (four questions), (2) identity (four questions), (3) friendship choice (four questions), (4) behaviors (five questions), (5) generation/geographic history (three questions), (6) attitudes (one question) (Suinn et al., 1987). A factor analysis in 1992 reported that 17 items loaded on five factors: (a) reading/writing/cultural preference, (b) ethnic interaction, (c) affinity for ethnic identity and pride, (d) generational identity, and (e) food preference (Suinn, Ahuna, & Khoo, 1992). A principal components factor analysis in 1998 reported that 15 items loaded on six factors: (a) reading, writing, and cultural preference; (b) generational identity; (c) food preference; (d) affinity for ethnic identity and pride; (e) ethnic interaction; and (I) Asian contact (Ownbey & Horridge, 1998). The SL-ASIA measures both actual behaviors and assessed ideals (preferences) (Suinn et al., 1987). Because the term of "Asian" covers a variety of ethnic heritages such as Chinese, Japanese, Korean, etc., items were worded to recognize these groups (Suinn et al., 1987).

The present study used item 12 of the SL-ASIA to measure the participant's generation as follows: 1st Generation = I was born in Asia or a country other than U.S., 2nd Generation = I was born in U.S., either parent was born in Asia or a country other than U.S., 3rd Generation = I was born in U.S., both parents were born in U.S, and all grandparents were born in Asia or a country other than U.S., 4th Generation = I was born in U.S., both parents were born in U.S, and at least one grandparent was born in Asia or a country other than U.S. and one grandparent was born in the U.S., 5th Generation = I was born in U.S., both parents were born in U.S., and all grandparents were born in U.S., or I don't know what generation best fits me since I lack some information.

A 5-point scale was used with the SL-ASIA (1 = low acculturation, 3 = bicultural, 5 = high acculturation) (Suinn et al., 1987). A total score was computed by summing across the answers for all 21 items (Suinn et al., 1987). A final acculturation score was calculated by then dividing the total value by 21 (Suinn et al., 1987). The overall SL-ASIA score ranges from a low of 1, indicative of low acculturation (i.e., high Asian identity) to a high of 5, indicative of high acculturation (i.e., high Western identity) (Suinn et al., 1992). Also, there are three levels of acculturation derived from the score of the SL-ASIA (Suinn et al., 1987). First, an Asian participant becomes completely identified as a part of the dominant Western society. This identification is termed "Western identified" and would be represented in an

SL-ASIA score of 5 (Suinn et al., 1987). Another Asian may retain identity with their ethnic heritage and refuse attempts to become integrated into Western society (Suinn et al., 1987). This identification would be called "Asian-identified" and would be represented in an SL-ASIA score of l (Suinn et al., 1987). Third, an Asian participant may be capable of assuming the best of two worlds, with denial to neither. The term used for this identification is "bicultural," and would be reflected in an SL-ASIA score of 3 (Suinn et al., 1987). In the present study, the overall SL-ASIA scores with 4 and 5 represent Western identity, 3 represents bicultural, and 1 and 2 represent Asian identity.

The Cronbach's alpha value of the overall SL-ASIA was .91 (Suinn et al., 1992). However, there have been no individual Cronbach's alpha of each factor reported. In this study, the Cronbach's alpha for the overall SL-ASIA was .86. Examining the criterion of generational level, the results demonstrated that the mean values on the scale reflected the predicted increase in acculturation scores for different generations as follows: first, 2.96; second, 3.57; third, 3.78; fourth, 3.78; and fifth generation, 3.85 (Suinn et al., 1987). The mean values on the scale reflect the predicted increase in the length of residence in the U.S., with higher scores (reflecting higher acculturation) being associated with greater number years in the U.S. (Suinn et al., 1987).

Level of Racial Discrimination

The level of perceived personal racial discrimination against Asian Americans was measured using the Subtle and Blatant Racism Scale for Asian Americans (SABR-A^2) (Yoo, Steger, & Lee, 2010). Yoo (2005) and his colleagues developed the SABR-A^2 to measure the extent to which one believes he or she has personally encountered racial discrimination. Appendix 3.6 displays a letter of permission to use the scale obtained from Dr. Hyung Chol (Brandon) Yoo. The SABR-A^2 has 10 items with two subscales, subtle racism, and blatant racism. Appendix 3.7 presents all 10 items of the scale. Subtle racism refers to experiences of discrimination attributable implicitly to racial discrimination or stereotyping. An example item of the subtle racism is “In America, I am treated differently because I’m Asian.” Blatant racism refers to experiences of discrimination due explicitly to racial discrimination or stereotyping. An example item of the blatant racism is “In America, I am told you speak English so well because I’m Asian” (Yoo, Steger, & Lee, 2010). In this study, the total scale of the SABR-A^2 was used to understand more general perceived racism for participants and was treated as one of the control variables.

A 5-point scale was used with the SABR-A^2 ranging from 1 (almost never), 2 (once in a while), 3(sometimes), 4 (often or frequent), to 5 (almost always) to measure the frequency of events (Yoo et al., 2005). Higher scores represent higher perceived personal racial discrimination (Yoo et al., 2005). In Yoo, Steger, and Lee’s study (2010), the Cronbach’s alpha of the overall SABR-A^2, the subtle racism subscale, and the blatant racism subscale were .84, .83 and .72, respectively. In this study, the Cronbach's alpha for the overall SABR-A^2, the subtle racism subscale, and the blatant racism subscale were .79, .77 and .58, respectively. The low Cronbach's alpha in the blatant racism subscale in this study indicated poor interrelatedness between items 5, 6, 8 and 9. In other words, those four items of the blatant racism subscale did not relate to each other well and may not measure the concept (i.e., blatant racism) well in our sample. A possible explanation for this low value is that the blatant racism subscale has only four items. Cronbach's alpha is affected by the length of the test and the value of Cronbach's alpha may be reduced if the length of the test is too short (Tavakol & Dennick, 2011).

The SABR-A^2 demonstrated good initial predictive validity and correlated with well-being measures such as the Satisfaction with Life Scale (r = -.20, p <.05) and the Problem

Solving Coping Subscale ($r = .19$, $p <.05$) (Yoo & Lee, 2005; Yoo, Steger, & Lee, 2010). In this study, the score of SABR-A^2 served as a control variable in the regression models for all study aims.

Level of Perceived Stress

The level of perceived stress was measured using the Perceived Stress Scale (PSS) (Cohen et al., 1983). The English version of the Perceived Stress Scale has been used in Singapore in the Asian population (Kouk et al., 2013). The PSS was developed by Cohen and colleagues (1983) to measure the degree in which situations in one‘s life are appraised as stressful. The PSS measures stress and perceptions of an individuals' capacity to manage perceived difficulties (Cohen et al., 1983). The PSS is not bound to any specific situation or event (Ingram, Clarke, & Lichtenberg, 2014). The questions are general and relatively free of content specific to any subpopulation group (Cohen et al., 1983).

The original PSS has 14 items but an exploratory factor analysis of the 14 item PSS reported poor factor loadings for four items (Ingram et al., 2014). Therefore, the four items were dropped and a 10-item version of the PSS (PSS-10) was suggested for use instead of the original 14 item version (Ingram et al., 2014). Appendix 3.8 presents all 10 items of the scale. The PSS-10 contains two subscales: (1) the Perceived Helplessness Subscale (i.e., the negative subscale, items 1, 2, 3, 6, 9, 10); and (2) the Perceived Self-Efficacy Subscale (i.e., the positive subscale, items 4, 5, 7, 8) (Taylor, 2015). Cohen and colleagues also developed a 4-item version of PSS for use with telephone interviews (Cohen et al., 1983). In this study, the 10-item version of the PSS was used to measure perceived stress in the participants.

The PSS was measured using a 5-point Likert scale ranging from 0 (never) to 4 (very often), indicating how often they felt or thought a certain way within the past month (Roberti, Harrington, & Storch, 2006). PSS scores were obtained by reversing coding the responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 and 4 = 0) to the four positively stated items (items 4, 5, 7, and 8) and then summing across all scale items (Cohen et al., 1983). Scores range from 0 to 40, with higher composite scores indicative of greater perceived stress (Roberti et al., 2006). An exploratory factor analysis established that the PSS-10 consisted of two factors (Roberti et al., 2006). One factor reflected perceived helplessness and the other factor reflected perceived self-efficacy (Roberti et al., 2006). In a previous study with 402 Asian participants, the Cronbach's alpha for the overall PSS-10, the Perceived Helplessness Subscale, and the Perceived Self-Efficacy Subscale were .74, .86, and .78, respectively (Lee, Chung, Suh, & Jung, 2015). In this study, the overall score of the PSS served as a control variable in the regression models for all study aims. The Cronbach's alpha in this study for the Overall PSS-10, the Perceived Helplessness Subscale, and the Perceived Self-Efficacy Subscale were .75, .89, and .87, respectively.

Recruitment Procedures

Recruitment strategies were as follows: (1) information about the study was posted on the electronic billboards of the TAA-NC, EFCNC, and FACSS websites and their Facebook pages, (2) information about study recruitment was posted on a Facebook group called "Taiwanese in the U.S.," which contains 20,179 Taiwanese immigrants, and "Taiwanese In the Carolinas," which contains 308 Taiwanese immigrants, (3) flyers and brochures containing information about study recruitment were placed at the EFCNC (church site), (4) information about the study recruitment was sent out by the TAA-NC, the FACSS, and the UNC-Chapel Hill campus mass email lists.

The study recruitment ad, flyers, and brochures contained information about how to contact the PI for further information by telephone and email. Once potential participants contacted the PI by phone or email, the PI briefly explained the study purpose, possible risks, and benefits of participating, and explained that participation was voluntary and they could withdraw at any time. The PI explained that all of the information collected would be kept confidential in a locked file cabinet behind a locked door. Their personal information would be kept in a separate locked file cabinet behind a locked door. If a participant was interested, the PI assessed their eligibility during a telephone call. If criteria were met, the PI made an appointment with the participant for a group data collection (10-15 participants) at either the EFCNC, RCCC, or CCMC church sites or the UNC Biobehavioral lab. During the telephone interview, eligible participants were asked if they had dyed their hair within the past year. If they did, the PI asked them not to dye their hair in the next 30 days to allow for new 1-cm hair growth and collected the hair sample and questionnaire data from them 30 days later.

Procedures

At the group site, the PI reviewed the consent with participants in a group. After all questions about the study were answered, the participants were invited to sign the consent. After consent was obtained, the PI collected anthropometric measurements, hair samples, and questionnaires. After the participants completed the questionnaires, the PI checked the content of the questionnaires to see if the participants left any items blank. If the participants did not respond to an item, then the PI asked them to consider responding to that item and the participants chose to respond or not. The participants received a $30 gift card when they completed the data collection.

The PI then took hair samples. The PI used a pair of scissors, a small hair band, comb, hair clip, aluminum foil and a padded envelope to collect the hair sample (Salimetrics, 2013). The PI (1) separated the hair at the back of the head with a hair clip, (2) collected a hair strand of about 3-5mm (approximately 50 mg of hair) at the posterior vertex, (3) combed the strand, (4) tied up the hair strand with a small hair band, (5) sterilized the PI's hands and scissors, (6) cut the hair as close as possible to the scalp, (7) kept the band on the hair to indicate the end nearest to the scalp, (8) put the hair in aluminum foil and folded the aluminum foil without bending the sample, (9) attached the participant's study identification number on the aluminum foil and placed the aluminum foil in an padded envelope (Salimetrics, 2013). The PI avoided pulling out the hair during the process and avoided folding the hair during transportation. The hair samples were stored at room temperature at the UNC-CH Biobehavioral Lab.

Retention Plan

Eligible participants who dyed their hair within the past year waited for 30 days to consent and then had data collected. To avoid the loss of these eligible participants, the PI sent a message via cell phone or directly called the participants once a week to remind the participants not to dye their hair and also reminded them of the date of the group data collection. Since the PI had difficulty enrolling the projected number of participants, the respective Taiwanese Student Associations from the University of North Carolina at Chapel Hill, North Carolina State University, and Duke University were contacted to help send out messages regarding the study to assist with recruitment.

Data Management

The PI completed all data entry. The PI double entered the data into two separate EXCEL files then converted these files to SAS files. Comparisons were conducted and any inaccuracies found were checked against the raw data. All corrections were noted in a data entry journal to establish an audit trail.

Data Analysis

Data were analyzed using SAS 9.3 (SAS Institute Inc., 2011). A *p* value of .05 or less was considered statistically significant. Descriptive statistics were used to provide the mean, standard deviation, range, number of participants, or frequencies and percentages (as appropriate) for demographic data, body weight and height, BMI, hair cortisol, hair-related characteristics, and the scores of the five questionnaires.

In this study, participants were divided into categories for whether overweight (BMI=23.0-27.5 kg/m^2) or obese (BMI >27.5 kg/m^2) for between-group comparisons for hair cortisol, weight stigma, binge eating, and acculturation. Also, the final hair cortisol values were converted from μg/dl to pg/mg based on each sample's hair weight by using the previously mentioned formula.

For hair cortisol, independent groups *t*-tests were used to compare the mean of hair cortisol between the overweight and obese groups since previous studies indicated that participants with obesity might have higher hair cortisol concentration than participants with overweight (Stalder et al., 2013; Veldhorst et al., 2014; Wester et al., 2014). One-way ANOVA was used to compare the means of hair cortisol among different hair washing water temperature groups since hair cortisol is significantly affected by hot water (Hoffman et al., 2014).

For weight stigma experiences, an independent groups *t*-test was used to compare the mean of the frequency of weight stigma experiences between the overweight and obesity groups since previous research has found that the higher the severity of obesity, the more weight stigma experiences a person may suffer (Puhl et al., 2017). Also, the highest scores of the top ten items from the Stigmatizing Situations Inventory (SSI) (Myers & Rosen, 1999) were displayed to show the most frequently experienced stigmatizing situations in this study sample.

For binge eating, the degree of binge eating (i.e., not binge eater $\leq$17 points; moderate binge eating = 18-26 points; severe binge eating $\geq$27 points) was reported by frequencies and percentages. An independent group *t*-test was used to compare the mean of Binge Eating Scale between the overweight and obese groups since more severe obesity is correlated with more severe binge eating symptoms (Wu & Liu, 2015). An exact test was used to examine whether weight status (overweight and obese) and degree of binge eating (not binge eater, moderate binge eating, and severe binge eating) were independent of one another. The exact test was used because the smallest of the group numbers (i.e., cell count) was less than 5 (Stokes, 2012). The null hypothesis of the exact test was that the distribution of weight status was independent of the degree of binge eating. A one-way ANOVA was used to compare the means of the frequency of weight stigma experiences among different degrees of binge eating since previous research has found that higher the weight stigma experiences led to more severe binge eating symptoms (Vartanian & Porter, 2016).

Three independent group *t*-tests were used to compare the means of acculturation, racial discrimination, and perceived stress separately between the overweight and obese groups to understand if any results between the different weight categories were evident in the study sample.

Spearman correlation analysis was used to determine the bivariate relationships among continuous variables. Spearman correlation analysis was chosen in this study because of the non-normal distribution of hair cortisol levels. The main purpose of this study was to examine the relationships between weight stigma and hair cortisol and binge eating. Therefore, any continuous variables that exhibited significant correlations with hair cortisol and binge eating were selected and included in multiple regression models as controlling variables since they may have potentially affected the relationships.

Multiple regression analyses were used for all aims because this study contained more than two measurement variables (one dependent variable and the remainder independent and control variables). Multiple regression models were examined to understand which independent variables had a major effect on the dependent variable, controlling for covariates, and to find an equation that could best predict the dependent variable as a linear function of the independent variables within the present study's data (McDonald, 2014).

A coefficient of determination (R^2) was generated from each regression model. The R^2 illustrated the proportion of variance in the dependent variable explained by the combination of two or more independent variables (Holcomb, 2010). An intercept (β_0) was generated from each regression model. The β_0 represented a predicted mean value of a dependent variable when the independent variables were jointly zero. A slope (β_j) of each independent variable was generated for each regression model. Each β_j indicated the predicted change in the mean value of the dependent variable for a one-unit change in the independent variable. Importantly, the sign of β_j for an independent variable illustrated a positive or negative effect of that independent variable on the dependent variable.

In Aims 3 and 4, the level of acculturation was introduced into multiple regression models as a moderator variable (i.e., pairwise interactions with other primary independent variables in a model) to see if the effect of weight stigma on hair cortisol and binge eating depended on the level of acculturation. Therefore, an interaction term (i.e., a product of two existing independent variables) between weight stigma and acculturation and its coefficient (β_3) was generated in the regression models for Aims 3 and 4. In the presence of an interaction effect, the coefficient of the interaction term represented the change in slope for hair cortisol or binge eating for a one-unit change in weight stigma per one unit change in acculturation.

In the present study, the null hypothesis used for testing each over all multiple regression models was that there was no relationship between our independent and dependent variables. A significant p-value of .05 or less rejected the null hypothesis. A null hypothesis for each independent variable as H_0: $\beta_j = 0$ was also tested in multiple regression, indicating that adding an independent variable to the multiple regression did not improve the fit of the multiple regression equations any more than expected by chance (McDonald, 2014). A significant *p*-value of .05 or less rejected this null hypothesis (H_a: $\beta \neq 0$). This study used the log transformation of hair cortisol data in the multiple regression analyses due to its non-normal distribution. Table 3.2 presents the independent, dependent, moderator/interaction, and control variables for all of the aims, rationale for regression models, equations of regression models, and interpretations of parameters.

Table 3.2. Details of Multiple Regression Models for All Aims

Detail	Aim 1
Purpose	To examine the relationship between the experience of weight stigma and hair cortisol levels among Asian Americans with overweight and obesity.
Independent Variable	• Weight stigma
Dependent Variable	• Hair cortisol
Control Variables	• Age • Perceived racism • Perceived stress
Rationale for Regression Models	We proposed unadjusted and adjusted models as Model 1 and 2 for Aim 1 to see the change of weight stigma's influence on hair cortisol before and after controlling for the control variables. These two models helped us to understand how weight stigma alone was associated with hair cortisol after controlling for age, perceived racism and perceived stress.
Regression Equations and Parameters Interpretations	Model 1(unadjusted model): E (log hair cortisol) = $\beta_0 + \beta_1$ weight stigma + ε • E (log hair cortisol) = Estimation of mean value of log hair cortisol. • β_0 = Mean of log hair cortisol when the frequency of weight stigma was zero. • β_1 = expected change in the mean of log hair cortisol for a one-unit change in the frequency of weight stigma. Model 2 (adjusted model): E (log hair cortisol) = $\beta_0 + \beta_1$ weight stigma + β_2 age + β_3 perceived racism + β_4 perceived stress + ε • E (log hair cortisol) =Expected value of log hair cortisol.

Detail	Aim 1
	• β_0 = Mean of log hair cortisol when the frequency of weight stigma, age, perceived racism, and perceived stress are zero. • β_1 = expected change in the mean of log hair cortisol for a one-unit change in the frequency of weight stigma, holding age, perceived racism, and perceived stress constant.
	Aim 2
Purpose	To examine the relationship between the experience of weight stigma and binge eating among Asian Americans with overweight and obesity.
Independent Variable	•Weight stigma
Dependent Variable	•Binge eating
Control Variables	• Age • BMI • Years lived in the U.S. • Perceived racism • Perceived stress
Rationale for Regression Models	We proposed unadjusted and adjusted models as Model 3 and 4 for Aim 2 to examine the change of weight stigma's influence on binge eating before and after controlling for the control variables.
Regression Equations and Parameters Interpretations	Model 3 (unadjusted model): E (binge eating) = $\beta_0 + \beta_1$ weight stigma + ε • E (binge eating) = Expected value of binge eating. • β_0 = Mean of binge eating when the frequency of weight stigma is zero. • β_1 = expected change in the mean of binge eating for a one-unit change in the frequency of weight stigma. Model 4 (adjusted model): E (binge eating) = $\beta_0 + \beta_1$ weight stigma + β_2 age + β_3 BMI + β_4 years lived in the U.S. + β_5 perceived racism + β_6 perceived stress + ε • E (binge eating) = Estimation of mean value of binge eating. • β_0 = Mean of binge eating when the frequency of weight stigma, age, perceived racism, and perceived stress are zero. • β_1 = expected change in the mean of binge eating for a one-unit change in the frequency of weight stigma, holding age, perceived racism, and perceived stress constant.
	Aim 3
Purpose	To examine whether the level of acculturation moderates the relationship between the experience of weight stigma and hair cortisol levels among Asian Americans with overweight and obesity.
Independent Variable	• Weight stigma
Dependent Variable	• Hair cortisol
Moderator Variable	• Acculturation

Detail	Aim 1
Interaction term	• Weight stigma × Acculturation
Control Variables	• Age • Perceived racism • Perceived stress
Rationale for Regression Models	We proposed unadjusted and adjusted models as Model 5 and 6 for Aim 3 to investigate the change of weight stigma, acculturation, and the interaction between weight stigma and acculturation's influence on hair cortisol before and after controlling for the control variables. We focused on the effect of the interaction term because it illustrated whether the level of acculturation moderated the relationship between the experiences of weight stigma and hair cortisol. Model 5 showed the effect of the interaction term on hair cortisol alone. Model 6 presented the effect of the interaction term on hair cortisol after adjusting for control variables.
Regression Equations and Parameters Interpretations	Model 5 (unadjusted model): E (log hair cortisol) = $\beta_0 + \beta_1$ weight stigma + β_2 acculturation + β_3 weight stigma × acculturation interaction + ε • E (log hair cortisol) = Estimation of mean value of log hair cortisol. • β_0 = Mean of log hair cortisol when the frequency of weight stigma and the level of acculturation are zero. • β_1 = expected change in the mean of log hair cortisol for a one-unit change in the frequency of weight stigma, holding the level of acculturation and the interaction between weight stigma and acculturation constant. • β_2 = expected change in the mean of log hair cortisol for a one-unit change in the level of acculturation, holding the frequency of weight stigma and the interaction between weight stigma and acculturation constant. • β_3 = expected change in the mean of log hair cortisol for a one-unit change in weight stigma, when acculturation also change by one unit. Model 6 (adjusted model): E (log hair cortisol) = $\beta_0 + \beta_1$ weight stigma + β_2 acculturation + β_3 weight stigma × acculturation interaction + β_4 age + β_5 perceived racism + β_6 perceived stress + ε • E (log hair cortisol) =Expected value of log hair cortisol. • β_0 = Mean of log hair cortisol when the frequency of weight stigma, the level of acculturation, age, perceived racism and perceived stress are zero. • β_1 = expected change in the mean of log hair cortisol for a one-unit change in the frequency of weight stigma, holding the

Detail	Aim 1
	level of acculturation, the interaction between weight stigma and acculturation, age, perceived racism and perceived stress constant. • β_2 = expected change in the mean of log hair cortisol for a one-unit change in the level of acculturation, holding the frequency of weight stigma, the interaction between weight stigma and acculturation, age, perceived racism and perceived stress constant. • β_3 = expected change in the mean of log hair cortisol for a one-unit change in weight stigma, when acculturation also change by one unit, holding age, perceived racism and perceived stress constant.
	Aim 4
Purpose	To examine whether the level of acculturation moderated the relationship between the experience of weight stigma and binge eating among overweight and obese Asian Americans.
Independent Variable	• Weight stigma
Dependent Variable	• Binge eating
Moderator Variable	• Acculturation
Interaction term	• Weight stigma × Acculturation
Control Variables	• Age • BMI • Years lived in the U.S. • Perceived racism • Perceived stress
Rationale for Regression Models	We proposed unadjusted and adjusted models as Model 7 and 8 for Aim 4 to examine the change of weight stigma, acculturation, and the interaction between weight stigma and acculturation's influence on binge eating before and after controlling for the control variables. We focused on the effect of the interaction term since it indicated whether the level of acculturation moderated the relationship between the experience of weight stigma and binge eating. Model 7 showed the effect of the interaction term on binge eating alone. Model 8 illustrated the effect of the interaction term on binge eating after adjusting for the control variables.
Equations of regression models	Model 7 (unadjusted model): E (binge eating) = $\beta_0 + \beta_1$ weight stigma + β_2 acculturation + β_3 weight stigma × acculturation interaction + ε • E (binge eating) =Expected value of binge eating. • β_0 = Mean of binge eating when the frequency of weight stigma and the level of acculturation are zero. • β_1 = expected change in the mean of binge eating for a one-unit change in the frequency of weight stigma, holding the

Detail	Aim 1
	level of acculturation and the interaction between weight stigma and acculturation constant. • β_2 = expected change in the mean of binge eating for a one-unit change in the level of acculturation, holding the frequency of weight stigma and the interaction between weight stigma and acculturation constant. • β_3 = expected change in the mean of binge eating for a one-unit change in weight stigma, when acculturation also change by one unit. Model 8 (unadjusted model): E (binge eating) = $\beta_0 + \beta_1$ weight stigma + β_2 acculturation + β_3 weight stigma × acculturation interaction + β_4 age + β_5 BMI + β_6 years lived in the U.S. + β_7 perceived racism + β_8 perceived stress + ε • E (binge eating) = Expected value of binge eating. • β_0 = Mean of binge eating when the frequency of weight stigma, the level of acculturation, age, BMI, years lived in the U.S., perceived racism, and perceived stress are zero. • β_1 = expected change in the mean of binge eating for a one-unit change in the frequency of weight stigma, holding the level of acculturation, the interaction between weight stigma and acculturation, age, BMI, years lived in the U.S., perceived racism, and perceived stress constant. • β_2 = expected change in the mean of binge eating for a one-unit change in the level of acculturation, holding the frequency of weight stigma, the interaction between weight stigma and acculturation, age, BMI, years lived in the U.S., perceived racism, and perceived stress constant. • β_3 = expected change in the mean of binge eating for a one unit change in weight stigma, when acculturation also change by one unit, holding age, BMI, years lived in the U.S., perceived racism and perceived stress constant.

For regression model diagnostics, Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling statistics were performed for tests of normally distributed residuals for all models. Scatterplots of plots were generated to determine the homogeneity of variances for all models. If the tests of normality and the homogeneity of variances did not show good models fits, we examined the model distribution and probability plots for the studentized residual, removed outliers and re-fit the models without outliers to determine whether we have for robust model results with improved model diagnostics.

