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Toward A Biopsychosocial Model of Obesiy: Can Psychological Well-Being Be the Bridge to Integration?

Alexia Holovatyk

TOWARD A BIOPSYCHOSOCIAL MODEL OF OBESITY: CAN PSYCHOLOGICAL WELL-BEING BE THE BRIDGE TO INTEGRATION?

by

Alexia Holovatyk

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This dissertation was submitted by Alexia Holovatyk under the direction of the Chairperson of the committee listed below. It was submitted to the College of Psychology and approved in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Clinical Psychology at Nova Southeastern University.

Approved:

DocuSigned by:
Barry Nierenberg
43E7BD283C2445E...

___4/2/2020__________
Date of Defense

Barry Nierenberg, Ph.D., ABPP, Chairperson

DocuSigned by:
Christian Delucia
3390335F5B0248D...

Christian Delucia, Ph.D.

DocuSigned by:
Paula Brochu
2DC516DE28694C8...

Paul Brochu, Ph.D.

DocuSigned by:
Barry Nierenberg
43E7BD283C2445E...

___4/2/2020____________
Date of Final Approval

Barry Nierenberg, Ph.D., ABPP, Chairperson

Statement of Original Work

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Alexia Holovatyk___________
Name

April 02, 2020_____________
Date

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TOWARD A BIOPSYCHOSOCIAL MODEL OF OBESIY: CAN PSYCHOLOGICAL WELL-BEING BE THE BRIDGE TO INTEGRATION?

by

Alexia Holovatyk

Nova Southeastern University

ABSTRACT

The complications associated with obesity are some of the most pressing health concerns facing the United States. At present, cardiovascular disease, stroke, and certain types of cancer are some of the leading causes of death, and researchers have cited obesity as one related factor (NIH, 2000). The topic of obesity has typically been approached through two seemingly contradictory lenses: The biomedical model that views obesity as a disease risk factor (e.g. Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010) and the psychosocial model that considers the stigma associated with obesity to be more harmful than weight itself (e.g., Hatzenbuehler, Keyes, & Hasin, 2009). This study examines whether Psychological Well-Being (PWB; Ryff, 1989a) can unify the seemingly contradictory viewpoints by testing its effect on health outcomes for higher body weight (HBW) individuals. Previous literature has found that obesity predicts lower levels PWB facets (Margallares, Benito de Valle, Irles, Bolaños-Rios, & Jauregui-Lobera 2014) and that this finding is disproportionately true for women (Bookwala & Boyar, 2008). There is also promising literature that PWB can have positive effects on health outcomes (Koizumi, Ito, Kaneko, & Motohashi, 2008) as well as biomarkers that are predictive of diseases (Boylan & Ryff, 2015). This study adds to the existing literature by hypothesizing that the relationship between PWB and HBW will no longer be significant once relevant covariates are added (e.g., perceived discrimination). Additionally, this study explored the cross-sectional predictive relationship between PWB and biomarkers known to be associated with obesity (e.g., triglycerides) as well as the longitudinal effects of PWB on an aggregate measure of health outcomes (e.g., cardiovascular disease) after 10 years. Moderating effects of PWB were also examined for each of the aforementioned relationships. The following results are reported for the full models with covariates included. It was found that adiposity was not a significant predictor of any facet of PWB. With regard to biomarker outcomes, Positive Relations with Others was a predictor of worse biomarker outcomes, while Environmental Mastery was a predictor of more favorable outcomes. Finally, this study provided modest, preliminary support that Autonomy was a positive predictor of disease outcomes 10 years later. The findings of this study provide modest evidence that scoring high on a scale that measures one's capability to effectively manipulate one's environment led to improved cross-sectional biomarker outcomes, while scoring high on a domain that suggests one is less likely to be persuaded by external influences (i.e., Autonomy) leads to poorer longitudinal health outcomes. The context of an individual's social network with regard to biomarker outcomes was also illuminated. In sum, these findings seem to support biopsychosocial influences (especially behavioral) with regard to short- and long-term health outcomes. Past literature on PWB encourages balance in each domain as being too high or low in either direction can lead to impairments in functioning (Fredrickson & Losada, 2005; Ryff, 1989b). Perhaps most importantly, the mixed findings of this study provide preliminary support that the ideal of balance in PWB domains also extends to the realm of physical health.