Summary of Chapter Three

The cross-sectional design was used in this study because no studies had been conducted to illustrate the possible influences of weight stigma on hypothalamic-pituitary-adrenal axis (HPA) activity and binge eating for Asian Americans with overweight and obesity in N.C. Therefore, the results of this study could be the first to give much needed insight into the relationships among weight stigma, acculturation, HPA activity, and binge eating for the target population. Study participants were enrolled from nine Asian American Associations, Taiwanese Student Associations, and churches in N.C. Demographic data, hair-related characteristics, height and weight, BMI, the Stigmatizing Situations Inventory (Myers & Rosen, 1999), the Binge Eating Scale (Gormally et al., 1982), the Suinn-Lew Asian Self-Identity Acculturation Scale (Suinn, Ahuna, & Khoo, 1992), the Subtle and Blatant Racism Scale for Asian Americans (Yoo, Steger, & Lee, 2010), and Perceived Stress Scale (Cohen et al., 1983) were collected. Internal consistency reliability was examined using Cronbach's alpha for the five questionnaires. A 50 milligrams hair sample of one-centimeter from the posterior vertex was collected for cortisol analysis. Hair cortisol was extracted by using EIA kits at the UNC-CH Biobehavioral Lab and the Duke University Greenleaf Lab. Spearman correlation and multiple regression analyses were used for all aims. Eight regression models were proposed to understand the change of weight stigma's influence on hair cortisol and binge eating before and after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress. Tests of normally distributed residuals and homogeneity of variances were conducted for regression model diagnostics. In Chapter 4, the results of a descriptive analysis, between-groups comparisons, correlation analysis, and multiple regressions are reported.

CHAPTER 4: RESULTS

Introduction

This chapter includes four sections. First, the results of the descriptive analysis, followed by correlation analysis, multiple regression models for all of the study aims, and the summary of chapter four.

Aims

The purpose of this study was to: (1) examine the relationship between the experience of weight stigma and hair cortisol levels among Asian Americans with overweight and obesity; (2) examine the relationship between the experience of weight stigma and binge eating among Asian Americans with overweight and obesity; (3) examine whether the level of acculturation moderates the relationship between the experience of weight stigma and hair cortisol levels among Asian Americans with overweight and obesity; and (4) examine whether the level of acculturation moderates the relationship between the experience of weight stigma and binge eating among Asian Americans with overweight and obesity.

Descriptive Analysis and Between-Groups Comparison Results

Participant Characteristics

One hundred and sixty-eight adults were recruited from Chapel Hill, Durham, Raleigh and Cary, North Carolina (N.C.), United States (U.S.). Two participants did not complete the surveys. Therefore, a total of 166 participants completed all data collection (See Table 4.1). The study sample included 166 adults (92 men, 74 women) who primarily identified as first-generation Asian Americans (94%) and had a mean age of 45.7 years. The average years lived in Asia was 26.6 years and 18.6 years in the U.S. The average years attending school in the U.S. was 3.8 years. Participants had a mean body mass index (BMI) of 26.6 kg/m^2 with 68.7% overweight (BMI 23.0-27.5 kg/m^2, n = 114) and 31.3% with obesity (BMI >27.5 kg/m^2, n = 52). The majority of the participants had graduate degrees (70.5%), were employed (79.6 %) with a mean annual income of $63,163, were married and living with a spouse (83.7%), and had not dieted in the last six months (86.1%).

Table 4.1. Demographic Characteristics and Anthropometric Measures

Characteristics	Mean ± SD	Range	n (%)
Age	45.7 (9.8)	21-65	
Gender			
Male			92 (55.4)
Female			74 (44.6)
Height (centimeters)	166.9 (8.7)	149.5-191.0	
Weight (kilograms)	74.4 (12.3)	52.7-120.1	
BMI (kg/m^2)	26.6 (3.1)	23.0-45.3	
Weight status			
Overweight (23.0-27.5 kg/m^2)			114 (68.7)
Obese (>27.5 kg/m^2)			52 (31.3)
Education			
Graduate school			117 (70.5)
College/university			46 (27.7)
High school			3 (1.8)
Marital status			
Single			18 (10.9)
Divorced			1 (0.6)
Widowed			3 (1.8)
Unmarried but in a relationship without living with partner			4 (2.4)
Cohabitation			0 (0)
Married and living with a spouse			139 (83.7)
Married but separated			1 (0.6)
Occupation (n = 162)			
Business/Market/Financial			20 (12.4)
Computer/Information technology			53 (32.7)

Characteristics	Mean ± SD		Range	n (%)	
Research/Education				32	(19.6)
Healthcare Practitioners				5	(3.2)
Self-employment				7	(4.3)
Housewife/ Student/ Unemployment				26	(16.1)
Retired				7	(4.3)
Other				12	(7.4)
Annual income (U.S. dollars, n = 150)	63,163	(48,339)	0-250,000		
Place of birth					
Taiwan				73	(44.0)
Hong Kong				7	(4.2)
China				74	(44.6)
Malaysia				1	(0.6)
South Korea				2	(1.2)
USA				9	(5.4)
Generation					
1st Generation				156	(94.0)
2nd Generation				9	(5.4)
Don't know				1	(0.6)
Years lived in Asia (years)	26.6	(9.4)	0-60		
Years lived in the U.S.(years)	18.6	(9.8)	1-44		
Age upon beginning school in the U.S. (years old)	18.5	(12.8)	0-50		
Years attending school in the U.S.(years)	3.8	(4.1)	0-20		
Dieted during the last 6 months					
Yes				23	(13.9)
No				143	(86.1)

Note. SD = Standard deviation; n = number of participants; Other in Occupation = religious workers, lawyers, artists, food preparation and serving related occupations, sales and related occupations, and translator; 1st Generation = participant was born in Asia or country other than U.S.; 2nd Generation = participant was born in U.S., either parent was born in Asia or country other than U.S.; * = based on participants' own judgment; mg = milligram; pg/mg = picogram per milligram of hair.

Hair Cortisol and Hair Characteristics

As a whole, the mean hair cortisol of all participants was 23.43 picograms per milligram of hair (pg/mg) (Table 4.2). Due to skewness and outliers of hair cortisol, median and inter-quartile range (IQR) of hair cortisol were provided as follows:16.21 and 14.57 pg/mg, respectfully. The majority (71.7%) of the participants had black hair and washed their hair an average of 5.2 times per week in the previous month. The majority (75.9%) of the participants washed their hair using warm water. The average time of participants swimming in the previous month was 0.5 times per week. The mean weight of hair subjected to extraction was 35.67 milligrams (mg).

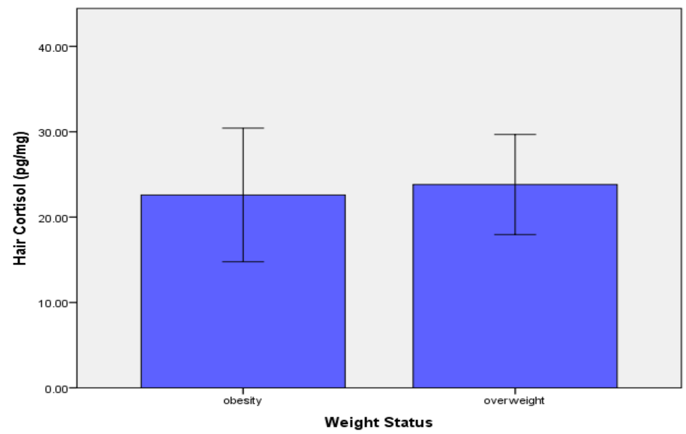
Table 4.2. Hair Cortisol and Hair Characteristics

Characteristics	Mean	(SD)	Range	n	(%)
Hair cortisol (pg/mg)†	23.43	(30.47)	3.37-215.05		
Average number of times swimming during last month (per week)	0.5	(1.1)	0-7		
Average number of hair washings during last month (per week)	5.2	(2.6)	1-14		
Water temperature for washing hair*					
Hot water				39	(23.5)
Warm water				126	(75.9)
Cold water				1	(0.6)
Hair color					
Black				119	(71.7)
Mix (black, gray and white)				47	(28.3)
Weight of hair subjected to extraction (mg)	35.67	(12.58)	11-66		

Note. SD = Standard deviation; n = number of participants; † = median: 16.21 pg/mg; inter-quartile range (IQR): 14.57 pg/mg; * = based on subjects' own judgment; mg = milligram; pg/mg = picogram per milligram of hair.

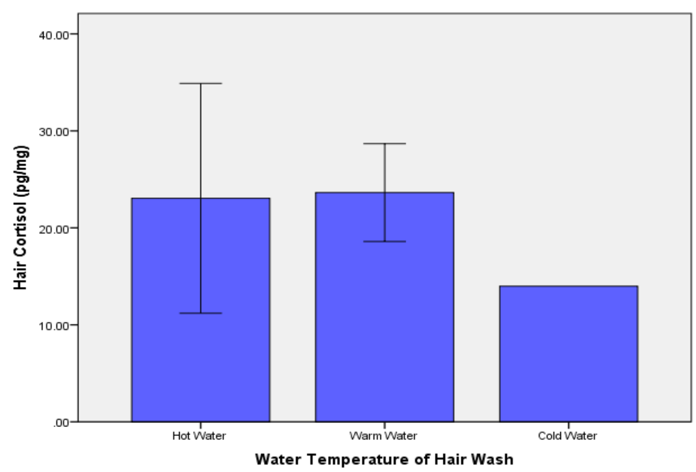
The mean hair cortisol of participants with overweight (n = 144) was 23.82 pg/mg and the mean hair cortisol of participants with obesity (n = 52) was 22.6 pg/mg (t (164) = -.24, p = .081) (Figure 4.1).

Figure 4.1. Hair Cortisol by Weight Status



The results of the one-way ANOVA showed that the hair cortisol means were not significantly different among the different water temperatures used for washing hair (F (2, 163) =.053, p = .948) (Figure 4.2).

Figure 4.2. Hair Cortisol by Water Temperature of Hair Washing



Weight Stigma Experiences

A majority (89.8%, n = 149) of participants faced weight-based stigmatization in their lifetime (Table 4.3). Only 17 (10.24%) never experienced weight-based stigmatization. The overall mean score for the frequency of weight-based stigmatization of all participants was 0.28, indicating that participant's experienced one episode of weight-based stigmatization in their lifetime, on average. The overall mean score for the frequency of weight stigma experiences created by people (Stigmatizing Situations Inventory from People; SSIP subscale) (Myers & Rosen, 1999) for all participants was 0.25. The overall mean score for frequency of weight stigma experiences created by others (Stigmatizing Situations Inventory from Others; SSIO subscale) (Myers & Rosen, 1999) for all participants was 0.03. Both results indicated that participants experienced, on average, one episode of weight stigma in their lifetime.

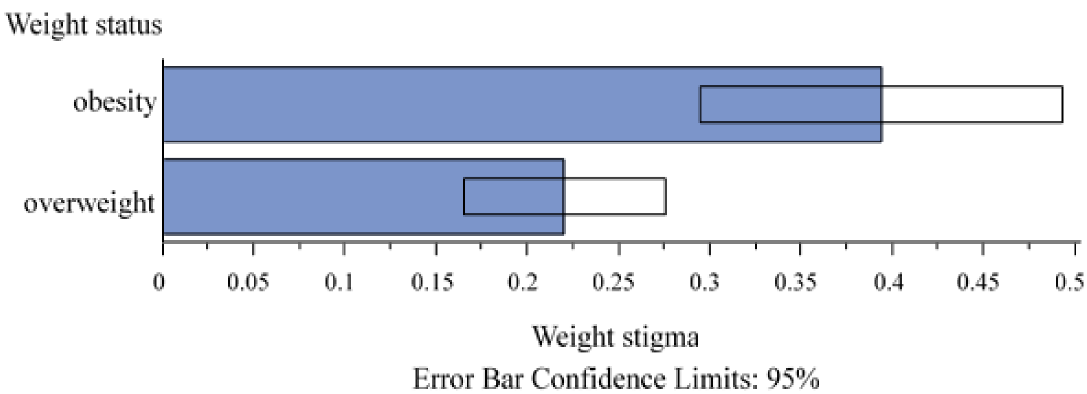
Table 4.3. Description of the Results of the Stigmatizing Situations Inventory

Overall scale/ Sub-scales	Total group (n = 166) Mean ± SD (range)	Overweight (n = 114) Mean ± SD	Obese (n = 52) Mean ± SD	*t*	*p*
Stigmatizing Situations Inventory (50 items, 0-3 points/ item)	0.28±0.33 (0-2.4)	0.22±0.30	0.40±0.36	3.28	0.0013
SSIP subscale (43 items)	0.25±0.28 (0 -1.98)	0.20±0.26	0.35±0.31	3.30	0.0012
SSIO subscale (7 items)	0.03±0.06 (0-0.42)	0.02±0.05	0.05±0.07	2.07	0.0422

Note. SD = Standard deviation; SSIP = Stigmatizing Situations Inventory from People; SSIO = Stigmatizing Situations Inventory from Other; Overweight = 23.0-27.5 kg/m^2; Obese = > 27.5 kg/m^2; *p* = *p*-value for independent groups *t*-test (degrees of freedom = 164)

Participants with obesity reported more weight stigma experiences than participants with overweight (Figure 4.3). There were significant differences between participants with overweight and the obesity and the overall mean score of weight-based stigmatization (t (164) = 3.28, p = .0013).

Figure 4.3. Weight Stigma by Weight Status



The most frequently experienced stigmatizing situations were item 3 “a parent or other relative nagging you to lose weight,” followed by item 5 “a spouse/partner telling you to lose weight in order to be more attractive,” and item 44 “parents or other relatives telling you how attractive you would be, if you lost weight” (Table 4.4).

Table 4.4. Individual Items Scores of the Stigmatizing Situations Inventory

Rank	Stigmatizing Situations Inventory items	Mean (SD)
1	A parent or other relative nagging you to lose weight.	1.91 (1.09)
2	A spouse/partner telling you to lose weight in order to be more attractive.	1.48 (1.19)
3	Parents or other relatives telling you how attractive you would be, if you lost weight.	1.37 (1.10)
4	Not being able to find clothes that fit.	1.26 (1.22)
5	A doctor saying that your weight is a health problem, even when you are in good health.	1.26 (1.05)
6	Having people assume that you overeat or binge-eat because you are overweight.	1.22 (1.16)
7	Being called names, laughed at, or teased by other children when you were young.	1.14 (1.11)
8	Being told, "All you really need is a little willpower."	1.04 (1.11)
9	A spouse/partner calling you names because of your weight.	0.87 (1.08)
10	A child coming up to you and saying something like, "You're fat!"	0.86 (1.09)

Note. SD = Standard deviation

Binge Eating

A majority (93.4%, n = 155) of the participants were not binge eating (score less than or equal to 17 points) (Table 4.5); 4.2% were moderately binge eating (18-26 points); and 2.4% of the participants were severely binge eating (score 27 points or more). The mean scores for the overall Binge Eating Scale (Gormally et al., 1982) was 8.25 for all participants, 7.54 for participants with overweight, and 9.83 for participants with obesity.

The *p*-value of the independent group *t*-tests for overweight and obese participants' overall Binge Eating Scale (Gormally et al., 1982) score were significant ($p = .0462$), indicating that participants with obesity had higher mean scores than the participants with overweight. The *p*-value of the exact tests examining whether weight status (overweight and obesity) and degree of binge eating (not binge eater, moderate binge eating, and severe binge eating) were independent of one another was not significant ($\chi^2 = 1.73$, degrees of freedom = 2, $p = .488$), indicating that the proportion of weight status did not significantly vary by degree of binge eating. The mean scores of the two Binge Eating subscales (Gormally et al., 1982) were similar, 4.02 for the Emotional and Cognitive Response Subscale and 4.23 for the Behavioral Characteristics Subscale for all participants.

Table 4.5. Description of the Results of the Binge Eating Scale

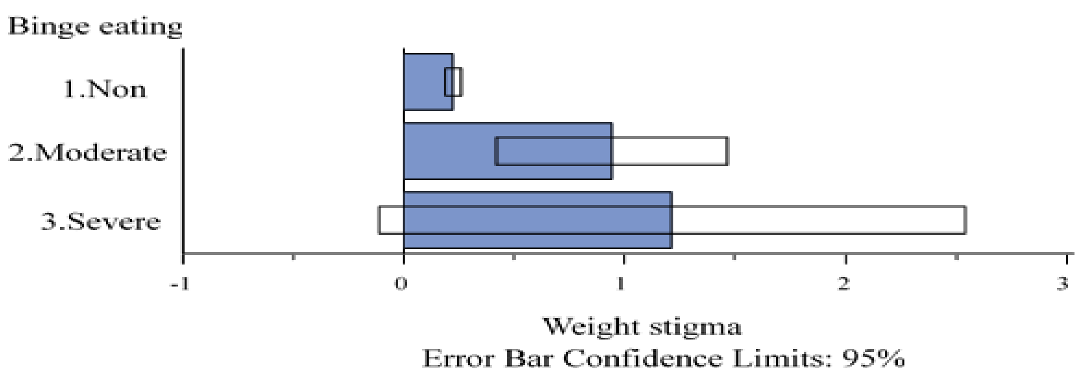
Overall scale/ Sub-scales	Total group (n = 166) Mean ± SD (range)		Overweight (n = 114) Mean ± SD		Obese (n = 52) Mean ± SD		*t*	*p*
Binge Eating Scale (16 items, 0-46 points)	8.25±6.88 (0-42)		7.54±6.76		9.83±6.94		2.01	0.0462
Emotional subscale (8 items)	4.02±3.36 (0-20)		3.69±3.31		4.75±3.40		1.89	0.0601
Behavioral subscale (8 items)	4.23±3.99 (0-22)		3.84±3.82		5.08±4.25		1.86	0.0641
Degree of binge eating	n	%	n	%	n	%	χ^2	*p*
Not binge eater	155	93.4%	108	94.7%	47	90.4%	1.73	0.488

Overall scale/ Sub-scales	Total group (n = 166) Mean ± SD (range)		Overweight (n = 114) Mean ± SD		Obese (n = 52) Mean ± SD		t	p
(≤17 points)								
Moderate binge eating (18-26 points)	7	4.2%	4	3.5%	3	5.8%	--	--
Severe binge eating (≥27 points)	4	2.4%	2	1.8%	2	3.8%	--	--

Note. SD = Standard deviation; Emotional subscale = Emotional and cognitive responses subscale; Behavioral subscale=Behavioral characteristics subscale; Overweight = 23.0-27.5 kg/m^2; Obese = >27.5 kg/m^2; t = t-value for independent groups t-test of difference weight status in all variables (degrees of freedom = 164); χ^2 = value of exact test for weight status and degree of binge eating (degrees of freedom =2)

Interestingly, the result of the one-way ANOVA showed that severe binge eaters experienced more weight stigma experiences than non-binge eaters (F (2,163) = 48.86, p < .0001) (Figure 4.4).

Figure 4.4. Weight Stigma by Binge Eating



Level of Acculturation

The mean scores of the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) (Suinn, Ahuna, & Khoo, 1992) was 2.21 for all participants (Table 4.6). Regarding cultural identity, the mean score indicated that participants saw themselves between an “Asian identity” (score of 1 or 2) and “Bicultural” (score of 3), instead of Western identified” (score of 4 or 5) (Suinn et al., 1992). Ninety-four percent of the participants saw themselves as having “Asian identity” (n = 156), which indicated that they retained identity with their ethnic heritage and refused attempts to become integrated into Western society (Suinn et al., 1992). Smaller proportions (4.8%, n = 8) reported being “Bicultural” (score 3.05-3.76), indicating that they may be capable of assuming the best of both Asian and Western society, with denial to neither (Suinn et al., 1992). Only two participants (1.2%) reported being “Western identified” (score 4.05 and 4.57), which indicated that they completely identified as a part of the dominant Western society (Suinn et al., 1992). There were no significant differences between participants with overweight and obesity for acculturation level.

Table 4.6. Description of the Results of the Suinn-Lew Asian Self-Identity Acculturation Scale

Overall scale/ Level of acculturation	Total group (n = 166) Mean ± SD (range)/n (%)	Overweight (n = 114) Mean ± SD	Obesity (n = 52) Mean ± SD	*t*	*p*
SL-ASIA (1.00-5.00 points)	2.21±0.42 (1.43-4.57)	2.20±0.36	2.24±0.51	0.55	0.5859
Asian identity (score of 1 or 2)	156 (94%)	--	--	--	--
Bicultural (score of 3)	8 (4.8%)	--	--	--	--
Western identity (score of 4 or 5)	2 (1.2%)	--	--	--	--

Note. SL-ASIA = Suinn-Lew Asian Self-Identity Acculturation Scale; SD = Standard deviation; Overweight = 23.0-27.5 kg/m^2; Obesity = >27.5 kg/m^2; *p* = *p*-value for independent groups *t*-test of difference weight status in all variables (degrees of freedom = 164)

Level of Racial Discrimination

The mean scores of the Subtle and Blatant Racism Scale for Asian Americans (SABR-A^2) (Yoo, Steger, & Lee, 2010) in the full sample was 20.07 (Table 4.7). Approximately half of the participants (52.4%, n = 87) had SABR-A^2 scores between 20 to 36 points (the maximum score of the SABR-A^2 is 50). This indicated that half of the participants experienced racial discrimination more than once in a while (Yoo et al., 2010). Only one participant reported never experiencing racial discrimination (total score of SABR-A^2 = 0). There was no significant difference between participants with overweight and obesity for racial discrimination levels.

Table 4.7. Description of the Results of the Subtle and Blatant Racism Scale

Overall scale	Total group (n = 166) Mean ± SD (range)	Overweight (n = 114) Mean ± SD	Obesity (n = 52) Mean ± SD	*t*	*p*
Subtle and Blatant Racism Scale (10-50 point)	20.07±5.68 (0-36)	20.44±5.02	19.25±6.88	-1.12	0.2672

Note. SD = Standard deviation; Overweight = 23.0-27.5 kg/m^2; Obesity = >27.5 kg/m^2; *p* = *p*-value for independent groups *t*-test of difference weight status in all variables (degrees of freedom = 164)

Level of Perceived Stress

The mean scores of the Perceived Stress Scale (PSS) (Cohen, Karmack, & Mermelstein, 1983) in the full sample was 16.20 (Table 4.8). There was no significant difference between participants with overweight and obesity for perceived stress levels.

Table 4.8. Description of the Results of the Perceived Stress Scale

Overall scale	Total group (n = 166) Mean ± SD (range)	Overweight (n = 114) Mean ± SD	Obesity (n = 52) Mean ± SD	*t*	*p*
Perceived Stress Scale (0-40 points)	16.20±5.62 (2-30)	15.82±5.42	17.04±6.03	-0.42	0.1948

Note. SD = Standard deviation; Overweight = 23.0-27.5 kg/m^2; Obesity = >27.5 kg/m^2; *p* = *p*-value for independent groups *t*-test of difference weight status in all variables (degrees of freedom = 164)

Correlation Analysis Results

Our results showed that weight stigma was significantly negatively correlated with hair cortisol ($r = -.22$, $p < .01$) and positively correlated with binge eating ($r = .57$, $p < .01$) (Table 4.9).

Table 4.9. Spearman Correlation Coefficients for Weight Stigma with Hair Cortisol and Binge Eating

Variables	Stigmatizing Situations Inventory
Hair cortisol	-0.22**
Binge Eating Scale	0.57**

Note. * $p < .05$; ** $p < .01$

The two subscales of the Stigmatizing Situations Inventory (Myers & Rosen, 1999) demonstrated a significant correlation between binge eating and hair cortisol (Table 4.10). Hair cortisol had a significant negative correlation with the Stigmatizing Situations Inventory from People (SSIP) subscale ($r = -.18$, $p < .05$) and the Stigmatizing Situations Inventory from Others (SSIO) subscale ($r = -.24$, $p < .01$). Binge eating had a significant positive correlation with the SSIP subscale ($r = .55$, $p < .01$) and the SSIO subscale ($r = .39$, $p < .01$). Interestingly, the SSIP subscale had a higher correlation with binge eating than the SSIO subscale, indicating that weight-based stigmatization created by people such as being called names or laughed at by others may have a higher influence on binge eating than weight-based stigmatization created by physical barriers in public spaces.

Table 4.10. Spearman Correlation Coefficients for each of the Stigmatizing Situations Inventory from people and the Stigmatizing Situations Inventory from others with Hair Cortisol and Binge Eating

Variables	SSIP	SSIO
Hair cortisol	-0.18*	-0.24**
Binge Eating Scale	0.55**	0.39**

Note. SSIP = Stigmatizing Situations Inventory from people subscale; SSIO = Stigmatizing Situations Inventory from others subscale; * $p < .05$; ** $p < .01$

The level of Acculturation for Asian Americans significantly correlated with years lived in the U.S. and years attending school in the U.S., but did not significantly correlate with hair cortisol, binge eating or weight stigma (Table 4.11). We still included it in the multiple regression models for study Aims 3 and 4 secondary to the support in the literature (Guan, Lee, & Cole, 2012).

Table 4.11. Spearman Correlation Coefficients for the Acculturation Scale with Hair Cortisol, Binge Eating, Weight Stigma, Years Lived and Attending School in the United States, and Age

Variables	Suinn-Lew Asian Self-identity Acculturation Scale
Hair cortisol	-0.05
Binge Eating Scale	0.07
Stigmatizing Situations Inventory	0.08
Years lived in the U.S.	0.27**
Years attending school in the U.S.	0.39**
Age	-0.18*

Note. * $p < .05$; ** $p < .01$

Both perceived stress and racial discrimination were controlled for, and there was a significant positive correlation with binge eating ($r = .25$ and .36, respectively, all $p < .01$) but not with hair cortisol (Table 4.12). However, perceived stress and racial discrimination had a significant positive relationship with the independent variable experiences of weight stigma ($r = .30$ and .33, respectively, all $p < .01$). Therefore, we controlled for perceived stress and racial discrimination in the multiple regression models for all of the study aims.

Table 4.12. Spearman Correlation Coefficients for the Perceived Stress and Racial Discrimination Scales with Hair Cortisol, Binge Eating, and Weight Stigma

Variables	Perceived Stress Scale	Subtle and Blatant Racism Scale for Asian Americans
Hair cortisol	-0.08	-0.07
Binge Eating Scale	0.25**	0.36**
Stigmatizing Situations Inventory	0.30**	0.33**

Note. * $p < .05$; ** $p < .01$

Age showed a significant positive correlation with hair cortisol ($r = .24$, $p < .01$) and a negative correlation with binge eating ($r = -.25$, $p < .01$) (Table 4.13). We controlled for age in the regression models for all study aims.

Table 4.13. Spearman Correlation Coefficients for Age with Hair Cortisol and Binge Eating

Variables	Age
Hair cortisol	0.24**
Binge Eating Scale	-0.25**

Note. * $p < .05$; ** $p < .01$

Furthermore, body weight, BMI, and years lived in the U.S. were significantly correlated to binge eating ($r = .22$, .23, and -.20, respectively, all $p < .05$) (Table 4.14). Based on the correlation results, we controlled for body weight, BMI, and years lived in the U.S. in the regression models for Aims 2 and 4. However, body weight and BMI provide similar measures, and BMI reported a slightly higher correlation coefficient with binge eating than did body weight. Therefore, we controlled for BMI instead of body weight for Aims 2 and 4.

Table 4.14. Spearman Correlation Coefficients for Body Weight, BMI, and Years Lived in the United States with Hair Cortisol and Binge Eating

Variables	Body Weight	BMI	Years Lived in the U.S.
Hair cortisol	-0.07	-0.08	0.15
Binge Eating Scale	0.22**	0.23**	-0.20*

Note. * $p < .05$; ** $p < .01$

Finally, the average frequency of hair washing per week during the last month (r = -.04, p >. 05) and the average frequency of swimming per week during last month ($r = -.02$, p >. 05) were not correlated with hair cortisol (Table 4.15).

Table 4.15. Spearman Correlation Coefficients for the Frequency of Hair Washing and Swimming with Hair Cortisol

Variables	Hair Washing	Swimming
Hair cortisol	-0.04	-0.02

Note. Hair Washing = the average frequency of hair washing per week during last month; Swimming = the average frequency of swimming per week during the last month; * $p < .05$; ** $p < .01$

In conclusion, we controlled for certain variables for our regression models based on the results of correlation analysis. We controlled for age, perceived stress, and racial discrimination for Aims 1 and 3. We controlled for age, BMI, years lived in the U.S., perceived stress, and racial discrimination for Aims 2 and 4.

Multiple Regressions Models for Study Aims

In this section, the results of each regression model are presented as follows: (1) the results of multiple regression; (2) the results of test of normality; (3) the results of homogeneity of variance; (4) the results of re-fitted model without extreme observations to examine the robustness of the result (i.e., with and without the effect of outliers), and (5) a summary of the results for each aim is presented.

Aim One: Relationship between Weight Stigma and Hair Cortisol

Models one and two were tested for Aim 1 to examine the change of weight stigma's influence on hair cortisol levels before and after controlling for perceived racism and perceived stress.

Model 1(unadjusted model): E (log hair cortisol) = $\beta 0 + \beta 1$ weight stigma + ε

Model 2 (adjusted model): E (log hair cortisol) = $\beta 0 + \beta 1$ weight stigma + $\beta 2$ age + $\beta 3$ Perceived Racism + $\beta 4$ Perceived Stress + ε

Multiple regression for model one. Model one (n = 166, unadjusted model, not including control variables) showed that weight stigma was able to explain 4% of the variance in the log hair cortisol levels, with an unadjusted R^2 at 0.04 (Table 4.16). This explanation was determined to be statistically significant (F (1,164) = 6.06, p = .0149). In model one, weight stigma was a significant factor in the hair cortisol. Surprisingly, the regression coefficient demonstrated a negative explanation of weight stigma and hair cortisol levels, indicating that the lower the weight stigma, the higher the hair cortisol level of an individual. Exponential of regression coefficients for log hair cortisol have been computed and presented as e^{number}. For a one-unit increase in weight stigma, we expect to see about a 36% decrease in hair cortisol, since $e^{-0.44}$ = 0.64 (β = -.44, t = -2.46, p = .0149). The equation of regression model one is: E (log hair cortisol) = 2.91 + -0.44 weight stigma + ε

Table 4.16. Multiple Regression for Weight Stigma and Hair Cortisol

	Model 1	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Hair cortisol (log)	-.44 (.18) *	.04*

Note. S.E. = standard error; * = p < .05; ** = p < .01.

Test of normality for model one. The null hypothesis is that residuals are normally distributed (Table 4.17). All models have been tested by the Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling tests for normality. Model one of hair cortisol exhibited mixed normality test results. Two significant p-values in the statistics of Shapiro-Wilk (W = .97, p = .0006) and Anderson-Darling (A-Sq = .90, p = .0220) and two nonsignificant p-values in the statistics of Kolmogorov-Smirnov (D = .07, p = .0639) and Cramer-von Mises (W-Sq = .11, p = .0952) were reported, with significant results meaning that residuals were not normally distributed for the model, and the normality assumption was violated.

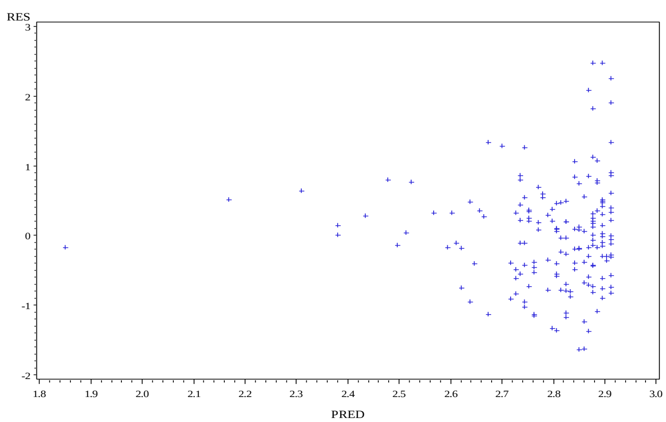
Table 4.17. Normality Tests for Model One

	Model 1			
	Weight Stigma			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log)	.97**	.07	.11	.90*

Note. * = $p < .05$; ** = $p < .01$.

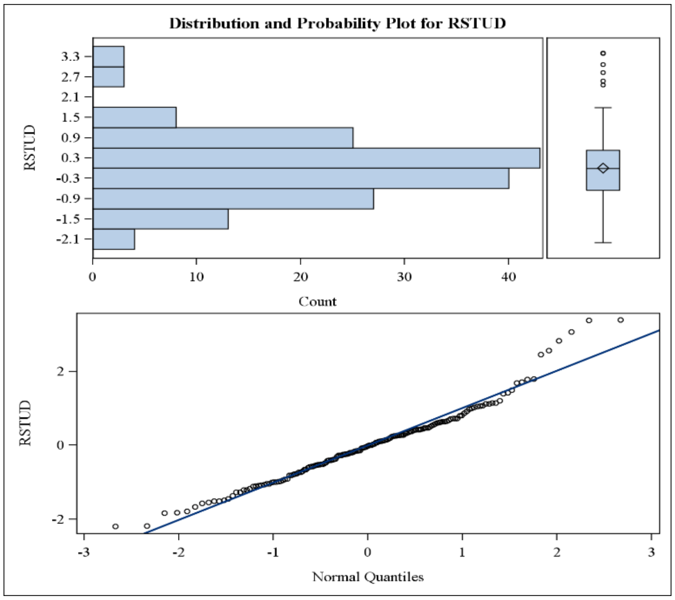
Homogeneity of variance for model one. A scatterplot of residuals on predicted values of log hair cortisol below shows that the residuals were not equally distributed (Figure 4.5), meaning that the variance of hair cortisol was not constant and the assumption of equal variances across samples was violated (Rosner, 2006).

Figure 4.5. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) in Model One



Re-fit model one without extreme observations for robust results. The model's distribution and probability plot for the studentized residual suggests the six highest extreme observations (ID = 58, 124, 119, 141, 81, and 111) required extra attention since they stood out from the other observations (Figure 4.6). Data entry error was not found for those six observations. Therefore, we removed the observations and re-fit the regression analysis to examine for robust results (i.e., whether significant effects remain significant, and nonsignificant results remain nonsignificant) (n = 160).

Figure 4.6. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model One



Comparing to model one with all of the observations, the unadjusted R^2 of the re-fit model was decreased from 0.04 to 0.02 and became nonsignificant (F (1,158) = 3.08, p = .0811) (Table 4.18). Furthermore, the standardized regression coefficient of weight stigma changed from -0.44 with a significant p-value (p = .0149) to -0.27 without a significant p-value (p = .0811), indicating that weight stigma was no longer a significant factor explaining hair cortisol when the extreme observations were removed.

Table 4.18. Multiple Regression for Weight stigma and Hair Cortisol without Extreme Observations

	Model 1 without Extreme Observations	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Hair cortisol (log, n = 160)	-.27(.15)	.02

Note. S.E. = standard error; * = p < .05; ** = p < .01.

The statistics of Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling had consistent nonsignificant results (Table 4.19), meaning that the assumption of normality was not violated.

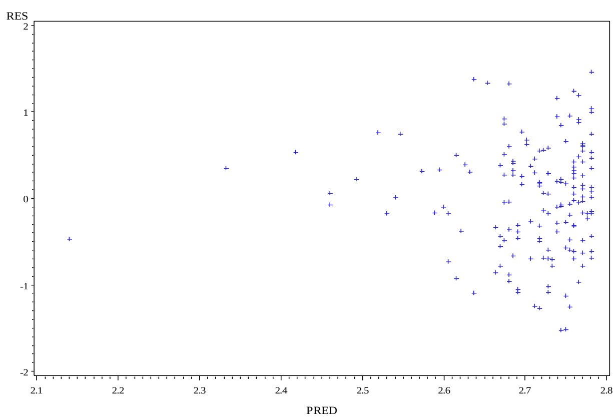
Table 4.19. Normality Tests for Model One without Extreme Observations

	Model 1 without Extreme Observations			
	Weight Stigma			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log, n = 160)	.99	.04	.04	.22

Note. * = *p* < .05; ** = *p* < .01.

A new scatterplot of residuals below showed a similar result when compared with the original model (Figure 4.7), indicating that the residuals were not equally distributed and the variance of hair cortisol was not constant.

Figure 4.7. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) on Model One without Extreme Observations



Multiple regression for model two. After controlling for age, perceived racism and perceived stress, weight stigma explained 8% of the variance in log hair cortisol levels, with an unadjusted R^2 of 0.08 (Table 4.20). After testing the entire model, this explanation was determined to be statistically significant (F (4,161) = 3.49, p = .0093). In model one, the standardized regression coefficient also demonstrated a negative explanation of weight stigma and hair cortisol levels, but in model two, this result became not statistically significant at 0.05

level after controlling for age, perceived racism and perceived stress, meaning that the influence of weight stigma on hair cortisol levels may decrease after controlling for age, perceived racism, and perceived stress. For a one-unit increase in weight stigma, we expected to see about a 30% decrease in hair cortisol, since $e^{-0.35} = 0.70$ in model two, holding age, perceived racism and perceived stress constant, but this result was not significant at the .05 level ($\beta = -.35$, $t = -1.77$, $p = .0789$). The equation of regression model two is: E (log hair cortisol) = 2.12 + -0.35 weight stigma + 0.02 age + -0.006 Perceived Racism + 0.008 Perceived Stress + ε

Table 4.20. Multiple Regression for Weight Stigma and Hair Cortisol after Adjusting for Control Variables

	Model 2†	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Hair cortisol (log)	-.35(.20)	.08**

Note. S.E. = standard error; †= after adjusting for age, perceived racism for Asian Americans and perceived stress; * = *p* < .05; ** = *p* < .01.

Test of normality for model two. The results of the normality test in model two were similar to model one (Table 4.21). Model two showed two significant *p*-values in the statistics of Shapiro-Wilk (W = .97, p <.01) and Anderson-Darling (A-Sq = .85, p <.05), indicating that the normality assumption was violated.

Table 4.21. Normality Tests for Model Two

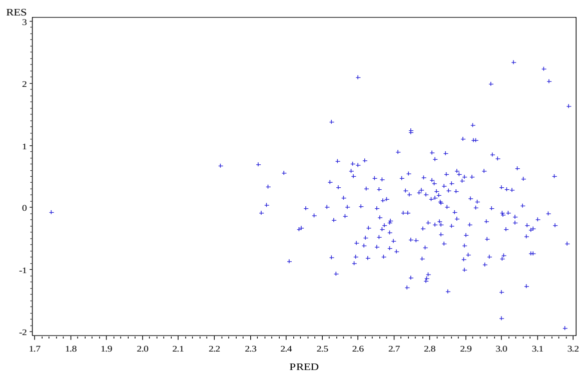
	Model 2†			
	Weight Stigma			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log)	.97**	.06	.10	.85*

Note. † = after adjusting for age, perceived racism for Asian Americans and perceived stress; * = *p* < .05; ** = *p* < .01.

Homogeneity of variance for model two. Figure 4.8 shows a scatterplot of residuals on the predicted values of log hair cortisol in model two. The residuals were not equally distributed, and the assumption of equal variances across samples was violated (Rosner, 2006).

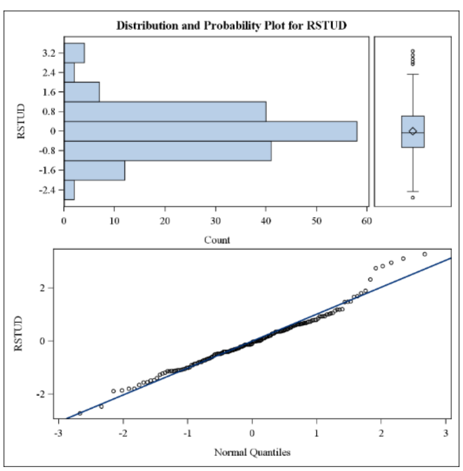
However, comparing the scatterplot of residuals in model one with all observations, the distribution of residuals in Figure 4.8 had a more normal distribution.

Figure 4.8. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) in Model Two



Re-fit model two without extreme observations for robust results. We removed the same six highest extreme observations (ID = 58, 124, 119, 141, 81, and 111) based on model two's distribution and probability plot below and re-fit the regression analysis for model two (n = 160) (Figure 4.9).

Figure 4.9. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model Two



Comparing model two with all of the observations, the unadjusted R^2 of model two without the extreme observations decreased from the value from 0.08 to 0.06 and the *p*-value changed from 0.0093 to 0.0496 (F (4,155) = 2.43, p = .0496) (Table 4.22). The standardized regression coefficient of weight stigma changed from -0.35 to -0.16 but remain nonsignificant (p = .3430).

Table 4.22. Multiple Regression for Weight Stigma and Hair Cortisol after Adjusting for Control Variables and Removing Extreme Observations

	Model 2 without Extreme Observations†	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Hair cortisol (log, n = 160)	-.16(.17)	.06*

Note. S.E. = standard error; † = after adjusting for age, perceived racism for Asian Americans and perceived stress; * = p < .05；** = p < .01.

Comparing model two with all of the observations, the results of normality tests fit better in model two without the extreme observations (Table 4.23). All statistical results of the normality tests reported nonsignificant p-values at the 0.05 level, indicating that the normality assumption was not violated.

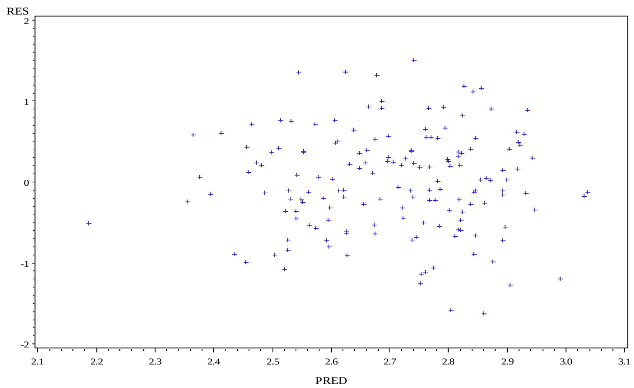
Table 4.23. Normality Tests for Model Two without Extreme Observations

	Model 2 without Extreme Observations †			
	Weight Stigma			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log, n=160)	1.00	0.04	0.04	0.20

Note. †= after adjusting for age, perceived racism for Asian Americans and perceived stress; * = p < .05；** = p < .01.

The residuals were equally distributed in a scatterplot of residuals of the re-fit model two (Figure 4.10), indicating that the assumption of homogeneity of variance was not violated (Rosner, 2006).

Figure 4.10. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) in Model Two without Extreme Observations



Summary for Aim 1. We presented the results of four regression models in the above section: model one with all of the observations (n = 166, unadjusted model, not including control variables), model one without extreme observations (n = 160, unadjusted model, not including controlled variables), model two with all observations (n = 166, adjusted model, included controlled variables (age, perceived racism, and perceived stress), and model two without extreme observations (n = 160, adjusted model, included controlled variables (age, perceived racism, and perceived stress).

Overall, we favor model two without the extreme observations for robust outcomes because this model incorporated the control variables and presented a better diagnostic result. There was a negative explanation between weight stigma and hair cortisol levels, but weight stigma did not play a significant role in explaining hair cortisol levels after controlling for age, perceived racism and perceived stress among Asian Americans with overweight and obesity in N.C.

Aim Two: Relationship between Weight Stigma and Binge Eating

Models three and four were tested for Aim two to examine the change of weight stigma's influence on binge eating before and after controlling for perceived racism and perceived stress:

Model 3 (unadjusted model): E (binge eating) = $\beta 0 + \beta 1$ weight stigma + ε

Model 4 (adjusted model): E (binge eating) = $\beta 0 + \beta 1$ weight stigma + $\beta 2$ age + $\beta 3$ BMI + $\beta 4$ years lived in the U.S. + $\beta 5$ Perceived Racism + $\beta 6$ Perceived Stress + ε

Multiple regression for model three. Weight stigma was able to explain 49% of the variance in binge eating, with an unadjusted R^2 at 0.49 in model three (n = 166, unadjusted model, not including control variables) (Table 4.24). After testing the entire regression model, this explanation was determined to be statistically significant (F (1,164) = 155.65, p <.0001). Weight stigma was a significant factor in binge eating in model three. Standardized regression coefficients of the model reported a positive explanation between weight stigma and binge eating, indicating that the higher the weight stigma, the higher the binge eating of an individual. For every additional one unit (i.e. the frequency) of an individual's weight stigma, an individual's binge eating score would be increased by 14.70 in model three (β = 14.70, t = 12.48, p <.0001). The equation of regression model three is: E (binge eating) = 4.21+ 14.70 weight stigma + ε

Table 4.24. Multiple Regression for Weight Stigma and Binge Eating

	Model 3	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Binge eating	14.70(1.18) **	.49**

Note. S.E. = standard error; * = p < .05; ** = p < .01.

Test of normality for model three. Model three reported two significant p-values in the statistics of Shapiro-Wilk (W = .98, p = .0108) and Anderson-Darling (A-Sq = .90, p = .0224) and two nonsignificant p-values in the statistics of Kolmogorov-Smirnov (D = .06, p > .1500) and Cramer-von Mises (W-Sq = .12, p = .0681) (Table 4.25), with significant results indicating that the residuals were not normally distributed for the model and the normality assumption was violated.

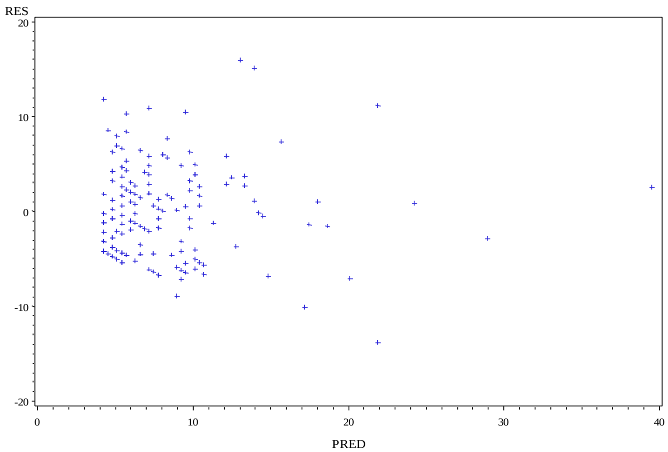
Table 4.25. Normality Tests for Model Three

Dependent Variable	Model 3			
	Weight Stigma			
	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating	.98*	.06	.12	.90*

Note. * = $p < .05$; ** = $p < .01$.

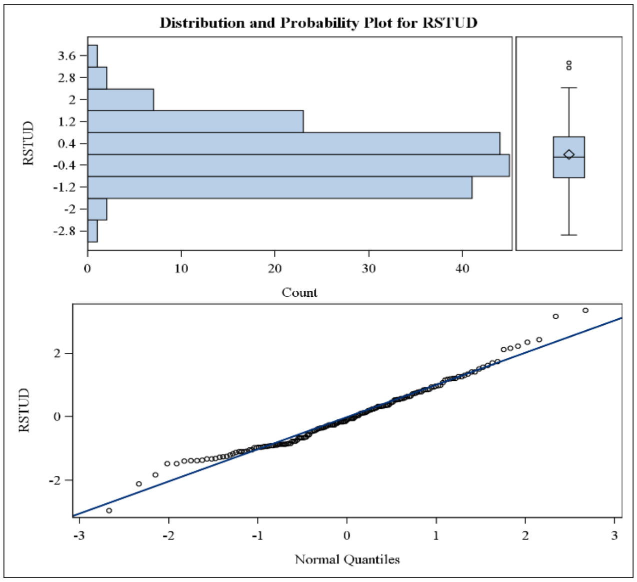
Homogeneity of variance for model three. Residuals of predicted values of binge eating (Figure 4.11) were not equally distributed and the assumption of equal variances across samples was violated (Rosner, 2006).

Figure 4.11. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Three



Re-fit model three without extreme observations for robust results. The seven highest observations (ID = 49, 161, 74, 6, 141, 46, and 25) and one lowest observation (ID = 33) were removed based on the model three's distribution, and probability statistics (Figure 4.12) and the regression model was re-fit with 158 observations.

Figure 4.12. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model Three



The unadjusted R^2 of the re-fit model increased from 0.49 to 0.54 (F (1,156) = 185.74, p < .0001) compared to model three with all of the observations (Table 4.26), indicating that weight stigma was able to explain an additional 5% of the variance in binge eating in model three without the eight extreme observations. The standardized regression coefficient of weight stigma changed little in the re-fitted model (β = 14.41, t = 13.63, p<.0001).

Table 4.26. Multiple Regression for Weight Stigma and Binge Eating without Extreme Observations

	Model 3 without Extreme Observations	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Binge eating (n=158)	14.41(1.06)**	.54**

Note. S.E. = standard error; * = p < .05; ** = p < .01.

Surprisingly, the p-values of the statistics of Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling all became significant after the extreme observations were removed (Table 4.27), indicating that the normality assumption was violated in the re-fit model.

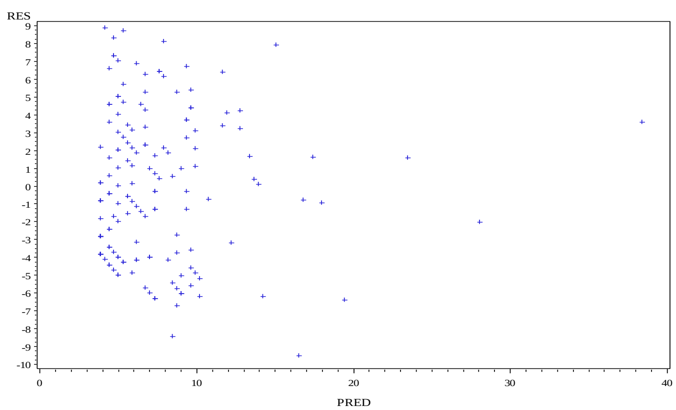
Table 4.27. Normality Tests for Model Three without Extreme Observations

Dependent Variable	Model 3 without Extreme Observations			
	Weight Stigma			
	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating(n = 158)	.98*	.08*	.14*	.98*

Note. * = p < .05; ** = p < .01.

In addition, the residuals of the re-fit model (Figure 4.13) were not equally distributed and the assumption of homogeneity of variance was violated (Rosner, 2006).

Figure 4.13. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Three without Extreme Observations



Multiple regression for model four. After adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress in model four (n = 166, adjusted model), the unadjusted R^2 increased to 0.53, indicating that weight stigma, age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress explain 53% of the variance in binge eating (R^2 = .53) (Table 4.28). After testing the entire regression model, this explanation was determined to be statistically significant (F (6,159) = 23.32, p <.0001). The unadjusted R^2 did not dramatically increase after controlling for the five variables in model three, indicating that the results remain consistent with the unadjusted vs. the adjusted models. In model four, an individual's binge eating score was predicted to be 2.53 if the individual's weight stigma frequency was a 0 value (β_0 = 2.53, t = 0.58, p <.0001). For every additional one unit (i.e., the frequency) of an individual's weight stigma, an individual's binge eating score would increase by 12.47 in model four (β = 12.47, t = 8.72, p <.0001). The equation of regression model four is: E (binge eating) = 2.53 + 12.47 weight stigma + -0.09 Age + 0.08 BMI+ 0.007 Years lived in the U.S. + 0.19 Perceived Racism+ 0.01 Perceived Stress + ε. To conclude, the change of the R^2 values between models three and four was not large, meaning that the results remain consistent before and after controlling for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress.

Table 4.28. Multiple Regression for Weight Stigma and Binge Eating after Adjusting for Control Variables

	Model 4†	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Binge eating	12.47(1.43) **	.53**

Note. S.E. = standard error; †= after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * =p < .05; **= p < .01.

Test of normality for model four. The results of normality tests in model four were better than model three (Table 4.29). The results of the statistics of the Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling were nonsignificant and the results of the statistics of the Shapiro-Wilk were almost not significant (W = .98, p = .0441), indicating that after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress, the assumption of normality was judged to be supported in model four.