Keywords: Psychological Well-Being; Higher Body Weight; Obesity; Autonomy; Environmental Mastery; Mind-Body Interventions; Health Outcomes

Chapter I: Statement of the Problem

For the past few decades, the biopsychosocial (BPS) model (Engels, 1977) has been utilized as a comprehensive, clinically robust framework from which providers can conceptualize the most relevant biological, psychological, and social aspects of a person to positively inform their care (e.g., Thomas, Waxmonsky, McGinnis, & Barry, 2006). In spite of this, the topic of obesity has been approached through two seemingly contradictory lenses: The biomedical model that views obesity as a disease risk factor that is controllable through behavioral modifications (e.g., diet and exercise) versus the psychosocial model that considers the stigma and discrimination associated with obesity to be more harmful than weight gain. Throughout this paper, these ostensibly opposing viewpoints will be reviewed to determine if a middle ground (i.e., Psychological Well-Being; PWB) can be reached that utilizes the most meritorious aspects of each approach to positively influence health outcomes for individuals with higher body weight. If a study used specific terminology (e.g., obese) to identify the population of interest based on objective metrics (e.g., body mass index [BMI]), that language will be retained. Otherwise, the colloquial term "higher body weight" (HBW) will be used to describe those who fall along the overweight/obesity spectrum (Logel, Stinson, & Brochu, 2015; Meadows & Danielsdottir, 2016). While the health outcomes of HBW children and those who are underweight are worthwhile areas of study, they are beyond the scope of this paper.

The complications associated with obesity are a few of the most pressing public health concerns facing the United States. At present, cardiovascular disease, stroke, and certain types of cancer are some of the leading causes of death, and some researchers have cited obesity as one related factor (NIH, 2000). Medical researchers also point to overweight and obese individuals as being more likely than normal-weight persons to have metabolic syndrome, type-II diabetes, hypertension, sleep apnea, mental illness, and dyslipidemia (e.g., WHO, 2000). According to the Centers for Disease Control and Prevention (CDC), overweight is defined by a BMI between 25.0 - 29.9 kg/m^2, obese is characterized by a BMI between 30-39.9 kg/m^2, and extreme/severe obesity is defined by a BMI of greater than 40 kg/m^2 (Freedman, Horlick, & Berenson, 2013; Garrow & Webster, 1985; Wohlfahrt-Veje et al., 2014). Research has shown that combining BMI with measures of visceral adipose tissue, such as waist circumference (WC) and waist to hip ratio (WHR), increases the discriminative capability to predict disease and metabolic abnormalities (Huxley, Mendis, Zheleznyakov, Reddy & Chan, 2010; Janssen, Katzmarzyk, & Ross, 2004; WHO, 2008). In the U.S., a WC of ≥ 94 cm (37 inches) in men and ≥ 80 cm (31.5 inches) in women is indicative of an increased risk of metabolic complications, while a WC of ≥ 102 cm (40 inches) in men and ≥ 88 cm (34.6 inches) in women leads to a substantially increased risk (WHO, 2000).

Despite the deleterious consequences associated with obesity, it is more common in the U.S. for individuals to be overweight or obese than to be under or normal-weight. Currently, more than two-thirds (68.8%) of American adults are overweight or obese and more than one-third (34.9% or 78.6 million) are obese (Ogden, Carroll, Fryar, & Flegal, 2015). Extreme obesity affects 7% of the adult population in the U.S. (Sturm & Hattori, 2013).