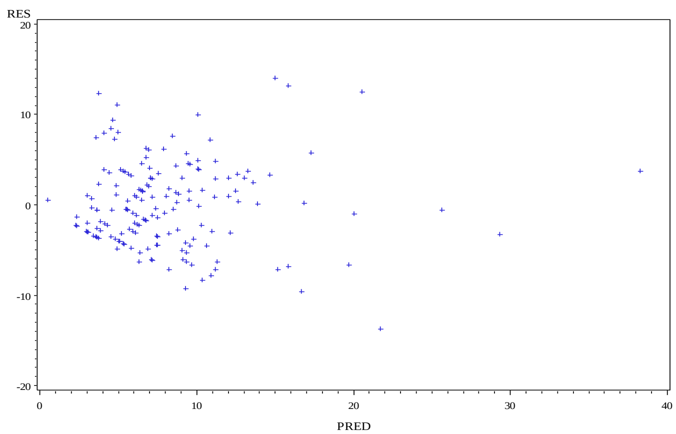
Table 4.29. Normality Tests for Model Four

	Model 4†			
	Weight Stigma			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating	.98*	.05	.09	.66

Note. † = after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * = p < .05; ** = p < .01.

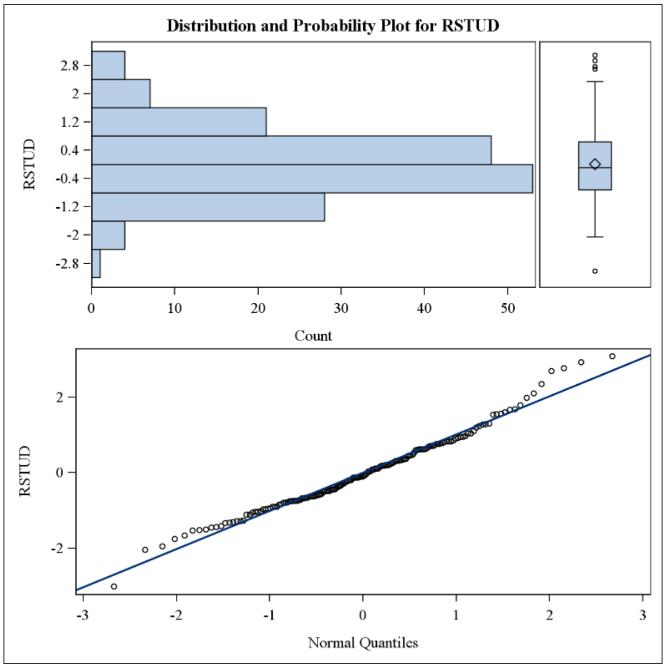
Homogeneity of variance for model four. A scatterplot of residuals on the predicted values of binge eating in model four showed that the distribution of the residuals still was not equal but better than model three's residual distribution (Figure 4.14).

Figure 4.14. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Four



Re-fit model four without extreme observations for robust results. We removed the same eight extreme observations from model two (ID = 49, 161, 74, 6, 141, 46, 25, and 33) based on the distribution and probability plot below (Figure 4.15) and re-fit the regression analysis with 158 observations.

Figure 4.15. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model Four



Compared to model four with all of the observations, the unadjusted R^2 of model four without the extreme observations increased from 0.53 to 0.57 (F (6,151) = 33.97, p < .0001) (Table 4.30), meaning that model four without the extreme observations was able to explain an additional 4% of the variance in binge eating compared to the model four with all of the observations. The standardized regression coefficient of weight stigma in model four without extreme observations changed from 12.47 to 12.98 and remained significant (p < .0001), meaning that after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress and deleting the eight extreme observations, weight stigma still had a significant effect on binge eating.

Table 4.30. Multiple Regression for Weight Stigma and Binge Eating after Adjusting for Control Variables and Removing Extreme Observations

	Model 4 without Extreme Observations†	
	Weight Stigma	
Dependent Variable	ß(S.E.)	R^2
Binge eating (n = 158)	12.98(1.29)**	.57**

Note. S.E. = standard error; † = after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * = *p* < .05; ** = *p* < .01.

The results of normality tests were better in model four without the extreme observations (Table 4.31). All statistical results of the normality tests reported nonsignificant *p*-values at 0.05 level, indicating that the assumption of normality was not violated.

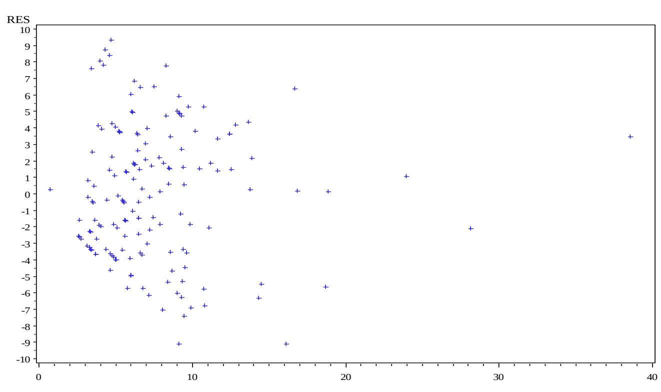
Table 4.31. Normality Tests for Model Four without Extreme Observations

	Model 4 without Extreme Observations †			
	Weight Stigma			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating(n = 158)	.99	.06	.09	.51

Note. † = after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * = *p* < .05; ** = *p* < .01.

A scatterplot of residuals (Figure 4.16) showed that the distribution of the residuals in model four without extreme observations was also better than model four with all of the observations.

Figure 4.16. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Four without Extreme Observations



Summary for Aim 2. We reported the results of four regression models in the above section: model three with all of the observations (n = 166, unadjusted model, not including the controlled variables), model three without the extreme observations (n = 158, unadjusted model, not including the controlled variables), model four with all of the observations (n = 166, adjusted model, including the controlled variables of age, BMI, years lived in the U.S., perceived racism, and perceived stress), and model four without extreme observations (n = 158, adjusted model, including the controlled variables of age, BMI, years lived in the U.S., perceived racism, and perceived stress). In conclusion, we favor model four without the extreme observations since this model's diagnostics showed the best support for the assumptions of normality and homogeneity of variance.

Aim Three: Whether Acculturation Moderates the Relationship between Weight Stigma and Hair Cortisol

Models five and six were tested for Aim three to examine the change of weight stigma, acculturation, and the interaction between weight stigma and acculturation and influence on hair cortisol before and after controlling for the above mentioned variables:

Model 5 (unadjusted model): E (log hair cortisol) = *ß0*+*ß1* weight stigma +*ß2* acculturation +*ß3* weight stigma × acculturation interaction + ε

Model 6 (adjusted model): E (log hair cortisol) = *ß0*+*ß1* weight stigma +*ß2* acculturation +*ß3* weight stigma × acculturation interaction +*ß4* age + *ß5*Perceived Racism+*ß6* Perceived Stress + ε

Multiple regression for model five. Model five (n = 166, unadjusted model, not including control variables) showed that weight stigma, acculturation, and interaction between weight stigma and acculturation explained 4% of the variance in log hair cortisol levels, with an unadjusted R^2 at 0.04 (Table 4.32). After testing the entire regression model, this explanation was determined to be not statistically significant (*F* (3,162) = 2.05, *p* = .1092). The interaction term between weight stigma and acculturation in model five was nonsignificant, meaning that the effect of the relationship between weight stigma and log hair cortisol was not influenced by the level of acculturation. The equation for regression model five is: E (log hair cortisol) = 3.07 + -0.64 weight stigma + -0.07 acculturation + 0.08 weight stigma × acculturation interaction + ε

Table 4.32. Multiple Regression for Weight Stigma, Acculturation and Hair Cortisol

	Model 5			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	ß (S.E.)	ß (S.E)	ß (S.E.)	R^2
Hair cortisol (log)	-.64 (.62)	-.07 (.91)	.08 (.23)	.04

Note. S.E. = standard error; * = *p* < .05; ** = *p* < .01.

Test of normality for model five. Model five reported two significant *p*-values in the statistics of Shapiro-Wilk (W = .97, *p* = .0006) and Anderson-Darling (A-Sq =.91, *p* = .0210) and two nonsignificant *p*-values in the statistics of Kolmogorov-Smirnov (D = .06, *p* = .0954) and Cramer-von Mises (W-Sq = .10, *p* = .0992) (Table 4.33), indicating that the residuals were not normally distributed for the model, and the normality assumption was violated due to the mixed results of the normality tests.

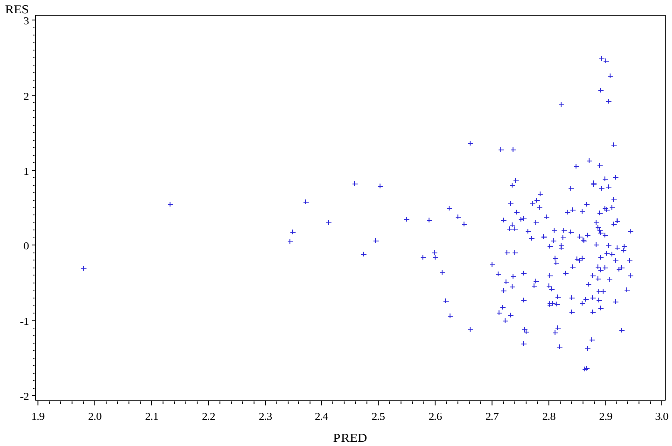
Table 4.33. Normality Tests for Model Five

	Model 5			
	Weight Stigma x Acculturation x (Interaction of Weight Stigma and Acculturation)			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log)	.97**	.06	.10	.91*

Note. * = *p* < .05; ** = *p* < .01.

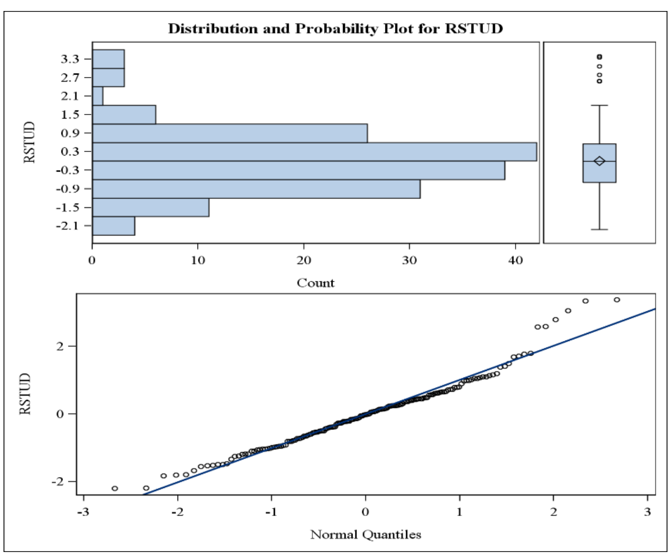
Homogeneity of variance for model five. Model five's residuals for log hair cortisol were not equally distributed (Figure 4.17), and the assumption of homogeneity of variance was violated (Rosner, 2006).

Figure 4.17. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) in Model Five



Re-fit model five without extreme observations for robust results. We removed the six highest observations from model five (ID = 58, 124, 119, 141, 81, and 111) based on a distribution and probability plot of the model (Figure 4.18) and re-fit model five without the extreme observations (n = 160).

Figure 4.18. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model Five



Comparing model five with all of the observations, the unadjusted R^2 of model five without the extreme observations decreased from 0.04 to 0.02 (F (3,156) = 1.27, p = .2853)

(Table 4.34). This means that the explanation of weight stigma, acculturation, and the interaction term in the variance of log hair cortisol decreased by 2%. However, this result was not significant at the 0.05 level. The standardized regression coefficient of the interaction term decreased from 0.08 in model five with all of the observations to 0.05 in model five without extreme observations and remained nonsignificant, indicating that the level of acculturation may not moderate the relationship between weight stigma and hair cortisol before and after removing the six highest observations from model five.

Table 4.34. Multiple Regression for Weight Stigma, Acculturation and Hair Cortisol without Extreme Observations

	Model 5 without Extreme Observations			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	*ß* (S.E.)	*ß* (S.E)	*ß* (S.E.)	R^2
Hair cortisol (log, n = 160)	-.37 (.53)	-.13 (.16)	.05 (.19)	.02

Note. S.E. = standard error; * = p < .05; **= p < .01.

The p-values of the statistics of Shapiro-Wilk, Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling in model five all became nonsignificant after we removed the six highest observations (Table 4.35), meaning that the normality assumption was not violated.

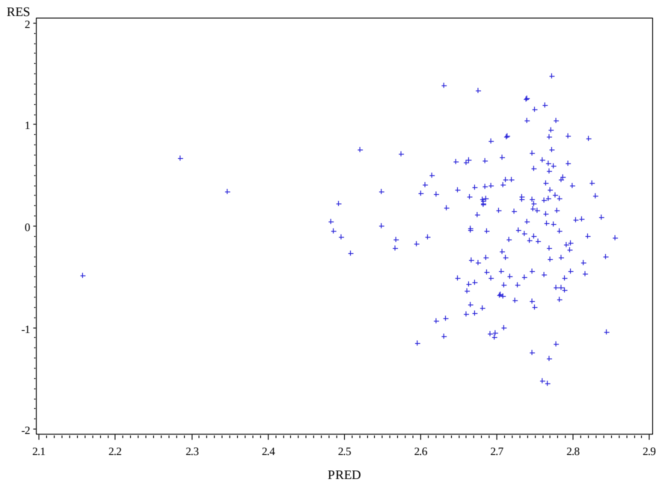
Table 4.35. Normality Tests for Model Five without Extreme Observations

	Model 5 without Extreme Observations			
	Weight Stigma x Acculturation x (Interaction of Weight Stigma and Acculturation)			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log, n = 160)	.99	.05	.05	.25

Note. * = p < .05; ** = p < .01.

The residuals in the scatterplot below (Figure 4.19) were not equally distributed, and the assumption of homogeneity of variance was violated (Rosner, 2006). However, comparing to the residual distribution of model five with all of the observations, the residual distribution was better in model five without the extreme observations.

Figure 4.19. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) in Model Five without Extreme Observations



Multiple regression for model six. After controlling for age, perceived racism and perceived stress in model six (n = 166, adjusted model) (Table 4.36), model six was able to explain 8% of the variance in log hair cortisol levels with an unadjusted R^2 at 0.08 and this was statistically significant (F (6,159) =2.34, p = .0339). Compared to model five, model six was able to explain an additional 4% of the variance in log hair cortisol levels. This value of R^2 was statistically significant (p = .0339). The interaction term between weight stigma and acculturation in model six also demonstrated a nonsignificance. The standardized regression coefficient of the interaction term decreased from 0.08 in model five to 0.02 in model six after controlling for age, perceived racism and perceived stress.

Table 4.36. Multiple Regression for Weight Stigma, Acculturation, and Hair Cortisol after Adjusting for Control Variables

	Model 6†			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	ß (S.E.)	ß (S.E.)	ß (S.E.)	R^2
Hair cortisol (log)	-.42 (0.63)	.07 (.20)	.02 (.22)	.08*

Note. S.E. = standard error; † = after adjusting for age, perceived racism for Asian Americans and perceived stress for hair cortisol; * = $p < .05$; ** = $p < .01$.

Importantly, both standardized regression coefficients in model five and six exhibited nonsignificant *p*-values, indicating that the impact of weight stigma on log hair cortisol levels was not dependent on the level of acculturation. In other words, the effect of the relationship between weight stigma and log hair cortisol levels was not influenced by the level of acculturation after adjusting for the control variables. Our results did not reject the null hypothesis that the level of acculturation did not moderate the relationship between weight stigma and hair cortisol in both models five and six. The equation of regression model six is: E (log hair cortisol) = 1.96 + -0.42 weight stigma + 0.07 acculturation + 0.02 weight stigma × acculturation interaction + 0.02 Age + -0.0006 Perceived Racism + 0.008 Perceived Stress + ε

Test of normality for model six. The normality assumption was violated in model six (Table 4.37). Two significant *p*-values in the statistics of Shapiro-Wilk (W = .98, $p = .0048$) and Anderson-Darling (A-Sq = .87, $p = .0258$) and two nonsignificant p-values in the statistics of Kolmogorov-Smirnov (D = .06, $p = .0983$) and Cramer-von Mises (W-Sq = .11, $p = .0914$) were reported in the model diagnostics.

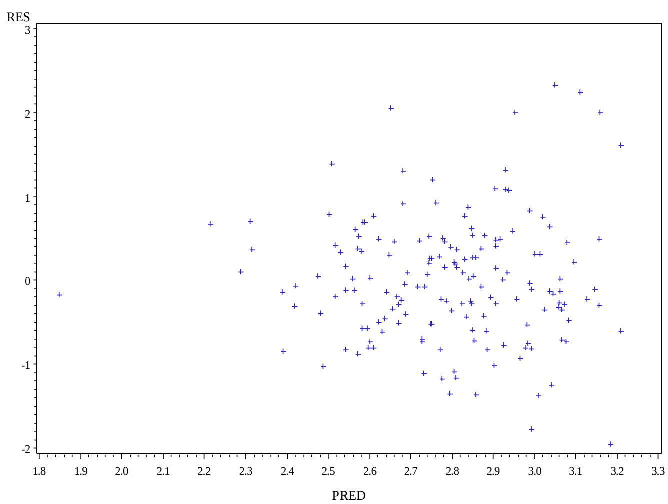
Table 4.37. Normality Tests for Model Six

Dependent Variable	Model 6† Weight Stigma x Acculturation x (Interaction Weight Stigma and Acculturation) Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log)	.98**	.06	.11	.87*

Note. † = after adjusting for age, perceived racism for Asian Americans and perceived stress for hair cortisol; * = *p* < .05; **= *p* < .01.

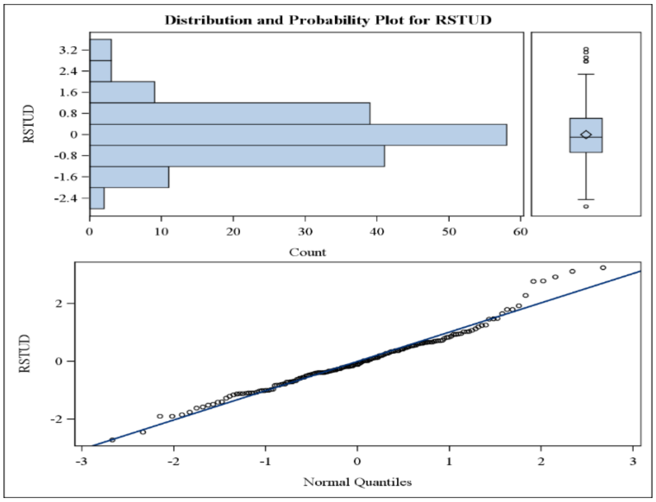
Homogeneity of variance for model six. The distribution of residuals was relatively even in model six (Figure 4.20), meaning that the assumption of equal variances across samples was not violated.

Figure 4.20. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) in Model Six



Re-fit model six without extreme observations for robust results. Due to the mixed results of the normality tests, we removed the six highest observations from model six (ID = 58, 124, 119, 141, 81, and 111) based on the distribution and probability plot (Figure 4.21) and re-fit model six with 160 observations.

Figure 4.21. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model Six



Compared to model six with all of the observations, the unadjusted R^2 of model six without the six highest observations decreased from 0.08 to 0.06, and the *p*-value became nonsignificant (F (6,153) = 1.61, p = .1470) (Table 4.38). The standardized regression coefficient of the interaction term changed from 0.02 in model six with all of the observations to 0.005 in model six without the six highest observations and both coefficients exhibited nonsignificant *p*-values, indicating that after controlling for age, perceived racism and perceived stress, the level of acculturation may not moderate the relationship between weight stigma and hair cortisol, whether before or after removing six highest observations from the model six.

Table 4.38. Multiple Regression for Weight stigma, Acculturation, and Hair Cortisol after Adjusting for Control Variables and Removing Extreme Observations

	Model 6 without Extreme Observations †			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	ß (S.E.)	ß (S.E.)	ß (S.E.)	R^2
Hair cortisol (log, n = 160)	-.17 (.54)	.03 (.17)	.005 (.19)	.06

Note. S.E. = standard error; † = after adjusting for age, perceived racism for Asian Americans and perceived stress for hair cortisol; * = p < .05; ** = p < .01.

The results of the normality tests were improved in model six after removing the six highest observations (Table 4.39). All normality tests reported nonsignificant *p*-value at 0.05 level, indicating that the normality assumption was not violated.

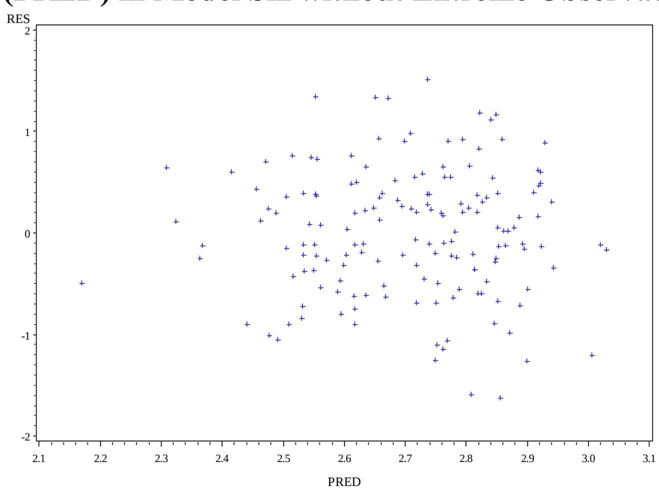
Table 4.39. Normality Tests for Model Six without Extreme Observations

	Model 6 without Extreme Observations †			
	Weight Stigma x Acculturation x (Interaction Weight Stigma and Acculturation)			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Hair cortisol (log, n = 160)	1.00	.03	0.4	.20

Note. † = after adjusting for age, perceived racism for Asian Americans and perceived stress for hair cortisol; * = $p < .05$; ** = $p < .01$.

The residuals were equally distributed after removing the six highest observations (Figure 4.22), indicating that the assumption of homogeneity of variance was not violated.

Figure 4.22. Scatterplot of Residuals (RES) versus Predicted Values of Log Hair Cortisol (PRED) in Model Six without Extreme Observations



Summary for Aim 3. We reported results of four regression models in the above section for Aim 3: model five with all of the observations (n = 166, unadjusted model, not including controlled variables), model five without extreme observations (n = 160, unadjusted model, not including controlled variables), model six with all of the observations (n = 166, adjusted model, after controlling for age, perceived racism, and perceived stress), and model six without extreme observations (n = 160, adjusted model, after controlling for age, perceived racism, and perceived stress).

In conclusion, we favor model six without the extreme observations for robust outcomes secondary to the better results of the model diagnostics. Our results indicated that we did not have enough evidence to support the moderator role of acculturation in the relationship between weight stigma and hair cortisol after controlling for age, perceived racism, and perceived stress among Asian Americans with overweight and obesity living in N.C.

Aim Four: Whether Acculturation Moderates the Relationship between Weight Stigma and Binge Eating

Models seven and eight were tested for Aim four to examine the change of weight stigma, acculturation, and the interaction between weight stigma and the influence of acculturation on binge eating before and after controlling for the variables mentioned above:

Model 7 (unadjusted model): E (binge eating) = $\beta 0+\beta 1$ weight stigma $+\beta 2$ acculturation $+\beta 3$ weight stigma × acculturation interaction + ε

Model 8 (adjusted model): E (binge eating) = $\beta 0+\beta 1$ weight stigma $+\beta 2$ acculturation $+\beta 3$ weight stigma × acculturation interaction $+\beta 4$ age $+\beta 5$ BMI $+\beta 6$ years lived in the U.S. $+\beta 7$ Perceived Racism $+\beta 8$ Perceived Stress + ε

Multiple regression for model seven. Model seven (n = 166, unadjusted model, not including controlled variables) demonstrated that weight stigma, acculturation, and the interaction of weight stigma and acculturation were able to explain 50% of the variance in binge eating, and this explanation was statistically significant (F (3,162) = 52.86, p <.0001) (Table 4.40). The standardized regression coefficients of the interaction term in model seven were not significant (β = 1.07, t = 0.73, p = .4675). The results indicated that the impact of weight stigma on binge eating was not dependent on the level of acculturation. The equation of regression model seven is: E (binge eating) = 2.75 + 11.41 weight stigma +0.76 acculturation + 1.07 weight stigma × acculturation interaction + ε

Table 4.40. Multiple Regression for Weight Stigma, Acculturation and Binge Eating

	Model 7			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	ß (S.E.)	ß (S.E)	ß (S.E.)	R^2
Binge eating	11.41 (4.07)**	.76 (1.23)	1.07 (1.46)	.50**

Note. S.E. = standard error; * = *p* < .05; ** = *p* < .01.

Test of normality for model seven. The results of normality tests in model seven indicated that the normality assumption was violated (Table 4.41). Only the statistics of Kolmogorov-Smirnov reported a nonsignificant *p*-value of 0.0569 (D = .07, *p* = .0569). The statistics of Shapiro-Wilk (W =.97, *p* = .0020), Cramer-von Mises (W-Sq = .17, *p* = .0160), and Anderson-Darling (A-Sq = 1.22, *p* <.0050) all indicated that the residuals were not normally distributed for model seven.

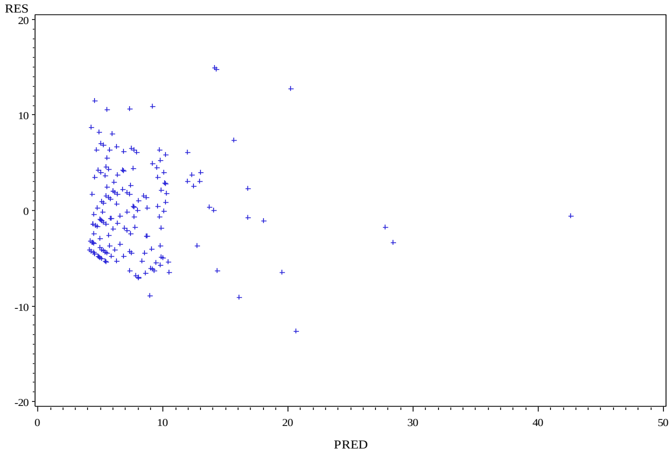
Table 4.41. Normality Tests for Model Seven

	Model 7			
	Weight Stigma x Acculturation x (Interaction of Weight Stigma and Acculturation)			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating	.97**	.07	.17*	1.22**

Note. * = *p* < .05; ** = *p* < .01.

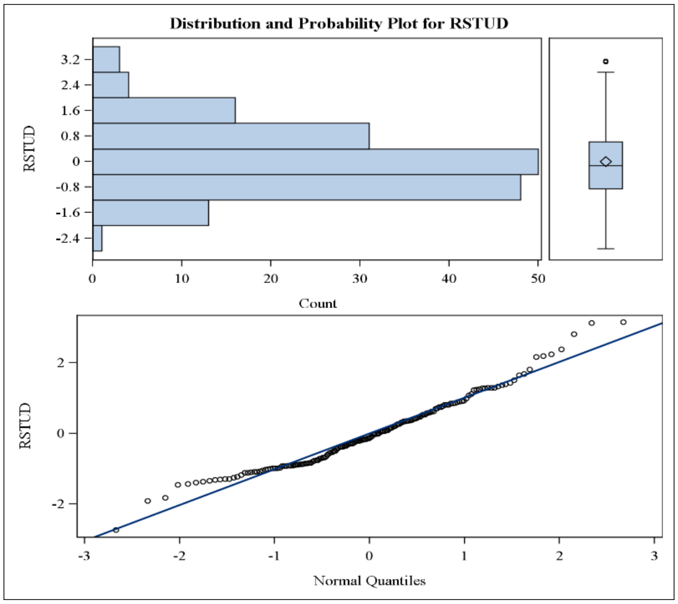
Homogeneity of variance for model seven. A scatterplot of residuals on the predicted values of binge eating indicated that the residuals were not equally distributed (Figure 4.23). The assumption of homogeneity of variance in model seven was violated.

Figure 4.23. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Seven



Re-fit model seven without extreme observations for robust results. Model seven's distribution and probability plots were reviewed and found to have extreme observations (Figure 4.24). The seven highest observations (ID = 49, 161, 74, 6, 141, 46, and 25) and one lowest observation (ID =33) were removed from model seven and we re-fit the model with 158 observations.

Figure 4.24. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model Seven



Compared to model seven with all of the observations, the unadjusted R^2 of model seven without the eight extreme observations increased from 0.50 to 0.55 (F (3,154) = 62.72, p <.0001) (Table 4.42), indicating that weight stigma, acculturation, and the interaction terms of weight stigma and acculturation were able to explain an additional 5% of the variance of binge eating after removing the eight extreme observations. The standardized regression coefficient of the interaction term changed from 1.07 in model seven with all of the observations to 1.57 in model seven without the eight extreme observations. However, both coefficients were nonsignificant at a 0.05 level. Therefore, with or without the eight extreme observations, we did not reject the null hypothesis and the level of acculturation did not moderate the relationship between weight stigma and hair cortisol levels.

Table 4.42. Multiple Regression for Weight Stigma, Acculturation and Binge Eating without Extreme Observations

	Model 7 without Extreme Observations			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	ß (S.E.)	ß (S.E)	ß (S.E.)	R^2
Binge eating (n = 158)	9.82 (3.71)**	-.11 (1.07)	1.57 (1.29)	.55**

Note. S.E. = standard error; * = p < .05; ** = p < .01.

The normality assumption was also violated after removing the eight extreme observations from the model (Table 4.43). All of the p-values of the normality testing showed a significant result after the eight extreme observations were removed.

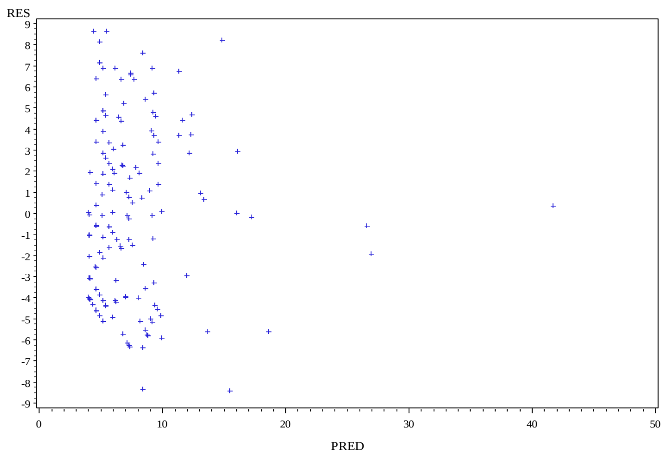
Table 4.43. Normality Tests for Model Seven without Extreme Observations

	Model 7 without Extreme Observations			
	Weight Stigma x Acculturation x (Interaction of Weight Stigma and Acculturation)			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating (n = 158)	.97**	.09**	.18**	1.29**

Note. * = p < .05; ** = p < .01.

Compared to the distribution of residuals in model seven with all of the observations, the distribution of residuals in model seven without the eight extreme observations were more even but still not equally distributed (Figure 4.25). Therefore, the assumption of homogeneity of variance was violated after removing the extreme observations (Rosner, 2006).

Figure 4.25. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Seven



Multiple regression for model eight. After adding age, BMI, years lived in the U.S., perceived racism, and perceived stress as controlling variables in model eight (n = 166, adjusted model) (Table 4.44), model eight was able to explain 53% of the variance in binge eating with an unadjusted R^2 of 0.53 and this explanation was statistically significant (F (8,157) = 22.12, p <.0001). Compared to model seven, model eight was able to explain an additional 3% of the variance in binge eating. The standardized regression coefficients of the interaction term in model eight were not significant (β =1.61, t = 1.11, p = .2681). The results indicated that the impact of weight stigma on binge eating was not dependent on the level of acculturation after controlling for age, BMI, years lived in the U.S., perceived racism and perceived stress levels. The equation of regression model eight is: E (binge eating) = 3.12 + 8.05 weight stigma + -0.18 acculturation + 1.61 weight stigma × acculturation interaction +-0.08

Age + 0.07 BMI + -0.01Years lived in the U.S. + 0.19 Perceived Racism + 0.01Perceived Stress + ε

Table 4.44. Multiple Regression for Weight Stigma, Acculturation, and Binge Eating after Adjusting for Control Variables

	Model 8†			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	ß (S.E.)	ß (S.E.)	ß (S.E.)	R^2
Binge eating	8.05 (4.15)	-.18 (1.45)	1.61 (1.45)	.53**

Note. S.E. = standard error; † = after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * = *p* < .05; ** = *p* < .01.

Test of normality for model eight. Model eight illustrated mixed results of the normality tests, and the normality assumption was violated in this model (Table 4.45). Two significant *p*-values in the statistics of Shapiro-Wilk (W = .98, *p* = .0098) and Anderson-Darling (A-Sq =.82, *p* = .0344) and two nonsignificant *p*-values in the statistics of Kolmogorov-Smirnov (D =.06, *p* >.1500) and Cramer-von Mises (W-Sq = .11, *p* = .0804) have been found in the model diagnostics.

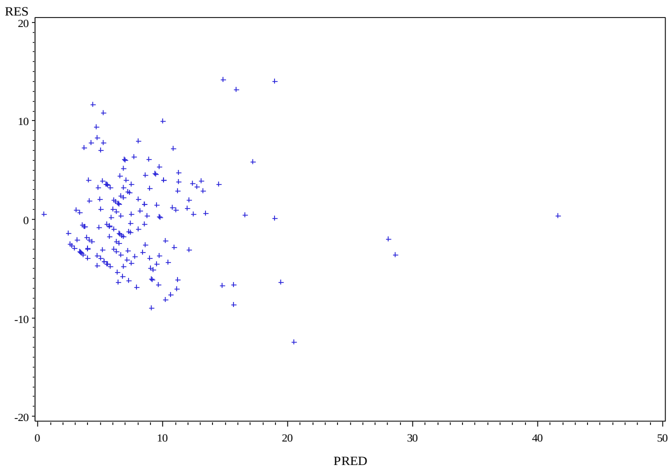
Table 4.45. Normality Tests for Model Eight

	Model 8†			
	Weight Stigma x Acculturation x (Interaction Weight Stigma and Acculturation)			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating	.98**	.06	.11	.82*

Note. † = after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * = *p* < .05; ** = *p* < .01.

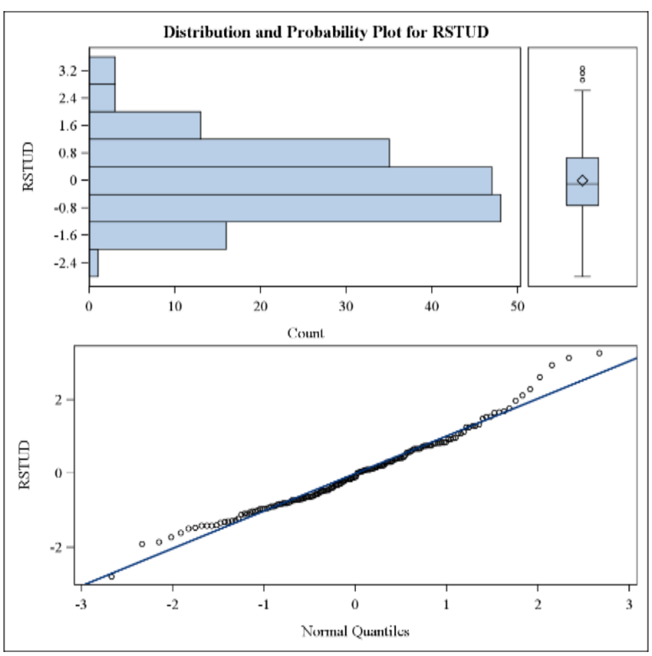
Homogeneity of variance for model eight. The distribution of residuals were not even in model eight (Figure 4.26), indicating that the assumption of homogeneity of variance was violated (Rosner, 2006).

Figure 4.26. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Eight



Re-fit model eight without extreme observations for robust results. Seven of the highest observations (ID = 49, 161, 74, 6, 141, 46, and 25) and the one lowest observation (ID = 33) were removed from model eight based on the distribution and probability plot (Figure 4.27), and model eight was re-fitted with 158 observations.

Figure 4.27. Distribution and Probability Plot for the Studentized Residuals (RSTUD) in Model Eight



Compared to model eight with all of the observations, the unadjusted R^2 of model eight without the extreme observations increased from 0.53 to 0.58 (F (8,149) = 25.86, p <.0001) (Table 4.46), indicating that after removing the extreme observations and after controlling for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress, model eight was be able to explain an additional 5% of the variance of binge eating. The standardized regression coefficient of the interaction term changed from 1.61 (p = .2681) in model eight with all of the observations to 2.00 (p = .1228) in model eight without the eight extreme observations. Both coefficients were not significant at the 0.05 level, meaning that the level of acculturation did not moderate the relationship between weight stigma and hair cortisol even after we removed the eight extreme observations from model eight.

Table 4.46. Multiple Regression for Weight Stigma, Acculturation, and Binge Eating after Adjusting for Control Variables and Removing Extreme Observations

	Model 8 without Extreme Observations †			
	Weight Stigma	Acculturation	Weight Stigma × Acculturation	
Dependent Variable	ß (S.E.)	ß (S.E.)	ß (S.E.)	R^2
Binge eating (n=158)	7.46 (3.84)	-1.22 (1.25)	2.00 (1.29)	.58**

Note. S.E. = standard error; † = after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * = p < .05; ** = p < .01.

The normality assumption was not violated in model eight without the eight extreme observations (Table 4.47). All normality tests reported nonsignificant p-values at the 0.05 level after we removed the eight extreme observations from model eight.

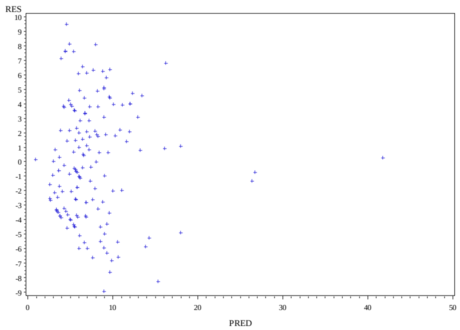
Table 4.47. Normality Tests for Model Eight without Extreme Observations

	Model 8 without Extreme Observations †			
	Weight Stigma x Acculturation x (Interaction Weight Stigma and Acculturation)			
Dependent Variable	Shapiro-Wilk	Kolmogorov-Smirnov	Cramer-von Mises	Anderson-Darling
Binge eating (n = 158)	.99	.06	.10	.60

Note. † = after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress; * = p < .05; ** = p < .01.

Compared to the scatterplot of residuals in model eight with all of the cases, the residuals of model eight without the extreme observations were still not equally distributed (Figure 4.28).

Figure 4.28. Scatterplot of Residuals (RES) versus Predicted Values of Binge Eating (PRED) in Model Eight without Extreme Observations



Summary for Aim 4. We demonstrated the results of the four regression models in the above section for Aim 4: model seven with all of the observations (n = 166), model seven without the extreme observations (n = 158), model eight with all of the observations (n = 166, after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress), and model eight without the extreme observations (n = 158, after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress).

In conclusion, we favor model eight without the extreme observations because of the improved model diagnostic results. Our results indicated that we did not have enough evidence to support the moderating effect of acculturation in the relationship between weight stigma and binge eating after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress. The impact of weight stigma on binge eating was not dependent on the level of acculturation after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress among Asian Americans with overweight and obesity in N.C.

Additional Analysis

We did an additional multiple regression analysis to further clarify whether the impact of weight stigma on hair cortisol and binge eating differed in different acculturation groups (See Table 4.48). A majority of our participants were scored as having “Asian identity” (score of 1 or 2, n = 156) with only a few being scored as “Bicultural identity” (score of 3, n = 8) or “Western identity” (score of 4 or 5, n = 2). For the purpose of the additional multiple regression analysis, we re-grouped our sample as “High Asian identity” (score < 2.05, n = 57), “Bicultural identity” ($2.05 <$ score > 2.29, n = 61), or “High Western identity” ($2.29 <$ score > 4.57, n = 48). The results across these three acculturation groups were similar, indicating a nonsignificant inverse trend between weight stigma and hair cortisol and a significant positive association between weight stigma and binge eating across all groups (of roughly similar magnitude). The results of the additional analysis supported our statement that the impacts of weight stigma on hair cortisol and binge eating were not influenced by the level of acculturation.

Table 4.48. Multiple Regression for the Associations of Weight Stigma, Hair Cortisol, and Binge Eating by Acculturation Groups

	High Asian Identification (n = 57)		High Asian Identification† (n = 57)		Bicultural (n = 61)		Bicultural† (n = 61)		High Western Identification (n = 48)		High Western Identification† (n = 48)	
Dependent	Weight Stigma		Weight Stigma		Weight Stigma		Weight Stigma		Weight Stigma		Weight Stigma	
Variables	ß	R^2	ß	R^2	ß	R^2	ß	R^2	ß	R^2	ß	R^2
Hair cortisol (log)	-.27	.01	-.01	.08	-.54	.05	-.47	.12	-.47	.06	-.44	.15
Binge eating	11.23**	.24**	10.92**	.35**	15.01**	.59**	13.50**	.61**	16.33**	.61**	12.00**	.70**

Note: High Asian Identification = Acculturation score < 2.05; Bicultural =2.05 < Acculturation score > 2.29; High Western Identification =2.29 < Acculturation score > 4.57; Binge eating = the total score of the Binge Eating Scale; Emotional and cognitive = the emotional and cognitive responses subscales of binge eating scale; Behavioral = the behavioral characteristics subscale of binge eating scale; S.E. = standard error; † = after adjusting for age, perceived racism for Asian Americans and perceived stress in hair cortisol and after adjusting for age, BMI, years lived in the U.S., perceived racism for Asian Americans and perceived stress in binge eating and the subscales; * = $p < .05$; ** = $p < .01$.

Summary of Chapter Four

Weight stigma was significantly positively correlated with binge eating but negatively correlated with hair cortisol levels. The level of acculturation for Asian Americans did not significantly correlate with hair cortisol levels, binge eating or weight stigma. Perceived racism, perceived stress, age, BMI, and years lived in the U.S. reported significant correlations with hair cortisol levels, binge eating, and weight stigma, therefore, they were controlled for in the regression models.

For Aim 1, our results showed that there was a negative association between weight stigma and hair cortisol levels, and weight stigma did not play a significant role in explaining hair cortisol levels after controlling for age, perceived racism and perceived stress. For Aim 2, after controlling for age, BMI, years lived in the U.S., perceived racism and perceived stress, weight stigma played a significant role in explaining binge eating. For Aims 3, 4, and the additional analysis, there was not enough evidence to support the moderator role of acculturation in the relationship between weight stigma, hair cortisol levels, and binge eating after controlling for age, perceived racism, and perceived stress, meaning that the impact of weight stigma on hair cortisol and binge eating were not dependent on the level of acculturation.

CHAPTER 5: DISCUSSION

Introduction

This chapter includes seven sections. First, the discussion of aims one, two, three, and four and implications for clinical practice, future research directions, strengths and limitations, and conclusions.

Aim One: Relationship between Weight Stigma and Hair Cortisol

Aim one was to examine the relationship between the experience of weight stigma and hair cortisol levels among Asian Americans with overweight and obesity. The correlation analysis showed a significant inverse correlation between weight stigma and hair cortisol. More weight stigma experiences correlate with lower hair cortisol levels. To date, there is only one study (Jackson, Kirschbaum, & Steptoe, 2016) examining the association between weight stigma and hair cortisol. Therefore, the author of the present study focused on comparing the results of this study to those studies that examined the relationship between chronic stress and hair cortisol. The results of this study were consistent with Ouellette and colleagues (2015) study that examined the relationship between hair cortisol and maternal chronic stress using a longitudinal study design with 60 mother-daughter dyads in southwestern Ontario. Ouellette (2015) and colleagues assessed mothers' chronic stress in the previous 6 months using a Life Stress Interview and rated the degree of stress using a 5-point scale in eight domains such as social support and finances. Similar to this study, a one-centimeter hair sample from the posterior vertex region was collected from Ouellette's participants. Ouellette and colleagues

(2015) found that mothers with higher stress had significantly lower hair cortisol levels compared to mothers with lower stress.

Similar to this study, Wells and colleagues (2014) examined the association of hair cortisol with self-reported stress and mental health-related factors among 324 community participants in Southern Ontario. Wells et al. (2014) tested curvilinear associations of perceived stress and chronic stress with hair cortisol levels using regression analyses and found a significant negative quadratic association between perceived stress and hair cortisol after controlling for gender, age, body mass index (BMI), use of glucocorticoids and hair dye (β = -.127, p = .022). They also examined mean hair cortisol levels across the five categories of the Perceived Stress Scale (Cohen, Karmack, & Mermelstein, 1983) using scores of 0-8, 9-16, 17-24, 25-32 and 33-40 and found significant overall mean differences among the levels of perceived stress (F (4,288) = 2.96, p < 0.01). The results of Wells and colleagues (2014) study indicated that hair cortisol levels increased when participants had lower perceived stress scale ranges of 0-8 to 17-24 and hair cortisol levels decreased when participants had higher levels of perceived stress (i.e., scores of 33-40). The difference between this study and Wells (2015) study was that they used a 2-centimeter hair sample to reflect systemic cortisol exposure over the previous two months, while this study used a 1-centimeter hair sample to reflect systemic cortisol exposure over the previous one month. Similar to Ouellette (2015) and Wells (2014) results and this study is that all of the studies found that chronic stress may lead to a down-regulation of the HPA axis function over time.

The results of regression analysis in this study reported a nonsignificant trend for an inverse association between weight stigma and hair cortisol after controlling for age, perceived racism, and perceived stress. The findings of the nonsignificant inverse association between weight stigma and hypothalamic-pituitary-adrenal (HPA) axis function was consistent with a study on work-related psychosocial stress (Janssens, Clays, Fiers, Verstraete, de Bacquer, & Braeckman, 2017). The study reported a nonsignificant inverse association between job stress and hair cortisol for 102 Belgian workers ($r = -.060$, $p > .05$) (Janssens et al., 2017). An insufficient sample size for detecting significant differences was one possible explanation why the association between weight stigma and hair cortisol did not reach statistical significance. Before controlling for age, perceived racism and perceived stress in our model one regression, the inverse association between weight stigma and hair cortisol was statistically significant. This association became nonsignificant after controlling for those variables in our model two regression. However, the regression coefficient of weight stigma ($\beta 1$, expected change in the mean of hair cortisol for a one-unit change in weight stigma) did not show a great change from model one ($\beta 1 = -.44$, $p < .05$) to model two ($\beta 1 = -.35$, $p > .05$), indicating that there still may be some clinical meaning between weight stigma and hair cortisol even after the statistical significance in model two was lost. Larger samples offer greater test sensitivity to detect an effect (Kraemer & Blasey, 2016). The association between weight stigma and hair cortisol might have remained statistically significant after adjusting for the control variables if this study used a larger sample size. Nevertheless, our results along with Janssens et al. (2017) both discuss an emerging trend of low cortisol levels and psychosocial stress.

Our study results appeared dissimilar to Jackson (2016) and colleagues study who found a significant positive association between perceived weight discrimination and hair cortisol concentration after controlling for age, sex, socioeconomic status, ethnicity, hair treatment, BMI and time elapsed between data collection points, meaning that the experience of weight stigma may be associated with chronically elevated cortisol levels (Jackson et al., 2016). However, Jackson (2016) and colleagues measured weight stigma by dichotomizing the responses to whether or not participants had experienced weight stigma (Jackson et al., 2016), while we used a continuous measurement for the frequency of weight stigma. Furthermore, Jackson (2016) and colleagues used two-centimeter hair samples, which represented two-months of HPA-axis activity, while in our study we used one-centimeter hair samples, which represented one-month of HPA-axis activity. The measurement differences used in these two studies most likely led to different outcomes.

The findings from this study seemed inconsistent with Boesch (2015) and colleagues study, which showed that there was no correlation between stress and hair cortisol. Boesch (2015) and colleagues investigated the stress of 10-weeks of basic military training on hair cortisol among 177 young healthy males in the Swiss Army (Boesch et al., 2015). Participants in Boesch's (2015) study were asked to provide a hair sample and complete a German version of the Perceived Stress Questionnaire (Fliege et al., 2005) once during the first week and once during the 11th week of military training. The results from Boesch's study (2015) indicated that there was no correlation between the first week's hair cortisol and perceived stress or between the 11th week's hair cortisol and perceived stress. It is worth mentioning that 36% of the participants in Boesch's (2015) study were smokers. However, smoking was not adjusted for as a covariate in their analysis. In contrast, smokers were excluded from the present study since tobacco may lead to higher hair cortisol concentrations (Wosu et al., 2015). Also, a total of 34 participants who exhibited higher perceived stress scores in the first week quit the army before the 11th week (Boesch et al., 2015). Although there was no correlation between perceived stress and hair cortisol in the first week, those participants may have also exhibited higher perceived stress scores in the 11th week and resulted in a different outcome of perceived stress and hair cortisol. The difference in the inclusion criteria used for the participants in Boesch and colleagues (2015) study and the attrition of participants with higher stress may explain the different findings between their study and this study.

A possible explanation for the link between weight stigma and down-regulation of the HPA axis function in the present study may be a related to hypercortisolism. Hypocortisolism is a caused by the deregulation of adrenal steroid secretions (Maripuu, Wikgren, Karling, Adolfsson, & Norrback, 2016). Basal hypocortisolism and hyporeactivity are two very important concepts to understand (Woda, Picard, & Dutheil, 2016). Basal hypocortisolism can be described as a permanent decrease in cortisol levels, and hyporeactivity can be described as a flattened cortisol rhythm, meaning a decrease in the nictemeral variability (i.e., the variation of the day and night cycle) of cortisol levels despite a normal basal concentration (Woda et al., 2016). In short, hypocortisolism can be characterized as inadequate basal cortisol production, and flattened daytime cortisol production patterns (Edwards, Heyman, & Swidan, 2011).

Hypocortisolism or low HPA axis activity is influenced by the duration of stressors an individual endures (Hansen, Hogh, & Persson, 2011). Physical or psychological stress activates the HPA system by which the adrenal cortex produces high levels of cortisol (Woda et al., 2016). Cortisol serves as an energy mobilization hormone, and elevated cortisol levels give the ability to fight and overcome stressors (Lennartsson, Sjors, Wahrborg, Ljung, & Jonsdottir, 2015). The HPA axis activation is controlled by an auto-regulated feedback system (Woda et al., 2016). The system helps to maintain cortisol levels by circulating cortisol, which inhibits the production of the corticotropin-releasing hormone (CRH) and adreno-cortico-tropic hormone (ACTH) (Woda et al., 2016). However, persistent HPA axis hyperactivity during chronic stress may eventually develop into hypoactivity after long-term exposure to stressful situations without sufficient recovery and denoted as hypocortisolism. (Lennartsson, et al., 2015; Maripuu et al., 2016). A workplace bullying study showed that persons who were frequently bullied had a 24.8% lower salivary cortisol concentration compared with persons who were not bullied (Hansen et al., 2011). During chronic stress, chronic hypersecretion of CRH happens first, followed by hypocortisolism (Woda et al., 2016). Thus, chronic stress may explain the correlation between frequent weight stigma and lower hair cortisol levels in our study participants. Failing to decrease the negative feedback of the HPA system leads to the down-regulation of the hypothalamus and pituitary receptors, reduced hormone synthesis, and hormone depletion, which may be involved in the mechanisms of hypocortisolism (Woda et al., 2016).

Hypocortisolism results in an insufficient metabolic adaptation to stress and may lead to the body becoming incapable of coping with a chronic "fight or flight" response (Edwards et al., 2011). It may also increase the vulnerability of bodily disorders like autoimmune disorders, inflammation, chronic pain, asthma, and allergies. (Heim, Ehlert, & Hellhammer, 2000). Although the phenomenon of hypocortisolism may not always act as an early alarm for adrenal fatigue (or hypoadrenia, a maladaptive state that adrenal corticosteroid production is significantly decreased in response to chronic stress), it is a sign of dysregulation of HPA axis function (Edwards et al., 2011).

Aim Two: Relationship between Weight Stigma and Binge Eating

Aim two was to examine the relationship between the experience of weight stigma and binge eating among Asian Americans with overweight and obesity. Our findings indicated that weight stigma positively correlated with binge eating severity and performed a significant role in explaining binge eating in our samples after controlling for age, BMI, years lived in the U.S., perceived racism, and perceived stress. Our results were consistent with many published studies identifying a significant effect of the frequency of experiences of weight stigma on binge eating symptoms (Almeida, Savoy, & Boxer, 2011; Ashmore, Friedman, Reichmann, & Musante, 2008; Friedman, Ashmore, & Applegate, 2008; Wott & Carels, 2010; Wu & Liu, 2015). The firmly established relationship between weight stigma and binge eating from prior studies and this study may change the practice of using stigmatization to motivate individuals with overweight and obesity to adopt a healthy lifestyle and lose weight.