In the past, annual increases in prevalence ranged from 0.3 to 0.9% (Wang, 2011). Although the biomedical and psychosocial models agree that rates of obesity in the U.S. remain high, they disagree as to whether this constitutes a public health crisis. Because proponents of the biomedical model believe that higher body weight is causally linked to several chronic diseases (e.g., type-II diabetes; Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010), the magnitude of increasing body weight would certainly constitute a major concern. On the other hand, subscribers of the psychosocial model see this as an alarmist view influenced by artificial classifications of overweight and obesity (Campos, Saguy, Ernsberger, Oliver, Gaesser, 2005). As Campos and his colleagues point out, subtle shifts in weight (i.e., 3-5 kilograms) are moving people formerly classified as 'normal' into the 'overweight' category and formerly 'overweight' persons into the 'obese' classification. In combination with the view that obesity is not linked with increased levels of morbidity (Flegal, Kit, Orpana, & Graubard, 2013), the grave apprehension surrounding this issue appears unwarranted and exaggerated. Regardless of the language used to describe this phenomenon, data show that the U.S. population continues to gain weight (Shin, Bohra, Kongpakpaisarn, & Lee, 2018).

The "cost" of obesity is one of the main points of contention between the biomedical and psychosocial models. On one hand, the biomedical model sees HBW as an issue that is strongly correlated with serious economic and societal burdens. Proponents of this view point to the fact that the medical care costs of obesity in the U.S. in 2008 were estimated to be 147 billion dollars and medical costs for people who were obese were $1,429 higher than those of normal weight over a one-year period (Finkelstein, Trogdon, Cohen, & Dietz, 2009). Direct medical costs may include preventative, diagnostic, and treatment services related to obesity. Although medical spending for obesity is higher at a given point in time, the long-term financial consequences of obesity are less well known. Thorpe, Florence, Howard, and Joski (2004) examined the obesity-attributable health care spending increases between 1987 and 2001. After adjusting for inflation, increases in the spending on persons with obesity relative to people of normal weight account for 27%; spending for diabetes, 38 %; spending for hyperlipidemia, 22 %; and spending for heart disease, 41 %. Thus, they argue the rise in health spending linked to obesity is likely due to higher spending for treating related medical conditions. Medical care spending among severely obese, near-elderly persons (BMI 35.0 or higher; ages 50-69) is 60% higher than those of normal weight (Sturm, 2002). Studies have estimated that health care spending is approximately 36% higher among obese individuals under age 65 (Finkelstein, Fiebelkorn, & Wang, 2003). Perhaps at the crux of the biomedical argument is the assertion that the risk of death is higher among overweight and obese men and women, regardless of age (Field et al., 2001; van Baal et al., 2008; Willet, Dietz, & Colditz, 1999), although other research refutes this claim (Flegal, Kit, Orpana, & Graubard, 2013). Because researchers have historically concluded there are ties between obesity and morbid conditions (e.g., type-II diabetes, cardiovascular disease) and even premature death compared to healthy controls, it is no wonder why biomedical proponents have come to regard HBW as an issue that is in dire need of amelioration.

On the other hand, those who endorse the psychosocial view cite evidence that expands the dominant view on the "costs" of obesity. In the paper by Bacon and Aphramor (2011), the authors point out that most of the research on obesity-related costs is flawed. Namely, they fail to include important covariates, such as discrimination, physical activity, nutrient intake, and access to medical care. According to them, the research also fails to take into account unintended negative consequences of promoting a weight-loss paradigm, such as eating disorders, weight cycling, depression, and discrimination. In addition, other research demonstrates that body image has a greater impact on health than body size (Simonsen, Hundrup, Obel, Grønbæk, & Heitmann, 2008). That is, two women of equal body size might have very different health outcomes depending on how they perceive themselves.

Furthermore, rather than concluding that HBW unequivocally leads to higher mortality rates, a meta-analysis by Flegal, Kit, Orpana, and Graubard (2013) has refined our understanding of this phenomenon. While they found that higher levels of obesity along a BMI continuum were associated with significantly higher mortality rates compared with normal weight individuals, they discovered that being overweight (as opposed to being obese) was actually a protective factor, and that these individuals experienced greater longevity than normal weight controls. Those who were on the lower end of the HBW spectrum had similar longevity to normal weight controls. It appears as though HBW does not absolutely pose a health risk, and at times, can even be beneficial. In general, the psychosocial and biomedical views can agree that obesity at the extreme end of the spectrum is associated with greater disease morbidity and higher mortality rates; however, they disagree on the mechanisms that lead to these adverse consequences. Biomedical proponents view body weight as the root of the problem, while psychosocial advocates attribute negative outcomes to external mediators, such as stress and stigma. Questions then arise such as, what are the factors that influence obesity and what mechanisms explain the relationship between obesity and negative health consequences?