The regression results of this study were similar with Almeida and colleagues (2011) study. Almeida (2011) and colleagues examined the relationship of weight stigmatization, known risk factors of binge eating such as environmental stress, psychological functioning, and social support with binge eating among 99 patients with bariatric surgery and 100 undergraduate students. Similar to the present study, the Stigmatizing Situations Inventory (Myers & Rosen, 1999) and Binge Eating Scale (Gormally, Black, & Daston, 1982) were used in Almeida's study. The hierarchical regression of Almeida's (2011) study showed that weight stigmatization alone made a unique contribution to the prediction of binge eating after controlling for sex, BMI, age, and ethnic minority status in student participants, with higher weight stigma related to higher binge eating symptoms (Almeida et a., 2011).

The correlation results of this study were similar to Wott and Carels (2010) study. Wott and Carels (2010) examined the relationship between weight stigma, binge eating, depressive symptoms, and weight loss treatment outcomes among 55 patients with overweight and obesity from a 14-week behavioral weight loss program. The Stigmatizing Situations Inventory (Myers & Rosen, 1999) and the Binge Eating Scale (Gormally, Black, & Daston, 1982) were collected before and after the 14-week program. Wott and Carels found that higher weight stigma was significantly related to greater binge eating symptoms in baseline measures ($r = .24$, $p < .05$).

The correlation and regression results of this study were consistent with the author's prior research in Taiwan (Wu & Liu, 2015). Wu and Liu (2015) investigated the relationship between weight stigma and binge eating symptoms among 141 adults with overweight and obesity from a weight loss program and local communities in southern Taiwan. Wu and Liu (2015) reported that the score of the Stigmatizing Situations Inventory (Myers & Rosen, 1999) was positively correlated with the score of the Binge Eating Scale (Gormally, Black, & Daston, 1982) ($r = .33$, $p < .01$) and hierarchical regression analyses demonstrated a significant association between weight stigma and binge eating ($F\ (2,131) = 12.5$, $p < .001$), indicating that higher weight stigma experiences were related to higher binge eating symptoms.

The psychological mechanisms underpinning the connection between weight stigma and binge eating are still underexplored. It is believed that internalization of weight stigma may occur after the direct or indirect experience of weight-related discrimination and may mediate the association between stigmatizing experiences and binge eating (Nolan & Eshleman, 2016). Weight bias internalization can be characterized as a respondent's belief that negative stereotypes about individuals with overweight and obese apply to them (Schvey & White, 2015). O'Brien et al. (2016) reported that the frequency of weight stigma experiences was associated with greater weight bias internalization and the relationship between weight stigma experiences and disordered eating behavior were mediated by weight bias internalization and psychological distress in 634 undergraduate students with various body sizes (i.e., underweight, normal weight, overweight, and obese). Sienko, Saules, and Carr (2016) found that internalized weight bias was significantly correlated with disordered eating behaviors among individuals who both believed themselves to be overweight and also with those who were overweight. Weight bias internalization not only is found in individuals with overweight and obesity, but also in individuals who are lean and who perceive themselves to be overweight or obese. Schvey and White (2015) discovered that weight bias internalization predicted binge eating in individuals who were lean and lean individuals with binge eating had higher weight bias internalization compared to other individuals without binge eating. This demonstrated that individuals who were not classified as either overweight or obese could still experience weight stigma, internalize negative weight-related stereotypes, and suffer for its associated negative consequences like binge eating (Schvey and White). Individuals with high internalized weight bias many times believe that they should be stigmatized by others' negative weight-related attitudes and comments and such self-stigma may make the individuals vulnerable to unhealthy weight control practices like binge eating and purging (Schvey & White, 2015).

Self-criticism may be a key role in understanding the connection between internalized weight bias and binge eating (Palmeira, Pinto-Gouveia, Cunha, & Carvalho, 2017). Palmeira, Palmeira, Pinto-Gouveia, and Cunha, & Carvalho (2017) examined the mediating effects of self-criticism and self-reassurance on the association between weight self-stigma and binge eating symptoms and found that the effect of weight self-stigma on binge eating symptoms partially occurred through self-hate, one of the features of self-criticism, and reassured-self. Self-hate is characterized as a harsh and attacking attitude, and the reassured-self is characterized as focused on being warm and comforting (Gilbert, Clarke, Hempel, Miles, & Irons, 2004). Palmeira et al. (2017) found that individuals who internalized weight stigmatization tended to have a harsh and punitive attitude towards themselves. Moreover, the ability of the reassured-self was decreased when individuals internalized weight stigma, and they were unable to reassure themselves when facing difficulties (Palmeira et al., 2017). These poor coping strategies may lead to higher severity of binge eating symptoms (Palmeira et al., 2017).

The neurophysiological mechanisms underlying the link between weight stigma and binge eating have not been adequately investigated. The theory of stress-induced food-reward behavior may be a possible explanation of this relationship. It is believed that palatable food (i.e., tasty, high-calorie foods containing high amounts of sugars, fats, and carbohydrates) intake may relieve negative emotions by dampening signs of stress following exposure to acute or chronic stress (Weltens, Zhao, & Van Oudenhove, 2014). This phenomenon is known as stress-induced comfort eating (Ulrich-Lai, Fulton, Wilson, Petrovich, & Rinaman, 2015). Stress-induced comfort eating is characterized as an individual's focus on relieving negative emotions or affect from stress by eating a greater proportion of calories from palatable foods and self-medicate from stress by eating food (Gibson, 2012; Ulrich-Lai et al., 2015). Finch and Tomiyama (2015) found in young adults that perceived stress from adverse events such as moving to a new place or the loss of a significant relationship declined among comfort eaters compared to non-comfort eaters. Comfort eating also provides hedonic value (i.e., oral consumption of food provides stress-relief effects) to reduce the effects of stress (Merali, Graitson, Mackay, & Kent, 2013; Ulrich-Lai et al., 2010). Palatable food is capable of activating neural reward circuitry and eliciting dopamine release from the amygdala and nucleus accumbens (Merali et al., 2013). The effect of eliciting dopamine release by palatable food is similar to the effect of drug and alcohol abuse (Merali et al., 2013). Consequently, stopping a palatable diet may result in withdrawal-like behaviors (Merali et al., 2013). It is worthy to note that the concept of comfort eating may overlap with binge eating (Gibson, 2012). The difference between these two concepts is that binge eating requires clear evidence of excessive and frequent food intake, such as eating a larger than normal amount of food in a discrete period of time (Razzoli, Sanghez, & Bartolomucci, 2015). Comfort eating may not contain the excessive consumption of food (Gibson, 2012).

The mechanisms for stress-induced food-reward behavior is complex. Both stress and brain reward pathways activate a sequence of neurocircuits involving brain regions such as the amygdala and anterior cingulate cortex (Bissonette & Roesch, 2016). The amygdala contains the basolateral amygdala and the central amygdala (Merali et al., 2013). The basolateral amygdala is a response to brain reward circuitry and is activated by palatable food intake (Ulrich-Lai et al., 2015). It is believed that the basolateral amygdala encodes both appetitive and aversive signals (Bissonette & Roesch, 2016). In fact, basolateral amygdala neurons increase firing when animals expect a food reward (Bissonette & Roesch, 2016). Moreover, food intake induces synaptic remodeling in the basolateral amygdala (Ulrich-Lai et al., 2015). The anterior cingulate cortex has strong mutual connections with the basolateral amygdala and is involved in error processing, conflict monitoring, behavioral feedback, and attention (Bissonette & Roesch, 2016) and is also involved in food reward by responding to the hedonic properties and the palatability of food emotion (Merali et al., 2013).

When an individual experiences stress, cortisol sensitizes the reward system and promotes food intake (Tomiyama, 2014), a decision regulated by the homeostatic and the nonhomeostatic systems (Lutter & Nestler, 2009). The homeostatic system includes hypothalamic and brainstem pathways and responses to stress reaction, feeding signals and energy balance (Merali et al., 2013). The nonhomeostatic system mediates the pleasure associated with food consumption and the motivation to obtain food (la Fleur, van Rozen, Luijendijk, Groeneweg, & Adan, 2010). Stress activates the HPA axis to increase glucocorticoid synthesis (Ulrich-Lai et al., 2015). Glucocorticoids regulate the balance of body fat and increase appetite (Ulrich-Lai et al., 2015). Corticotropin-releasing factor should be released from the hypothalamus to inhibit eating; however, activation of the HPA axis reduces its release (Merali et al., 2013). Evidence of cortisol-driven eating is conflicting. Epel, Lapidus, McEwen, and Brownell (2001) applied actual stress sessions to fifty-nine healthy women who were pre-menopausal and found that those women had a high salivary cortisol response to the stress sessions and consumed more calories and sweet foods than low cortisol reactors. Tryon, DeCant, and Laugero (2013) reported that subjects with higher chronic stress demonstrated lower salivary cortisol reactivity to acute stress and consumed significantly more calories from chocolate, meaning that chronic stress significantly influenced chocolate cake consumption in those individuals with low cortisol stress reactivity. Our study results were similar to Tryon and colleagues (2013) study, indicating that the higher the weight stigma and binge eating symptoms, the lower the hair cortisol levels.

Stress management techniques may help to reset the brain regulation of the food reward system and prevent weight gain (Webber, Casey, Mayes, Katsumata, & Mellin, 2016). A randomized controlled pilot study with 33 campus-based participants with obesity demonstrated that the sample significantly improved food addiction symptoms after a seven-week stress-reduction program (Webber, Mellin, Mayes, Mitrovic, & Saulnier, 2017). Another randomized controlled study with 202 participants showed that an online stress management tool reduced stress-related unhealthy snacking when participants experienced daily stress (O'Connor, Armitage, & Ferguson, 2015). The development of stress management skills should include emotion-focused coping strategies when an individual is experiencing stress, such as changes in attitude and internal perceptions of a stress situation, and interacting with the environment by increasing physical abilities (Habibi, Tourani, Sadeghi, & Abolghasemi, 2013). Also, cognitive restructuring, saying no to unhealthy eating, and problem-solving should be introduced in a stress management program to overcome negative eating thoughts (Czegledi, 2016).

Aims Three and Four: Whether Acculturation Moderates the Relationships between Weight Stigma, Hair Cortisol, and Binge Eating

Aims three and four examined whether the level of acculturation moderated the relationship between weight stigma with hair cortisol and binge eating among Asian Americans with overweight and obesity. Our results indicated that the level of acculturation did not moderate the relationships between weight stigma and hair cortisol and binge eating after adjusting for controlled variables. Our additional analysis indicated that the association of weight stigma with hair cortisol and binge eating did not differ in different acculturation groups. In other words, the impact of weight stigma on hair cortisol and binge eating was not influenced by the subjects' cultural identity.

The results of this study are similar to Shim and Schwartz's (2008) study that found that the level of acculturation did not significantly associate with psychological distress in Korean immigrants. Shim and Schwartz (2008) investigated the association of the level of acculturation and adherence to Asian values with psychological distress among 118 Korean immigrants living in the Midwestern United States. The Suinn-Lew Asian Self-Identity Acculturation Scale (Suinn et al., 1992), the Asian Values Scale (Kim et al., 1999), and the Brief Symptom Inventory 18 (i.e., measures psychological distress including somatization, depression, and anxiety) (Derogatis & Fitzpatrick, 2004) were collected. The majority of participants (77.2%) were first-generation Korean immigrants, which is similar to this study in that 94% of participants self-identified as first-generation Asian immigrants. Not surprisingly, the correlation results of this study were similar to Shim and Schwartz's (2008) study, which indicated that the more years that the participants lived and received their education in the U.S., the higher their Western identity. Our study also reported that the younger the participant, the higher the Western identity. However, Shim and Schwartz (2008) did not detail the relationship between the level of acculturation and age in their sample. Moreover, Shim and Schwartz (2008) found that the level of acculturation and adherence to Asian values did not significantly associate with psychological distress after controlling for years of living and education in the U.S. and sex. The regression results of our study were similar to Shim and Schwartz (2008) study, which illustrated that acculturation alone or the interaction of weight stigma and acculturation were not significantly associated with hair cortisol. The results of both studies supported a view that other factors not included in the studies may account for the variance of psychological distress and cortisol.

The direct relationship between the level of acculturation and eating disturbances was not an aim in this study. However, the regression results of this study were similar to Jackson and colleagues (2006) who found that the level of acculturation was not significantly correlated with disordered eating in Korean women. Jackson et al. (2006) compared disordered eating attitudes and behaviors in second-generation Korean-American women (born and raised in the U.S., now live in the U.S. and either parent was born in Korea), Korean immigrant women (born and raised in Korea and now live in the U.S.), and Native Korean women (born and raised in Korea and now live in Korea) to understand if different levels of exposure to Western culture were associated with disordered eating. One of the hypotheses of their study was that Korean immigrant women should be expected to report the highest level of disordered eating if acculturation stress accounted for disordered eating, because they had maximum discordant between the Korean and American culture. The Suinn-Lew Asian Self-Identity Acculturation Scale (Suinn, Ahuna, & Koo, 1992) and the Eating Attitudes Test (Garner & Garfinkel, 1979) were collected. Results indicated that Korean immigrant women did report the highest levels of disordered eating among all three groups, but this finding did not reach statistical significance (Jackson et al., 2006). The level of acculturation was not significantly correlated with disordered eating in second-generation Korean-American women or Korean immigrant women (Jackson et al., 2006). Furthermore, second-generation Korean-American women reported significantly lower disordered eating compared with the other two groups (Jackson et al., 2006). The results of this study were similar with Jackson's (2006) study in that the level of acculturation was not associated with binge eating.

The nonsignificant influence of acculturation on the relationship between weight stigma and our outcome variables could be explained in several ways. First, our study did not have enough participants who represented the various levels of acculturation (low to medium to high). Ninety-four percent of our participants reported that they were of Asian identity, meaning that they preferred to retain identity with their ethnic heritage and may have refused to adapt to American society (Suinn et al., 1992). It was difficult to determine whether the degree of acculturation affected the relationship between weight stigma and the outcome variables since our sample represented only a certain degree of acculturation. Also, the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) (Suinn, Ahuna, & Khoo, 1992) did not contain questions that could determine the degree of beliefs and attitudes around a social issue like stigmatization. The purpose of the SL-ASIA (Suinn, Ahuna, & Khoo, 1992) is to determine the degree to which one has adapted to American culture. It focuses on actual practice and behaviors that are adopted when arriving in American society, such as speaking English, music and food preference, and association with neighborhood communities (Cheryan & Tsai, 2007; Suinn, Ahuna, & Khoo, 1992). Weight stigma contains the concepts of experiencing prejudice, discrimination, and stigma secondary to excess body weight (Tomiyama, 2014). However, it seems that such experiences are not affected by adapting to a new culture. Furthermore, our correlation analyses showed that the degree of acculturation was not significantly correlated with the frequency of weight stigma experiences, indicating that the degree of behavioral adaptation to American society may be irrelevant to how individuals perceived weight stigma experiences. Likewise, the degree of acculturation to American culture may also be unrelated to how weight stigma experiences affected binge eating symptoms. Our results indicated that the frequency of weight stigma experiences positively and significantly were associated with binge eating symptoms. Our results are similar to a previous study in Taiwan that also found a positive correlation between frequency of weight stigma experiences and binge eating symptoms (Wu & Liu, 2015). Both studies enrolled an Asian population as study sample but from totally different cultural environments. The similarity of the two study results may support the statement that the effect of weight stigma on binge eating is not influenced by adapting to a new culture.

To the best of our knowledge, there is no known research examining the influence of acculturation on weight stigma for Asian Americans. Previous acculturation studies focused on lifestyle and learning adaptation, such as the relationship between acculturation and physical activity (Abraído-Lanza, Shelton, Martins, & Crookes, 2017; Perez et al., 2017) or learning experiences of international students (Cao, Zhu, & Meng, 2017; Mitchell, Del Fabbro, & Shaw, 2017; Ting & Hwang, 2009). Thus, acculturation may be associated with knowledge. Kamitani, Fukuoka, and Dawson-Rose (2015) found that the degree of acculturation to American society was positively correlated with the knowledge of cardiovascular disease and acute coronary syndrome among Asian Americans in California (r = .36, p = .002), meaning that the more Asian Americans have adapted to American culture (i.e., high Western identification), the more knowledge of cardiovascular disease and acute coronary syndrome they have. High Western identification represents reading and speaking in English well (Suinn, Ahuna, & Khoo, 1992). Therefore, the better their English, the more knowledge of heart disease Asian Americans have (Kamitani, Fukuoka, & Dawson-Rose, 2015). Kamitani's study highlights the importance of language barriers to knowledge learning among Asian Americans. Thus, to reduce weight stigma situations and to prevent stigma-induced binge eating in Asian American communities, future anti-stigma interventions need to take language barriers into account, and the interventions need to be culturally appropriate.

Implications for Clinical Practice

We believe this study is the first to explore the relationship between weight stigma, acculturation, hair cortisol, and binge eating in Asian Americans. Our findings have implications for healthcare practice. The findings are encouraging. Health care providers need to start the conversation with patients with overweight and obesity to understand if they currently experience weight stigma situations. If long-term exposure to weight discrimination is found in those patients, providers may suggest a non-invasive cortisol test to determine if abnormal HPA axis function is noted and if that influences the patients' metabolic function and makes it more difficult for them to lose weight.

A second healthcare implication which follows from our findings is the need to decrease the perceived stress that weight stigma may trigger in the brain reward system, which may contribute to the obesity epidemic. It is important to prevent stress-induced binge eating by improving patient's stress-management skills. Habibi, Tourani, Sadeghi, & Abolghasemi (2013) suggest the following to build stress-management skills. First, use problem-focused strategies to identify sources of stress. Second, change the stressful situation or change the personal attitude and internal perceptions. Third, strengthen courage to refuse unhealthy coping behaviors and replace them with healthy ways to relax. Health care providers and therapists can introduce cognitive-behavioral stress-management programs to help patients with overweight and obesity to develop stress management skills to address weight stigmatization.

More specifically, anti-stigma interventions focused on bullying and stigmatizing for Asian Americans with overweight are needed. Our findings suggest that stigma reduction interventions need to include Asian American communities as targets and take language barriers into account to design culturally appropriate interventions. The first step of an anti-stigma reduction should be educating Asian American communities about the issue of weight stigmatization. In N.C., many Asian Americans participate in church activities and send their children to private Chinese schools to learn Mandarin. Church-based and school-based anti-stigma workshops may be feasible to advocate for the prevention of weight discrimination. Such workshops should include the following aspects with bilingual materials: (1) education about weight stigma and its effects, (2) providing evidence to emphasize that using stigmatization to encourage others to lose weight is a useless strategy, (3) educating about how to identify the situations of weight discrimination for yourself and others, (4) encouraging healthy communication between discriminators and those who are being discriminated against to reduce stigma situations, (5) promoting respect for all kinds of body sizes and saying no to weight stigma.

Future Research Directions

Our findings indicate the trend between weight stigma and low cortisol levels in a one-month time period using one-centimeter hair sample. However, it was difficult to know when the low cortisol tendency appeared and if an individual with overweight and obesity suffered from weight stigma situations and how long the down-regulation of cortisol continued before it developed into hypocortisolism. Future research could use a low dose dexamethasone suppression test (DST) with serum cortisol or 24-hour urinary free cortisol to answer the above questions and to determine hypocortisolism for patients with overweight and obesity (Maripuu et al., 2016). The DST can measure the basal cortisol level and the negative feedback of the HPA axis (Maripuu et al., 2016). Oral administration of a 0.5 or 1 milligram of dexamethasone is used in the DST (Direk et al., 2016). Cortisol secretion is suppressed in healthy subjects after an oral administration of dexamethasone (i.e., negative feedback) (Direk et al., 2016). High negative feedback sensitivity of the HPA axis and low basal cortisol level are both core symptoms of hypocortisolism (Maripuu et al., 2016).

Future studies should include more psychological measurements like internalization of weight stigma and self-criticism to explore the mechanisms between weight stigma and binge eating. Internalization of weight stigma and harsh self-criticism caused by weight stigma may lead to a desire to punish the self and result in unhealthy coping strategies like binge eating (Palmeira et al., 2017). Internalized weight stigma, the personal belief of weight stigma is hard to measure using the Stigmatizing Situations Inventory (Myers & Rosen, 1999). The Weight Bias Internalization Scale (Durso & Latner, 2008), an 11-item scale for measuring the degree to which a respondent believes that negative stereotypes about persons with overweight and obesity apply to himself or herself, is widely used in measuring internalized weight stigma (Durso et al., 2012). In addition, the Forms of Self-Criticizing, Attacking and Self-Reassuring Scale (Gilbert, Clarke, Hempel, Miles, & Irons, 2004), a 22-item scale which for measuring how respondents typically think and react (i.e., critical, attacking or supportive, reassuring) when things go wrong for them, was used in measuring the degree of self-criticism (Gilbert et al., 2004). Future research design might include the above two scales as an important measure in the weight stigma field.

Longitudinal studies could shed light on the directions of stress-induced binge eating prevention and anti-weight stigma interventions in Asian American communities. First, focus groups could be conducted in the community to gather information about Asian Americans perspectives and opinions about weight stigma and binge eating. Also, multidisciplinary experts, such as psychologists, nutritionists, and cognitive behavioral therapists could be included in research teams. Further, interventions could be developed based on the wealth of information gathered from the focus groups and consultation with the multidisciplinary experts. Third, a feasibility study of an intervention for Asian Americans with overweight and obesity could be conducted to determine the feasibility, acceptability and initial efficacy. Lastly, longitudinal studies could be developed and conducted to examine the outcomes of the interventions. Researchers need to develop the interventions based on the Asian culture and use not only English but also the native language of Asians in the interventions.

Strengths and Limitations of Present Study

We believe this study the first to explore the relationship of weight stigma and acculturation on hair cortisol and binge eating in Asian Americans. The present study has significant strengths. First, this study was comprised of a specific community sample of Asian Americans with overweight and obesity. Second, this study used hair cortisol as a novel and non-invasive indicator to examine HPA axis activity under long-term exposure to the stress of weight stigma. Third, this study was the first to explore the role of acculturation related to weight discrimination in Asian Americans.

The present study had several limitations. First, the sample range of this study was confined to the triangle area of N.C. We were unable to collect the data through random sampling due to the limitations of time and staff. Also, the majority of the participants in this study came from local Asian churches and private Chinese schools, which may limit our understanding of weight stigma on other Asian Americans outside the churches and schools. Although to date there is no research examining the influence of religion on weight stigma experiences, support from religious may also affect one's perception of weight discrimination. Third, the sample was almost exclusively Chinese-speaking Asian American, so findings cannot be assumed to be generalizable to other Asian American population such as Filipino or Japanese Americans. Also, we excluded participants who were under the age of 21. Therefore, we were unable to explore the role of weight stigma in children and adolescents. Finally, we were not able to conclude causality since a cross-sectional design was used in the current study.

Conclusion

This study examined weight stigma and acculturation in relation to hair cortisol and binge eating in Asian Americans with overweight and obesity in N.C. The results indicated a link between weight stigma and low HPA axis activity and high binge eating symptoms among Asian Americans regardless of how much they adapted to Western society. Ongoing experiences of weight discrimination may result in the change in HPA axis activity and also trigger a stress-induced food-reward system leading to binge eating behaviors. These findings highlight that weight stigma is a pervasive social problem in Asian American communities and the attitude of using fear and stigmatization to motivate individuals with excess body weight to engage in healthy behaviors must be changed. Although it may be a challenge to make lasting change to reduce weight bias among the general population, future studies should prioritize further development of interventions to reduce weight stigma and creating a world that respects the diversity of body sizes and to prevent stress-induced binge eating by decreasing bullying and stigmatization toward individuals with overweight and obesity.

APPENDIX 2.1: SUMMARY OF INCLUDED STUDIES

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
1. Ashmore *et al.* (2008) U.S.	Cross-sectional	Convenience n = 93	The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory).	1.Binge eating behaviors 2. Interpersonal sensitivity 3. Depressive symptoms 4. Social isolation 5. Anxiety 6. Suspiciousness 7. Obsessive/compulsive anxiety 8. Hostility 9. Somatization 10. Phobic anxiety	1. The correlations between weight- stigmatizing experiences and binge eating behavior, interpersonal sensitivity, depressive, social isolation, anxiety, and suspiciousness were positive (*r* = 0.45, 0.52, 0.31, 0.37, 0.33, 0.36, respectively. All $p < 0.001$). 2. The correlations between weight stigmatizing experiences and obsessive/compulsive anxiety and hostility were positive (*r* = 0.30, 0.26, respectively. All $p < 0.01$). 3. The correlations between weight stigmatizing experiences and somatization and phobic anxiety were not significant.
2. Friedman *et al.* (2008) U.S.	Cross-sectional	Convenience n = 94	The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory)	1. Binge eating behaviors 2. Depressive symptoms 3. Anxiety 4. Phobic anxiety 5. Self-esteem 6. Body image dissatisfaction	1. The correlation between weight- stigmatizing experiences and binge eating behavior was positive ($r = 0.26$, $p = 0.01$). But after controlling for age, gender, and BMI, the association between weight-stigmatizing experiences and binge eating behavior was not significant. 2. More frequent stigmatizing experiences were significantly related to higher depression ($b = 0.29$, $p < 0.004$), anxiety ($b = 0.35$, $p = 0.0006$), and phobic anxiety ($b = 0.45$, $p < 0.0001$) after controlling for age, gender, and BMI. 3. More frequent stigmatizing experiences were significantly related to lower self-esteem ($b = - 0.23$, $p < 0.02$). 4. More frequent stigmatizing experiences were significantly related to higher body image dissatisfaction ($b = 0.40$, $p < 0.0001$).

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
3. Carels *et al.* (2009) U.S	1-Group pretest/ posttest design. <u>Intervention:</u> 18-week weight loss program. <u>Follow-up:</u> 18 weeks.	Convenience n = 42	1. Explicit weight bias: the percentage of obese persons who possess positive and negative traits (Obese Persons Trait Survey) 2. Implicit weight bias (Implicit Associations Test)	1. Dropouts from the weight loss program 2. Weight loss outcome	1. Overweight and obese subjects reporting more positive traits, and fewer negative traits for obese persons were less likely to drop out of the program. 2. Subjects who lost at least 2.5% of their baseline weight reported more positive traits for obese persons. 3. Implicit bias and negative attributions were not associated with weight loss.
4. Farrow and Tarrant (2009) U.K.	Cross-sectional	Convenience n = 197	Personal experiences of weight-based discrimination (Experience of Weight- based Discrimination Scale)	1. Emotional eating. 2. Body image dissatisfaction 3. In-group social consensus 4. Social support satisfaction 5. Social support availability	1. The correlations between experience of weight discrimination and emotional eating was positive (r = 0.29, p < 0.01). 2. The correlations between experience of weight discrimination and body image dissatisfaction was positive (r = 0.41, p < 0.01). 3. The correlations between experience of weight discrimination and in-group social consensus was negative (r = - 0.20, p < .01). 4. The correlations between experience of weight discrimination and social support satisfaction was negative (r = - 0.19, p < 0.05). 5. The correlations between experience of weight discrimination and social support availability was not significant.

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
5. Hatzenbuehler *et al.* (2009) U.S.	Cross-sectional	Secondary database n = 31,558	The frequency of perceiving weight discrimination (Perceived Weight Discrimination Scale)	1. Perceived stress 2. Any mood disorder (i.e. major depressive episode, manic or hypomanic episode, and dysthymia) 3. Any anxiety disorder (i.e. generalized anxiety disorder, social phobia, post-traumatic stress disorder, and panic disorder) 4. Any substance disorder (i.e. nicotine dependence, alcohol abuse, alcohol dependence, drug abuse, and drug dependence)	1. Subjects who perceived weight discrimination were 3.21 (95% CI = 2.42–4.26) times more likely to be in the highest quartile of perceived stress compared to those who did not perceive weight discrimination. 2. Subjects who perceived weight discrimination were more likely to have major depressive episodes, manic or hypomanic episodes, dysthymia nicotine dependence, generalized anxiety disorder, social phobia, post-traumatic stress disorder, panic disorder nicotine dependence, alcohol dependence, and drug dependence compared to those who did not perceive weight discrimination.
6. Latner *et al.* (2009) U.S.	1-Group pretest/ post-test design <u>Intervention:</u> behavior weight loss program <u>Follow-up:</u> two month	Random n =185	The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory)	1. Percentage weight loss 2. Perceptions of success in weight loss treatment 3. Body image dissatisfaction 4. Fear of fat and weight gain 5. Self-esteem 6. Negative attitudes toward fat people	1. More weight-stigmatization experience was correlated with greater percentage weight loss ($r = 0.23$, $p < 0.005$) and perceptions of success in weight loss treatment ($r = 0.16$, $p < 0.05$). 2. Weight-stigmatization experience was associated with poorer body image ($r = 0.25$, $p < 0.001$) and with increased fear of fat and weight gain ($r = 0.17$, $p < 0.05$). 3. The correlations between weight- stigmatization experience and self-esteem and negative attitudes toward fat people were not significant.

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
7. Carels *et al.* (2010) U.S.	2-Group pretest/ post-test design Intervention: Two 14-week weight loss programs Follow-up: 14 weeks	Random n = 49	1. Implicit weight bias (Implicit Associations Test) 2. Internalized weight bias (Weight Bias Internalization Scale) 3. Explicit weight bias (Obese Persons Trait Survey)	1. Weight loss 2. Binge eating behaviors 3. Depressive symptoms 4. Body image: appearance evaluation (i.e. feelings about physical appearance) and appearance orientation (i.e. investment in appearance)	1. Implicit, internalized, and explicit weight bias was unrelated to weight loss during treatment 2. Greater good–bad implicit weight bias was positively related to binge eating (r = 0.36, p < 0.01) and appearance orientation (r = 0.27, p < 0.05). 3. The correlations between implicit weight bias and depressive and appearance evaluation were not significant. 4. Greater internalized weight bias was related to higher binge eating scores (r = 0.43, p < 0.01), lower appearance evaluation ratings (r = -0.63, p < 0.01), and greater appearance orientation (r = 0.48, p < 0.01). 5. The correlations between internalized weight bias and depressive was not significant. 6. The correlations between explicit weight bias and weight loss, binge eating behaviors, depressive and body image were not significant.
8. Wott and Carels (2010). U.S. (Same study with no.7)	2-Group pretest/ post-test design Intervention: Two 14-week weight loss programs Follow-up: 14 weeks	Random n = 49	The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory)	1. Weight loss 2. Binge eating behaviors 3. Depressive symptoms	1. The relationship between greater stigmatizing experiences and decreased weight loss during the intervention was not statistical significance (t (45) = –1.55, p = 0.06). 2. The correlations between weight- stigmatizing experiences and binge eating behavior was positive (r = 0.24, p < 0.05). 3. The correlations between weight- stigmatizing experiences and depressive was positive (r = 0.40, p < 0.01).

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
9. Savoy (2010) U.S. (study 1)	Cross-sectional	Convenience n = 123	The frequency of perceiving weight-based stigmatization experience in current and childhood (Weight-based Stigmatization Experience Scale)	1. Binge eating behaviors 2. Dietary restriction behavior 3. Compensatory behavior 4. Body image (weight and shape concern)	1. The correlations between the sum of current and childhood weight stigmatization experiences and binge eating and compensatory behaviors were positive (r = 0.21, 0.21, respectively. All $p < 0.05$) 2. The correlations between the sum of current and childhood weight stigmatization experiences and binge eating and Dietary restriction behavior, weight concern, and shape concern were positive (r = 0.24, 0.46, 0.44, respectively. All $p < 0.015$).
10. Carels *et al.* (2011) U.S.	1-Group pretest/ post-test design Intervention: 18-week weight loss program Follow-up: 18 weeks	Convenience n = 53	Implicit weight bias (Implicit Association Test)	Weight loss outcome at week 6	1. Greater implicit weight bias was significantly associated with a lower percentage of weight loss ($r = –0.33$, $p = 0.04$) at week 6 controlling for baseline BMI. 2. Greater implicit weight bias was significantly associated with a less overall weight loss ($r = – 0.34$, $p = 0.04$) at week 6 controlling for baseline BMI.
11. Tsenkova *et al.* (2011) U.S.	Cross-sectional	Secondary database n=938	The frequency of perceiving weight discrimination (Perceived Weight Discrimination Scale)	The effects of waist-to-hip ratio on HbA1c	Perceived weight discrimination moderate the effects of waist-to-hip ratio on HbA1c after controlling selected sociodemographic, health and psychosocial variables that have been linked to higher HbA1c levels and risk for type 2 diabetes ($R^2 = 0.171$, $b = 0.851$, $p < 0.05$).

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
12. Robinson (2011) U.S	Cross-sectional, web-based survey	Convenience n = 955	1. The frequency of perceiving weight- related teasing (Perception of Teasing Scale) 2. Assessing weight- related victimization (Gatehouse Bullying Scale)	1. Depressive symptoms 2. Body image dissatisfaction 3. Self-esteem	1. The correlations between perceiving weight- related teasing and depressive was positive (*r* = 0.35, *p* < 0.01). 2. The correlations between weight- related victimization and depressive was positive (*r* = 0.28, *p* < 0.01). 3. The correlations between perceiving weight- related teasing and body image dissatisfaction was positive (*r* = 0.42, *p* < 0.01). 4. The correlations between weight- related victimization and body image dissatisfaction was positive (*r* = 0.14, *p* < 0.01). 5. The correlations between perceiving weight- related teasing and self-esteem was negative (*r* = - 0.31, *p* < 0.01). 6. The correlations between weight- related victimization and self-esteem was negative (*r* = - 0.23, *p* < 0.01). 7. Self-esteem mediated the relationship between perceiving weight- related teasing and weight-related victimization in the prediction of depressive symptoms and body image dissatisfaction.
13. Durso Latner & Hayashi (2012) U.S.	Cross-sectional, web -based survey	Convenience n = 381	Internalized weight bias (Weight Bias Internalization Scale)	The relationship between perceived discrimination and eating disturbance.	The acceptable fit of the final structural equation model to the data indicates that internalization of weight bias partially mediates the relationship between perceived discrimination and eating disturbance among overweight and obese participants.
14. Durso *et al.* (2012) U.S.	Cross-sectional	Convenience n = 100	Internalized weight bias (Weight Bias Internalization Scale)	1. Binge eating behaviors 2. Eating disorder 3. Depressive symptoms 4. Fat phobia 5. Self-esteem	1. Internalized weight bias was positive correlated with depression (r = 0.65, p < 0.01) and fat phobia (r = 0.50, p < 0.01) and negative correlated with self-esteem (r = - 0.68, p < 0.01). 2. Internalized weight bias was positively correlated with eating disorder (r = 0.43, p < 0.01). 3. Internalized weight bias was not significantly correlated with the frequency of binge eating.

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
15. Durso (2012) U.S.	2-Group pretest/ post-test design <u>Intervention:</u> six month weight loss program <u>Follow-up:</u> 18 months	Random n = 75	Internalized weight bias (Weight Bias Internalization Scale)	1. Weight lost 2. Depressive symptoms 3. Anxiety 4. Stress 5. Self-esteem 6. Antifat Attitudes (fear of fat, will power) 7. Body image dissatisfaction	1. Participants reporting low levels of internalized weight bias at baseline lost twice as much weight when compared to participants reporting high levels of internalized weight bias at baseline. 2. Baseline scores of internalized weight bias were positively correlated with post-treatment body image dissatisfaction (r = 0.53, p < 0.01) and fear of fat (r = 0.37, p < 0.01) and negatively correlated with post-treatment self-esteem (r = - 0.41, p < 0.05). 3. Post-treatment internalized weight bias scores were positively correlated with post-treatment body image dissatisfaction (r = 0.60, p < 0.01), antifat attitudes (r = 0.57, p < 0.01), depression (r = 0.43, p < 0.01) and negatively correlated with post-treatment self-esteem (r = - 0.67, p < 0.01) 4. Baseline scores of internalized weight bias was not significant correlated with baseline and post-treatment stress.
16. Fettich and Chen (2012) U.S.	Cross-sectional	Convenience n = 234	The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory)	Depressive symptoms	Weight-stigmatizing situations (coping subscales) significantly explained 33.2% of the variance in depression for whites, and 25% for African Americans (p < 0.001), controlling for age, sex, BMI, years overweight, income, and education level.
17. Levy and Pilver (2012) U.S.	Cross-sectional	Secondary database n = 20,649	The frequency of perceived lifetime-weight discrimination (Experiences of Discrimination Scale)	The relationship between weight status and anxiety disorder, depressive disorder and suicide attempts.	The frequency of perceived lifetime-weight discrimination mediated the relationship between weight status and anxiety disorder, depressive disorder and suicide attempts in the formerly overweight group.
18. Savoy *et al.* (2012) U.S.	Cross-sectional	Convenience <u>Clinic sample:</u> n = 99 <u>Student sample:</u> n = 100	The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory)	1. Depressive symptoms 2. Anxiety symptoms 3. Antisocial behavior	1. The correlations between weight- stigmatizing experiences and depressive was positive (r = 0.51, p < 0.01). 2. The correlations between weight- stigmatizing experiences and anxiety was positive (r = 0.39, p < 0.01). 3. The correlations between weight- stigmatizing experiences and antisocial behavior was positive (r = 0.21, p < 0.05).

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
19. Carels *et al.* (2013) U.S.	Cross-sectional	Convenience n = 62	1. Explicit weight bias: subjects rated themselves as having more positive or negative traits than obese people (Obese Persons Trait Survey) 2. Internalized weight bias (Weight Bias Internalization Scale)	1. Binge eating behaviors 2. Depressive symptoms 3. Body image satisfaction	1. Negative self-ratings of Obese Persons Trait Survey were positive correlated to depression (r = 0.41, p = 0.001), binge eating (r = 0.55, p < 0.001) and negative correlated to body image satisfaction (r = - 0.37, p = 0.003). 2. Positive self-ratings of Obese Persons Trait Survey were negatively correlated with depression(r = - 0.30, p = 0.019). 3. Internalized weight bias was positive correlated to depression (r = 0.65, p < 0.001) and binge eating (r = 0.57, p < 0.001) and negatively related to body satisfaction (r = - 0.63, p < 0.001).
20. Sutin and Terracciano (2013) U.S.	Longitudinal (Follow-up: 4 years)	Secondary database n=6,157	Participants rated their experience of everyday discrimination related to weight (Experience of Everyday Discrimination Scale)	1. The odd ratio of became obese. 2. The odd ratio of remained obese.	1. Among participants who were not obese at baseline, those who reported weight discrimination were approximately 2.5 times (95 CI%=1.58–4.08) more likely to be obese by follow-up than those who did not report weight discrimination, after controlling for baseline BMI. 2. Participants who experienced discrimination based on their weight were over three times more likely to remain obese at follow-up (OR = 3.20, 95% CI =2.06–4.97), after controlling for baseline BMI.
21. Burmeister and Carels (2014) U.S.	Cross-sectional	Convenience n =116	Internalized weight stigma (Weight Bias Internalization Scale)	1. Binge eating behaviors 2. Depressive symptoms 3. Body satisfaction 4. Physical activity	1. Internalized weight stigma was positive correlated with binge eating (r = 0.56, p < 0.01) and depression (r = 0.56, p < 0.01). 2. Internalized weight stigma was negative correlated with body satisfaction (r = - 0.51, p < 0.01). 3. Internalized weight stigma was not significant correlated with physical activity.

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
22. Hilbert *et al.* (2014) Germany	Cross-sectional	Random 2,510 responded, but only selected BMI ≥25 kg/m^2, n =1,158.	Internalized weight stigma (Weight Bias Internalization Scale)	<u>Mediator:</u> Core self-evaluation <u>Health outcome:</u> 1. Depressive symptoms 2. Anxiety 3. Self-reported health status 4. Health care utilization (how many times a person received treatment over the last 12 months)	Core self- evaluation mediated the relationships between internalized weight stigma and depression, anxiety, health status and health care utilization.
23. Himmelstein *et al.* (2014) U.S.	2-Group pretest/ post-test design <u>Intervention:</u> weight stigma manipulation (Shopping activity with weight stigma scenarios) <u>Control:</u> Did not participate the shopping activity	Random n = 110	Experimentally manipulated weight stigma in a clothes shopping scenario	<u>Moderators:</u> Objective BMI Self-perceived body weight <u>Health outcome:</u> Saliva cortisol level at baseline and 30 minutes post-manipulation (to see the stress-responsive hypothalamic–pituitary–adrenal axis)	1. Weight stigma manipulation compared with the control condition led to sustained cortisol elevation regardless of baseline cortisol. 2. Participants perceiving them-selves as heavy displayed more cortisol in the stigma condition compared with the control condition.

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
24. Hunger and Major (2014) U.S.	Cross-sectional web-based survey	Convenience Study one: n = 171 Study two: n = 194	Study one: 1. The frequency of perceived weight discrimination over past 12 months (modified version of perceived racial discrimination). 2. Individual's weight stigma concerns (modified version of other forms of stigma concerns). Study two: 1. The frequency of perceived weight discrimination in lifetime (modified version of perceived racial discrimination). 2. Individual's weight stigma concerns (modified version of other forms of stigma concerns).	Study one: The relationship between BMI and psychological health (self-esteem, depression, quality of life). Study two: The relationship between BMI and current physical health.	Study one: Perceived weight discrimination and concerns about stigma mediated the relationship between BMI and psychological health (self-esteem, depression, quality of life). Study two: Perceived weight discrimination and concerns about stigma mediated the relationship between BMI and current physical health.
25. Jackson *et al.* (2014) U.S.	Longitudinal (Fellow-up: 4 years)	Secondary database Weight discrimination: n = 150 No weight discrimination: n = 2,794 Total: n = 2,944	The frequency of perceived weight discrimination (Perceived Discrimination Questionnaire)	1. Difference in mean weight change (kg) 2. Difference in waist circumference change (cm) 3. The odds ratio of becoming obese	1.There was a 1.66 kg difference in mean weight change between individuals who reported experiences of weight discrimination and those who did not over 4 years (1.66±0.42, $p < 0.001$). 2.There was a 1.12 cm difference in waist circumference change between individuals who reported experiences of weight discrimination and those who did not over 4 years (1.12± 0.59, $p = 0.046$). 3. Perceived weight discrimination was associated with higher odds of becoming obese (OR= 6.67, 95% CI= 1.85-24.04).

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
26. Lee *et al.* (2014) U.S. Australia	Cross-sectional, web-based survey	Convenience <u>U.S:</u> n = 215 <u>Australia:</u> n = 264 <u>Total:</u> n = 479	Weight-based stigma towards a fictional character (Questions were adapted from Attitudes to Mental Illness Questionnaire and the General Social Survey)	Food addiction diagnosis	Twelve percent of respondents met the for food addiction criteria but there was no difference in levels of weight-based stigma to the diagnosis of food addiction ($t\ [197] = 0.74$, $p = 0.455$).
27. Pearl *et al.* (2014a) U.S.	Cross-sectional	Convenience n = 245	Internalized weight stigma (Weight Bias Internalization Scale)	<u>Health outcomes:</u> Self-esteem <u>Mediator:</u> Overvaluation of shape and weight	1. Internalized weight bias was negative correlated with self-esteem ($r = -0.67$, $p < 0.001$). 2. Overvaluation of shape and weight mediates the relationship between self-esteem and weight bias internalization ($R^2 = 0.53$, 95% percent bias-corrected confidence interval: -0.04 - -0.02).
28. Pearl *et al.* (2014b) U.S.	Cross-sectional	Convenience n = 255	Internalized weight stigma (Weight Bias Internalization Scale)	1. Binge eating disorder symptom severity 2. Depressive symptoms 3. Self-report of overall mental and physical health	1. Binge eating disorder symptom severity significantly was not significant correlated with weight bias internalization. 2. More weight bias internalization was associated with poorer self-reported mental ($\beta = -0.53$, $p \leq 0.001$) and physical health such as physical functioning ($\beta = -0.20$, $p \leq 0.001$) and bodily pain ($\beta = -0.13$, $p \leq 0.001$). 3. Depressive symptoms mediate the relationship between the weight bias internalization and self-reported mental and physical health.
29. Sutin *et al.* (2014) U.S.	Cross-sectional	Secondary database n = 7,394	Experience of everyday discrimination because of weight (Single-item measures from Perceived Discrimination Scale)	C-reactive protein	1. Having experienced weight discrimination was associated with higher levels of C-reactive protein among participants with relatively lower BMI (BMI 25-30 kg/m^2). 2. Having experienced weight discrimination was not statistical associated with levels of C-reactive protein among participants with relatively higher BMI (BMI $\geq$ 40 kg/m^2).

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
30. Rudolph and Hilbert (2014) Germany	Cross-sectional	Convenience n = 78	The level of implicit self-discrimination (Self-Discrimination Implicit Association Test)	1. Eating disorder 2. Depressive symptoms 3. Self-esteem	1. The level of implicit self- discrimination was positive correlated with depressive symptoms (r = 0.53, p < 0.001) and negatively correlated with self-esteem (r = − 0.39, p < 0.001). 2. The correlation between the level of implicit self-discrimination and eating disorder psychopathology was not significant (r = 0.21, p = 0.07).
31. Schvey *et al.* (2014) U.S.	2-Group pretest/ post-test design <u>Intervention:</u> 10-minute weight stigmatizing video <u>Control:</u> 10-minute neutral condition video	Randomly n=123	10-minute weight stigmatizing video	The degree of change in salivary cortisol level from pre-video to post-video	1. Exposure to weight-stigmatizing stimuli was associated with greater degree of change in salivary cortisol level (Pillai trace = 0.073; F(1,86) = 6.66, p = 0.012), after controlling for body weight. 2. Subjects in the stigmatizing condition experienced sustained cortisol elevation, whereas those in the neutral condition experienced a greater decline from pre-video to post-video
32. Tomiyama *et al.* (2014) U.S.	Cross-sectional survey with repeat measure of salivary cortisol for 4 days	Convenience n = 47	1. The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory) 2. The consciousness of stigma due to weight (modified version of the Stigma Consciousness Scale) Calculated a sum score of 1 and 2 measures' z scores for capturing the total experience of weight stigma	<u>Health outcomes:</u> 1. Salivary cortisol levels: at awakening, 30 min post awakening, between 1:00 and 4:00 p.m. and bedtime 2. Oxidant stress status (F_2 - isoprostane levels) from blood sample <u>Mediator:</u> The level of perceived stress	1. The composite measure of weight stigma was positively related to morning serum cortisol levels and higher levels of oxidative stress. 2. Weight stigma frequency was positively related to morning serum cortisol levels and cortisol awakening response. 3. Weight stigma consciousness was positively related to morning serum cortisol levels and oxidant stress. 4. Perceived stress mediated the relationship between weight stigma consciousness and cortisol awakening response.

Source	Study Design	Sampling	Measures of Weight Stigma (Instruments)	Health Outcomes	Study Results
33. Wu and Liu (2015) Taiwan	Cross-sectional	Convenience n =141	The frequency of experienced weight-stigmatizing situations (Stigmatizing Situations Inventory).	Binge eating behaviors.	Weight-related stigmatizing experiences was positive correlated with binge eating behaviors (*r*=0.33, *p*<0.01).

Note: U.S. = United States; U.K. = United Kingdom; BMI = Body mass index; 95 CI% = 95 % confident interval

APPENDIX 3.1: DEMOGRAPHIC AND HAIR-RELATED QUESTIONS

Finally, please respond to the following <u>demographic questions</u>. Your answers here are confidential and will only be presented as a group without personal identification.

1. Age________________________(years)
2. Gender
   ☐ 1. Male
   ☐ 2. Female
3. Education level
   ☐ 1. Middle school and below
   ☐ 2. High school
   ☐ 3. College/university
   ☐ 4. Graduate school
4. Marital status:
   ☐ 1. Single
   ☐ 2. Divorced
   ☐ 3. Widowed
   ☐ 4. Unmarried but in a relationship and do not live with your partner.
   ☐ 5. Unmarried but in a relationship and live with your partner.
   ☐ 6. Married and living with a spouse
   ☐ 7. Legally married but separated

5. Occupation:_______________________________________
6. Annual income (U.S. dollar):__________________________
7. Are you:
   ☐ 1. A U.S. citizen?
   ☐ 2. A green card holder (lawful permanent resident) of the United States?

8. Your biological mother came from: ☐ 1. Taiwan ☐ 2. Hong Kong ☐ 3. China ☐ 4. Others (please write):__________________ ☐ 5. I don't know	9. Your biological father came from: ☐ 1. Taiwan ☐ 2. Hong Kong ☐ 3. China ☐ 4. Others (please write):__________________ ☐ 5. I don't know
10. Your biological grandmother came from: ☐ 1. Taiwan ☐ 2. Hong Kong ☐ 3. China ☐ 4. Others (please write):__________________ ☐ 5. I don't know	11. Your biological grandfather came from: ☐ 1. Taiwan ☐ 2. Hong Kong ☐ 3. China ☐ 4. Others (please write):__________________ ☐ 5. I don't know

12. Your country of birth:_________________________

13. Years lived in Asia:____________________(years)

14. Years lived in the U.S.:_________________(years)

15. Years lived in an Asian neighborhood in the U.S.:_____________(years)

16. Years lived in a non-Asian neighborhood in the U.S.:___________(years)

17. Age upon beginning school in the U.S.: ______________________(years)

18. Years attending school in the U.S.:___________________________(years)

19. On average, how many times you wash your hair per week during the last month?_____________

20. When you wash your hair, you normally used (based on your own judgment):

☐ 1. Hot water
☐ 2. Warm water
☐ 3. Cold water

21. On average, how many times you swim per week during the last month?_____________________
(Write "0" if you never swim during the last month)

22. On average, how many cigarettes you smoke per week during the last month?________________
(Write "0" if you never smoke during the last month)

23. Have you been on a diet in the past six months?

☐ 1. Yes

☐ 2. No

APPENDIX 3.2: STIGMATIZING SITUATIONS INVENTORY

The purpose of this section is to understand your weight stigma experiences in your life, such as receiving unpleasant comments because of your body size. Please select the one that best represents your experience. Please use the following scale when you answer the items.

There are no right or wrong answers to these questions. We are only interested in your experiences.