Chapter II: Review of the Literature

Causes of Obesity

The etiology and maintenance of excessive body adiposity are only partially understood. Although the state of the literature on obesity encompasses many disparate viewpoints, there seems to be a consensus that the causes of obesity are complex and multiply determined (e.g., Martinez, 2000). As such, several causes of obesity (e.g., genetic, biological, social) will be explored.

The dominant, biomedical explanation of obesity comes from a physical standpoint wherein weight gain can be explained in terms of energy balance, which encompasses metabolic, endocrine, and behavioral aspects of a person (Caballero, 2007). The laws of thermodynamics espouse that when input into the system (energy intake) consistently exceeds the output (energy expenditure), a positive energy balance occurs, and thus, weight is gained. In the year 2000, the human population reached a historical benchmark when the number of adults who were overweight exceeded those who were underweight (Gardner & Halweil, 2000). Dietary surveys suggest that there has been an increase in caloric intake over the past 20 years of about 200 kcals per day (Popkin, Nielsen, & Siega-Riz, 2002). A major contribution to excessive energy intake has been the replacement of healthy sources of energy (e.g., fruits and vegetables), which is currently far below recommended levels, with "empty" calories (US Department of Health and Human Services, 2005). Other factors contributing to an increased quantity, but not quality of, dietary calories include the relatively low cost of energy-dense foods, increased availability of prepared meals, and availability of snack foods throughout the day (Drewnowski & Specter, 2004). In addition, most persons in the United States engage in very low levels of physical activity. In 2008, the CDC released the *Physical Activity Guidelines for Americans* (Fulton &

Kohl, 2008), which recommended at least 150 minutes per week of moderate-intensity activity defined as “aerobically active” or 300 minutes per week defined as “highly active” as well as 2 or more days per week of muscle strengthening activities. Carlson, Fulton, Schoenborn, and Fleetwood Loustalot (2010) found that 44% and 28% of U.S. adults met the requirements for “aerobically active” and “highly active,” respectively. Approximately 22% met the muscle-strengthening guideline, while only 18% fulfilled both aerobic and muscle-strengthening criteria. Thus, with most Americans’ inadequate levels of physical activity, the energy balance could only be sustained with major reductions in food intake, perhaps even at the risk of foregoing essential nutrients (Caballero, 2007). Typically, advocates of the biomedical model target these aforementioned factors primarily because diet and exercise are directly under a person’s control. From a strictly medical standpoint, it makes good sense to try to influence factors that can be easily modulated. The problem with this approach is that it is ineffective over the long term (e.g., Wing & Phelan, 2005), provides a limited perspective, and discounts other causes with equal or greater influence on body weight outcomes.

Despite the undeniable influence of the aforementioned physical factors, a large body of research suggests that genetics account for anywhere between 50-90% of the variance across the range of BMI values (Maes, Neale, & Eaves, 1997; Sørensen, Price, Stunkard, & Schulsinger, 1989; Stunkard, Foch, & Hrubec, 1986; Stunkard, Harris, Pedersen, & McClearn, 1990). These studies were conducted in diverse populations across the United States, Sweden, Denmark, Nigeria, and Jamaica. Heritability estimates for waist circumference ranged from 37 to 81% (Hsueh et al., 2000; Hunt, et al., 2002; Sakul et al., 1997). However, heritability of higher body weight is not always consistently observed across cultures. A study conducted by Schousboe et al. (2003) that spanned eight countries in Europe as well as Australia found a dominant genetic influence in all countries except Norway and Italy.