	Multiple times	More than one time	One time	Never
1. A child coming up to you and saying something like, "You're fat!"	☐3	☐2	☐1	☐0
2. A doctor blaming unrelated physical problems on your weight.	☐3	☐2	☐1	☐0
3. A parent or other relative nagging you to lose weight.	☐3	☐2	☐1	☐0
4. A spouse/partner calling you names because of your weight (if never have a spouse/partner, please choose 0).	☐3	☐2	☐1	☐0
5. A spouse/partner telling you to lose weight in order to be more attractive (if never have a spouse/partner, please choose 0)	☐3	☐2	☐1	☐0
6. As an adult, having a child make fun of you.	☐3	☐2	☐1	☐0
7. Being called names, laughed at, or teased by other children when you were young.	☐3	☐2	☐1	☐0
8. Being glared at or harassed by bus passengers for taking up "too much" room.	☐3	☐2	☐1	☐0
9. Being hit, beaten up or physically attacked because of your weight.	☐3	☐2	☐1	☐0
10. Being offered fashion advice from strangers.	☐3	☐2	☐1	☐0
11. Being passed up for promotion, given bad assignments, or otherwise discriminated against at work.	☐3	☐2	☐1	☐0
12. Being sexually harassed (cat-calls, wolf-whistles, etc.) because of your weight.	☐3	☐2	☐1	☐0
13. Being singled out as a child by a teacher, school nurse, etc. because of your size.	☐3	☐2	☐1	☐0
14. Being stared at in public.	☐3	☐2	☐1	☐0
15. Being the only heavy person, or the heaviest person, at a family gathering.	☐3	☐2	☐1	☐0
16. A doctor saying that your weight is a health problem, even when you are in good health.	☐3	☐2	☐1	☐0
17. Being told, "All you really need is a little willpower."	☐3	☐2	☐1	☐0
18. Being unable to get a date because of your size.	☐3	☐2	☐1	☐0

	Multiple times	More than one time	One time	Never
19. Children loudly making comments about your weight to others.	☐3	☐2	☐1	☐0
20. Friends, acquaintances, co-workers, etc. making fun of your appearance.	☐3	☐2	☐1	☐0
21. Groups of people pointing and laughing at you in public.	☐3	☐2	☐1	☐0
22. Having a doctor make cruel remarks, ridicule you, or call you names.	☐3	☐2	☐1	☐0
23. Having a doctor recommend a diet even if you did not come in to discuss weight loss.	☐3	☐2	☐1	☐0
24. Having a romantic partner exploit you, because s/he assumed you were "desperate" and would put up with it (if never have a romantic partner, please choose 0).	☐3	☐2	☐1	☐0
25. Having a spouse or partner be ashamed to admit to being with you (if never have a spouse or partner, please choose 0).	☐3	☐2	☐1	☐0
26. Having family members feel embarrassed by you or ashamed of you.	☐3	☐2	☐1	☐0
27. Having friends not notice weight loss, or not encourage your efforts to lose weight.	☐3	☐2	☐1	☐0
28. Having people assume that you overeat or binge-eat because you are overweight.	☐3	☐2	☐1	☐0
29. Having people assume you have emotional problems because you are overweight.	☐3	☐2	☐1	☐0
30. Having strangers suggest diets to you.	☐3	☐2	☐1	☐0
31. Having strangers take photographs of you, as if you were an exhibit.	☐3	☐2	☐1	☐0
32. Having your children tease or insult you because of your weight (if never have children, please choose 0).	☐3	☐2	☐1	☐0
33. In the supermarket, having people criticize or make comments about your food choices.	☐3	☐2	☐1	☐0
34. Losing a job because of your size.	☐3	☐2	☐1	☐0
35. Not being able to find clothes that fit.	☐3	☐2	☐1	☐0
36. Not being able to find medical equipment in a size that works for you.	☐3	☐2	☐1	☐0
37. Not being able to find sports equipment in a size that fits you.	☐3	☐2	☐1	☐0

	Multiple times	More than one time	One time	Never
38. Not being able to fit into bus or airplane seats, into small cars, or into standard seatbelts.	☐3	☐2	☐1	☐0
39. Not being able to fit into seats at restaurants, theaters, and other public places.	☐3	☐2	☐1	☐0
40. Not being able to fit through turnstiles, on amusement park rides, or other places not already mentioned.	☐3	☐2	☐1	☐0
41. Not being hired because of your weight, shape, or size.	☐3	☐2	☐1	☐0
42. Other people having low expectations of you because of your weight.	☐3	☐2	☐1	☐0
43. Overhearing other people making rude remarks about you in public.	☐3	☐2	☐1	☐0
44. Parents or other relatives telling you how attractive you would be, if you lost weight.	☐3	☐2	☐1	☐0
45. People telling you that you will never find a partner if you don't lose weight.	☐3	☐2	☐1	☐0
46. Seeing bumper stickers, t-shirts, advertising, etc. that ridicules fat people.	☐3	☐2	☐1	☐0
47. Strangers asking intrusive, personal questions about your weight.	☐3	☐2	☐1	☐0
48. Strangers making abusive remarks to you (e.g. saying you are disgusting, or that you don't deserve to live).	☐3	☐2	☐1	☐0
49. When eating in public, being told "You really shouldn't be eating that."	☐3	☐2	☐1	☐0
50. When walking outside, having people drive by and laugh or shout insults.	☐3	☐2	☐1	☐0

APPENDIX 3.3: BINGE EATING SCALE

The purpose of this section is to understand <u>your eating behaviors</u>. Read all statements in each group and <u>choose the one</u> which best describes you (single answer please).

1.

☐ I don't feel self-conscious about my weight or body size when I'm with others.

☐ I feel concerned about how I look to others, but it normally does not make me feel disappointed with myself.

☐ I do get self-conscious about my appearance and weight which makes me feel disappointed in myself.

☐ I feel very self-conscious about my weight and frequently. I feel intense shame and disgust for myself. I try to avoid social contacts because of my self-consciousness.

2.

☐ I don't have any difficulty eating slowly in the proper manner.

☐ Although I seem to "gobble down" foods. I don't end up feeling stuffed because of eating too much.

☐ At times, I tend to eat quickly and then, I feel uncomfortably full afterwards.

☐ I have the habit of bolting down my food, without really chewing it. When this happens I usually feel uncomfortably stuffed because I've eaten too much.

3.

☐ I feel capable to control my eating urges when I want to.

☐ I feel like I have failed to control my eating more than the average person.

☐ I feel utterly helpless when it comes to feeling in control of my eating urges.

☐ Because I feel so helpless about controlling my eating I have become very desperate about trying to get in control.

4.

☐ I don't have the habit of eating when I'm bored.

☐ I sometimes eat when I'm bored, but often I'm able to "get busy" and get my mind off food.

☐ I have a regular habit of' eating when I'm bored, but occasionally, I can use some other activity to get my mind off eating.

☐ I have a strong habit of eating when I'm bored. Nothing seems to help me break the habit.

5.

☐ I'm usually physically hungry when I eat something.

☐ Occasionally, I eat something on impulse even thought I really am not hungry.

☐ I have the regular habit of eating foods, that I might not really enjoy, to satisfy a hungry feeling even though physically, I don't need the food.

☐ Even though I am not physically hungry, I get a hungry feeling in my mouth that only seems to be satisfied when I eat a food, like a sandwich, that fills my mouth. Sometimes, when I eat the food to satisfy my mouth hunger. I then spit out the food so I won't gain weight.

6.

☐ I don't feel any guilt or self-hate after I overeat.

☐ After I overeat, occasionally I feel guilt or self-hate.

☐ Almost all the time I experience strong guilt or self-hate after I overeat.

7.

☐ I don't lose total control of my eating when dieting even after periods when I overeat.

☐ Sometimes when I eat a "forbidden food" on a diet, I feel like I "blew it" and eat even more.

☐ Frequently, I have the habit of saying to myself, "I've blown it now, why not go all the way?" when on a diet. When that happens I eat even more.

☐ I have a regular habit of starting strict diets for myself, but I break the diets by going on an eating binge. My life seems to be either a "feast" or "famine."

8.

☐ I rarely eat so much food that I feel uncomfortably stuffed afterwards.

☐ Usually about once a month, I eat such a quantity of food, I end up feeling very stuffed.

☐ I have regular periods during the month when I eat large amounts of food, either at mealtime or at snacks.

☐ I eat so much food that I regularly feel quite uncomfortable after eating and sometimes a bit nauseous.

9.

☐ My level of caloric intake does not go up very high or go down very low on a regular basis.

☐ Sometimes after I overeat, I will try to reduce my calorie intake to almost nothing to compensate for the excess calories I've eating.

☐ I have a regular habit of' overeating during the night. It seems that my routine is not to be hungry in the morning but overeat in the evening.

☐ In my adult years I have had week—long periods where I practically starve myself this follows periods when I overeat. It seems I live life of either "feast or famine."

10.

☐ I usually am able to stop eating when I want to. I know when "enough is enough."

☐ Every so often, I experience a compulsion to eat which I can't seem to control.

☐ Frequently, I experience strong urges to eat which I seem unable to control, but at other times I can control my eating urges.

☐ I feel incapable of controlling urges to eat. I have a fear of not being able to stop eating voluntarily.

11.

☐ I don't have any problem stopping eating when I feel full.

☐ I usually can stop eating when I feel full but occasionally overeat leaving me feeling uncomfortably stuffed.

☐ I have a problem stopping eating once I start and usually I feel uncomfortably stuffed after I eat a meal.

☐ Because I have a problem not being able to stop eating when I want, I sometimes have to induce vomiting to relieve my stuffed feeling.

12.

☐ I seem to eat just as much when I'm with others (family, social gatherings) as when I'm by myself.

☐ Sometimes, when I'm with other persons, I don't eat as much as I want to eat because I'm self-conscious about my eating.

☐ Frequently, I eat only a small amount of food when others are present, because I'm very embarrassed about my eating.

☐ I feel so ashamed about overeating that I pick times to overeat when I know no one will see me. I feel like a "closet eater."

13

☐ I eat three meals a day with only an occasional between meal snack.

☐ I eat three meals a day, but I also normally snack between meals.

☐ When I am snacking heavily, I get in the habit of skipping regular meals.

☐ There are regular periods when I seem to be continually eating, with no planned meals.

14

☐ I don't think much about trying to control unwanted eating urges.

☐ At least some of the time, I feel my thought are pre-occupied with trying to control my eating urges.

☐ I feel that frequently I spend much time thinking about how much I ate or about trying not to eat anymore.

☐ It seems to me that most of my waking hours are pre-occupied by thoughts about eating or not eating. I feel like I'm constantly struggling not to eat.

15

☐ I don't think about food a great deal.

☐ I have strong cravings for food but they last only for brief periods of time.

☐ I have days when I can't seem to think about anything else but food.

☐ Most of my days seem to be pre-occupied with thoughts about. I feel like I live to eat.

16

☐ I usually know whether or not I'm physically hungry. I take the right portion of food to satisfy me.

☐ Occasionally, I feel uncertain about knowing whether or not I'm physically hungry. At these times, it's hard to know how much food I should take to satisfy me.

☐ Even though I might know how many calories I should eat, I don't have any idea what is a "normal" amount of food for me.

APPENDIX 3.4: PERMISSION TO USE THE SUINNLEW ASIAN SELFIDENTITY ACCULTURATION SCALE

SUINN-LEW ASIAN SELF-IDENTITY ACCULTURATION SCALE

(SL-ASIA)

This document provides formal permission to anyone wishing to use the SL-ASIA scale. The scale is duplicated in the last section . Also discussed are some practical research design suggestions as well as some theoretical issues. Finally some potential new items are described for those researchers who may wish to extend the scale. (The same information is duplicated in a more convenient format under separate links in the web site: http://www.awong.com/~randy/dad/index.html)

RESEARCH DESIGN:

Please note that if you feel your sample is one that requires reading a translated version, this could mean that your sample is very restricted to a first generation. If so, then by definition you would not have enough subjects who represent the various levels of acculturation (low to middle to high). If this is the case, then this restricted range will prevent you from testing any hypothesis regarding how "level of acculturation" or acculturation differences has effects.

Also note the usual principles regarding use of standardized tests: if you revise any part of the test - order of questions, wording of answers, etc. - then it may be questionable whether the test still is valid. Certainly, the question can be raised about whether the same norms can be used to interpret the results. If you choose to do such a revision, you should discuss the matter with a colleague who is a methodologist, or your advisor if you are a student.

After some thoughts about acculturation and its measurement, I have added questions 22-26 to the original 21 item scale. These questions can serve to further classify your research participants in ways that use current theorizing that acculturation is not linear, unidimensional but multi-dimensional and orthogonal. These new items were developed based on writings of those who felt that a linear, unidimensional scale was insufficient. Hence, some added items have been written as a potential separate way of classifying the subjects...if the original scale did not turn out predictive. I have not obtained any validity/reliability info on these added items, but hope that users of the added items will share their results with me.

USING THE ORIGINAL 21 ITEMS:

In scoring these 21 items, add up each answer for each question on the scale, then obtain a total value by summing across the answers for all 21 items. A final acculturation scores is calculated by then dividing the total value by 21; hence a score can range from 1.00 (low acculturation) to 5.00 (high acculturation). Because of the nature of the multiple choice content, it is possible to view low scores as reflective of high Asian identification, with high scores reflecting high Western identification. In other words, a low score reflects low acculturation, while a high score reflects high acculturation.

Optional Scoring System. Theorists suggest that the SL-ASIA items allow only for a linear, unidirectional scoring, since answer options go from Asian-identified choice to Western-identified choice. The issue is that it is not possible to obtain two scores: one representing a person's 'loading' on Asian cultural identity and another on Western cultural identity. Two researchers have offered scoring methods to achieve this objective within the existing framework of the 21 item SL-ASIA as follows:

1) Abe-Kim, Okazaki, & Goto (2001). Cultural Diversity and Ethnic Minority Psychology, 7, 232-246. -
Instead of adding the rating responses for each item, the number of responses in the Western direction are counted rather than summed. This provides a score representing identification with the Western culture. The same counting method is used to identify how many answers are in the Asian direction. This provides a score representing identification with the Asian culture. For defining a "bicultural" status, count the number of items in which a participant indicates an equal use of behaviors associated with the two cultures. - Through this scoring procedure , three 'scales' are obtained: measurement of level of Western identity, measurement of level of Asian identity, and biculturalism.

2) Mallinckrodt, Shigeoka, & Suzuki (2005). Cultural Diversity and Ethnic Minority Psychology, 11, 227-238. The SL-ASIA response-choices range from answers numbering from 1 – 5, with 1 representing high Asian-direction responses and 5 representing high Western-direction responses. This scoring procedure separate items for which a participant has selected a 4 or 5 answer choice from those involving either a 1 or 2 answer choice. Answers with a choice of "3" are ignored. Summing the ratings from items with 4 or 5 answers provides a score representing Western identity. Summing the ratings from items with 1 or 2 answers provides a score representing Asian identity. These latter ratings are reverse scored before summing so that higher scores represent greater Asian identification.
– Through this scoring procedure, two 'scales' are obtained: Western Cultural Identification and Asian Cultural Identification

USING THE NEW ITEMS (Questions: 22/23, 24/25, OR 26)

1).VALUES SCORE: Classifying by examining the answers to #22 and #23 together:

Using these questions, you can re-examine your data with these items being used to re-classify or re-categorize your sample. See Table 1 for scoring.

Because the categorizing method uses a different set of variables then classification using the original 21 item SL-ASIA scores, you might obtain different results when using these items.

2) BEHAVIORAL COMPETENCIES SCORE: Classifying by examining the answers to #24 and #25 together. See Table 1 for scoring.

As with use of items #22 and #23, this procedure involves categorizing and is not on a continuum

TABLE 1
SCORING OF QUES. 22/23 OR 24/25

		Answers to Questions 22 or 24				
		1	2	3	4	5
Q. 23 or 25	1	N	N	(A)	A	A
	2	N	N	(A)	A	A
	3	(W)	(W)	(B)	A	A
	4	W	W	W	B	B
	5	W	W	W	B	B

A=asian identified
B=bicultural
W=western
N=neither (Alienated)
The scoring in parentheses are open to question. Either they can be used to score, or the alternative is to eliminate these persons from the analyses

3) SELF-IDENTITY SCORE: Classifying by using item #26 is straightforward, since each possible answer is a category in itself:

a) answer 1 defines the person as Asian self-identified,

b) answer 2 is Western self-identified,

c) answers 3, 4, 5 are all bicultural-identified, but with sub-categories:

4) SELF-IDENTITY SCORE, ALTERNATE SYSTEM: Item #26 might also be scored by another procedure, based on a very small pilot study we just completed:

a) answers using either 1 OR 3 would classify the person as "Asian identified"

b) answers using either 2 OR 4 would classify the person as "Western identified"

c) answer using 5 classifies the person as "bicultural"

THEORETICAL COMMENT:

Let me suggest the following definitions (which is a simplified approach, but consistent with definitions used by some other writers):

Acculturation is a process that can occur when two or more cultures interact together. There are several possible outcomes of this process, including assimilation, whereby a host culture absorbs the immigrant culture, or multiculturalism, whereby both cultures exist side-by-side. On an individual level, exposure to another culture can lead a person to a) resisting change in his/her values and behavioral competencies, b) adopting the host culture's values and behavioral skills and styles as a replacement for his/her parent culture's values/behaviors, c) rejecting both his/her home culture and the host culture, or d) acquiring and maintaining parts of both the home and the host cultures' values/behaviors.

It is also theoretically possible that the level of acculturation displayed by an individual is dependent upon the situational context. Thus a person might show behaviors consistent with being assimilated in one setting (e.g., work) while showing behaviors reflective of his/her home culture in another setting (e.g. in family settings). Furthermore, in research, the type of measuring instrument used to define a participant's level of acculturation can produce different results from another acculturation instrument. For instance the Asian Values Scale has a low correlation with the SL-ASIA despite the fact that both are used as measurements of acculturation. This is because the Asian Values Scales focuses on values while the SL-ASIA emphasizes behaviors.

OUTCOMES USING DIFFERING WAYS OF MEASURING ACCULTURATION:

The above theoretical discussion points out the likelihood of different measurement approach yielding different predictions. In theory the original 21 items of the SL-ASIA along with the new items provide such differences: the 21 items might be said to be assessing cultural behaviors, items 22/23 might be assessing cultural values, items 24/25 might be assessing behavioral competencies, and item 26 might be assessing self-identity. It is therefore possible to obtain four separate acculturation scores using each as an independent predictor variable.

From this orientation, some new perspectives on acculturation and acculturation research might be proposed for future study. Two ideas are postulated below:

a) Using the SL-ASIA four scores to measure acculturation, it is likely that each score will be a significant predictor variable of an outcome variable which might not be equally predicted by the other SL-ASIA scores. Therefore using each of the four scores will permit a more refined method of analysis.

b) It is possible that the “Values” and “Self-Identity” scores from the SL-ASIA will represent more stable predictions across diverse settings, while the “Behavioral Competency” score will be more situationally based.

APPENDIX 3.5: THE SUINNLEW ASIAN SELFIDENTITY ACCULTURATION SCALE

The following 26 questions are for the purpose of collecting information about your historical background as well as more recent behaviors which may be related to your cultural identity. Choose the one answer which best describes you (Single answer please).

1. What language can you speak?
   - ☐1. Asian only (for example, Chinese, Japanese, Korean, Vietnamese, etc.)
   - ☐2. Mostly Asian, some English
   - ☐3. Asian and English about equally well (bilingual)
   - ☐4. Mostly English, some Asian
   - ☐5. Only English
2. What language do you prefer?
   - ☐1. Asian only (for example, Chinese, Japanese, Korean, Vietnamese, etc.)
   - ☐2. Mostly Asian, some English
   - ☐3. Asian and English about equally well (bilingual)
   - ☐4. Mostly English, some Asian
   - ☐5. Only English
3. How do you identify yourself?
   - ☐1. Oriental
   - ☐2. Asian
   - ☐3. Asian-American
   - ☐4. Chinese-American, Japanese-American, Korean-American, etc.
   - ☐5. American
4. Which identification does (did) your mother use?
   - ☐1. Oriental
   - ☐2. Asian
   - ☐3. Asian-American
   - ☐4. Chinese-American, Japanese-American, Korean-American, etc.
   - ☐5. American
5. Which identification does (did) your father use?
   - ☐1. Oriental
   - ☐2. Asian
   - ☐3. Asian-American
   - ☐4. Chinese-American, Japanese-American, Korean-American, etc.
   - ☐5. American

6. What was the ethnic origin of the friends and peers you had, as a child up to age 6?

☐1. Almost exclusively Asians, Asian-Americans, Orientals

☐2. Mostly Asians, Asian-Americans, Orientals

☐3. About equally Asian groups and Anglo groups

☐4. Mostly Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

☐5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

7. What was the ethnic origin of the friends and peers you had, as a child from 6 to 18?

☐1. Almost exclusively Asians, Asian-Americans, Orientals

☐2. Mostly Asians, Asian-Americans, Orientals

☐3. About equally Asian groups and Anglo groups

☐4. Mostly Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

☐5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

8. Whom do you now associate with in the community?

☐1. Almost exclusively Asians, Asian-Americans, Orientals

☐2. Mostly Asians, Asian-Americans, Orientals

☐3. About equally Asian groups and Anglo groups

☐4. Mostly Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

☐5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

9. If you could pick, whom would you prefer to associate with in the community?

☐1. Almost exclusively Asians, Asian-Americans, Orientals

☐2. Mostly Asians, Asian-Americans, Orientals

☐3. About equally Asian groups and Anglo groups

☐4. Mostly Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

☐5. Almost exclusively Anglos, Blacks, Hispanics, or other non-Asian ethnic groups

10. What is your music preference?

☐1. Only Asian music (for example, Chinese, Japanese, Korean, Vietnamese, etc.)

☐2. Mostly Asian

☐3. Equally Asian and English

☐4. Mostly English

☐5. English only

11. What is your movie preference?

☐1. Asian-language movies only

☐2. Asian-language movies mostly

☐3. Equally Asian/English-language movies

☐4. Mostly English-language movies only

☐5. English-language movies only

12. What generation are you? (choose the generation that best applies to you)

☐1. 1st Generation = I was born in Asia or country other than U.S.

☐2. 2nd Generation = I was born in U.S., either parent was born in Asia or country other than U.S.

☐3. 3rd Generation = I was born in U.S., both parents were born in U.S, and all grandparents born in Asia or country other than U.S.

☐4. 4th Generation = I was born in U.S., both parents were born in U.S, and at least one grandparent born in Asia or country other than U.S. and one grandparent born in U.S.

☐5. 5th Generation = I was born in U.S., both parents were born in U.S., and all grandparents also born in U.S.

☐6. Don't know what generation best fits since I lack some information.

13. Where were you raised?

☐1. In Asia only

☐2. Mostly in Asia, some in U.S.

☐3. Equally in Asia and U.S.

☐4. Mostly in U.S., some in Asia

☐5. In U.S. only

14. What contact have you had with Asia?

☐1. Raised one year or more in Asia

☐2. Lived for less than one year in Asia

☐3. Occasional visits to Asia

☐4. Occasional communications (letters, phone calls, etc.) with people in Asia

☐5. No exposure or communications with people in Asia

15. What is your food preference at home?

☐1. Exclusively Asian food

☐2. Mostly Asian food, some American

☐3. About equally Asian and American

☐4. Mostly American food

☐5. Exclusively American food

16. What is your food preference in restaurants?

☐1. Exclusively Asian food

☐2. Mostly Asian food, some American

☐3. About equally Asian and American

☐4. Mostly American food

☐5. Exclusively American food

17. Do you

☐1. read only an Asian language

☐2. read an Asian language better than English

☐3. read both Asian and English equally well

☐4. read English better than an Asian language

☐5. read only English

18. Do you

☐1. write only an Asian language

☐2. write an Asian language better than English

☐3. write both Asian and English equally well

☐4. write English better than an Asian language

☐5. write only English

19. If you consider yourself a member of the Asian group (Oriental, Asian, Asian-American, Chinese-American, etc., whatever term you prefer), how much pride do you have in this group?

☐1. Extremely proud

☐2. Moderately proud

☐3. Little pride

☐4. No pride but do not feel negative toward group

☐5. No pride but do feel negative toward group

20. How would you rate yourself?

☐1. Very Asian

☐2. Mostly Asian

☐3. Bicultural

☐4. Mostly Westernized

☐5. Very Westernized

21. Do you participate in Asian occasions, holidays, traditions, etc.?

☐1. Nearly all

☐2. Most of them

☐3. Some of them

☐4. A few of them

☐5. None at all

APPENDIX 3.6: PERMISSION TO USE THE SUBTLE AND BLATANT RACISM SCALE FOR ASIAN AMERICAMS

Re: Asking your permission for Perceived personal racial discrimination (P-Disc) survey

Hyung Chol (Brandon) Yoo [yoo@asu.edu]

Sent: Friday, January 08, 2016 2:04 PM
To: Wu, Ya Ke
Attachments: Yoo (2010) Internalization~1.doc (75 KB) ; Yoo Burrola Steger (2010) ~1.pdf (121 KB) ; Yoo Steger Lee (2010) Subt~1.doc (47 KB) ; Yoo Steger Lee (2010) Subt~2.pdf (100 KB)

Hi Ya-Ke,

That discrimination measure from the JCP "Ethnic Identity and Approach-Type Coping" paper was further analyzed and is now the "Subtle and Blatant Racism Scale for Asian Americans (SABR-A^2). The separately published paper and measure items are attached. I also included another measure, Internalization of the Model Minority Myth, that may be related to your research. You have my permission to you either scale. Best of luck on your dissertation and I look forward to reading your paper in the journals!

Best,
Brandon

From: "Wu, Ya Ke" <yakew@email.unc.edu>
Date: Wednesday, January 6, 2016 at 10:06 AM
To: Brandon Yoo <yoo@asu.edu>
Subject: Asking your permission for Perceived personal racial discrimination (P-Disc) survey

Dear Dr. Yoo,

This is Ya-Ke Wu and I hope this email finds you well. I am a third-year Ph.D. student in the University of North Carolina at Chapel Hill School of Nursing. The purpose of this email is to ask your permission for using the Perceived personal racial discrimination (P-Disc) survey in my dissertation research.

The title of my dissertation research is "*Weight Stigma and Acculturation in Relation to Hair Cortisol and Binge Eating in Overweight and Obese Asian-Americans*". I would like to examine the relationships among weight stigma, the level of acculturation, the level of hair cortisol, and binge eating among overweight and obese Asian Americans adults in North Carolina, United States.

Your 10-item P-Disc survey from a publication "*Ethnic Identity and Approach-Type Coping as Moderators of the Racial Discrimination/Well-Being Relation in Asian Americans*" in the Journal of Counseling Psychology is the best survey for measuring perceived racial discrimination for adults Asian Americans. It will help me a lot if I can have your permission to use the P-Disc survey in my dissertation research.

Any suggestions from you will be a great help for my research. Thank you for your consideration.

Sincerely,

Ya-Ke

Ya-Ke Wu, MSN, RN,
Doctoral Student

APPENDIX 3.7: SUBTLE AND BLATANT RACISM SCALE FOR ASIAN AMERICAMS

The following statements are general racial situations that you personally may have encountered. Read each situation and answer the questions using the following rating scales.

	Almost always	Often or frequent	Sometimes	Once in a while	Almost never
1. In America, I am treated differently because I'm Asian.	☐5	☐4	☐3	☐2	☐1
2. In America, I am viewed with suspicion because I'm Asian.	☐5	☐4	☐3	☐2	☐1
3. In America, I am expected to excel in academics because I'm Asian.	☐5	☐4	☐3	☐2	☐1
4. In America, I find it difficult to date some people because I'm Asian.	☐5	☐4	☐3	☐2	☐1
5. In America, I am called names such as, "chink, gook, etc." because I'm Asian.	☐5	☐4	☐3	☐2	☐1
6. In America, I am told "you speak English so well" because I'm Asian.	☐5	☐4	☐3	☐2	☐1
7. In America, I am overlooked because I'm Asian.	☐5	☐4	☐3	☐2	☐1
8. In America, I have been physically assaulted because I'm Asian.	☐5	☐4	☐3	☐2	☐1
9. In America, I am made fun of because I'm Asian.	☐5	☐4	☐3	☐2	☐1
10. In America, I am faced with barriers in society because I'm Asian.	☐5	☐4	☐3	☐2	☐1

APPENDIX 3.8: PERCEIVED STRESS SCALE

The questions in this section ask you about <u>your feelings and thoughts during the last month</u>. Read each situation and answer the questions using the following rating scales.

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

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