Obesity does not show a typical Mendelian heritability pattern, and instead may depend on several genes with low to moderate effects. There is supporting evidence to show that genes that play a role in energy homeostasis and thermogenesis, adipogenesis, leptin-insulin signaling transduction and hormone signaling peptides are especially implicated in the development of obesity (Loktionov, 2003). Another study conducted by Sørensen, Stunkard, and Schulsinger (1989) supported polygenetic inheritance for the full range of fatness and major genes specific for obesity. This study also suggested that recessive genes were the primary mechanism of transmission. While there was a significant difference in BMI between full siblings of obese and overweight adoptees, no difference was found between half-siblings or parents. This is because a person may share pairs of recessive genes with full siblings, but only one allele with parents or half-siblings.

As with most areas of study, there is not a uniform consensus among researchers about the influence of genetics on obesity. One study by Kmietowicz (2015, N = 13,836) found evidence conflicting with the extant literature, suggesting that lifestyle plays an almost equal role as genetics in children who are overweight. However, the study also showed that being obese (as opposed to being overweight) was more strongly influenced by genetics than by lifestyle factors, which is more congruent with existing data.

Gene-environment interactions also help to explain why some people are HBW and some are thin in a society where lifestyle and the environment are more conducive to increases in BMI. One argument, the “thrifty gene hypothesis,” put forth by Neel in his 1962 article, is that certain groups of people (e.g., hunter-gathers) gained a survival advantage through biological mechanisms (e.g., leptin-resistance; leptin is a hormone that acts to reduce food intake) that allowed them to efficiently store nutrients as adiposity during times of famine. Supporting evidence can be found in populations that were historically prone to starvation, such as Pima Indians and Pacific Islanders, who became the most obese when exposed to a Western diet and sedentary life-style (Dowse et al., 1990; Howard et al., 1991; Zimmet et al., 1984). If this evolutionary explanation is veridical, the root of obesity could be in the interaction of our genes with the environment. A body of evidence is growing to support that, in fact, weight is a factor that is largely uncontrollable by the individual. This has important implications for the medical model of treatment because trying to change a trait that is largely genetically-determined through behavioral factors alone has serious limitations.

Weight Loss and Maintenance

Although losing weight can be an arduous endeavor, data show that the real difficulty lies in maintaining the weight loss. Weight loss maintenance is defined as a ten or more percent reduction in initial body weight that is intentionally maintained over the course of a year (Wing & Phelan, 2005). Biomedical proponents note this marker because it is associated with statistically significant improvements in lipids ratios, blood glucose homeostasis, and lowered risk of heart disease (National Heart, Lung, and Blood Institute, 1998), although this claim is debated (Aphramor, 2010; Tomiyama, Ahlstrom, & Mann, 2013). Studies differ in their estimates of how many people regain lost weight one to five years after an episode of significant weight loss; however, nearly all research unanimously supports that successful weight loss maintenance through behavioral efforts alone is the exception and not the rule (Aphramor, 2010; Jain, 2005). A study by Wing and Phelan (2005; *N* = 4000) suggests that 80% of people who lost at least 30 pounds fail to maintain the weight loss at a one-year follow-up. One-third to two-thirds of dieters even regain more weight than they initially lost (Mann et al., 2007). In fact, frequent prior participation in weight loss programs (i.e., "yo-yo dieting") is a negative predictor of weight loss and is associated with more weight gain during maintenance attempts and worse health outcomes (Bangalore, Fayyad, Laskey, DeMicco, Messerli, & Walters, 2017; Teixeira, Going, Sardinha, & Lohman, 2005).

Some cognitive and personality components that have been linked to worse weight-loss outcomes include higher novelty seeking, a dichotomous thinking style (i.e., all-or-nothing thinking), eating to regulate mood, and a diagnosis of Attention-Deficit/ Hyperactivity Disorder (ADHD; Ohseik & Williams, 2011; Pagoto et al., 2008; Sullivan, Cloninger, Przybeck, & Klein, 2007). Unsurprisingly, multidisciplinary approaches that include physicians working in conjunction with other professionals who promote healthy lifestyles have demonstrated more positive outcomes (Montesi et al., 2016).

Biological forces are also a significant barrier to maintaining weight loss. When a person decreases their energy input, a method promoted by traditional dieting, the body reacts by increasing levels of appetite-regulatory hormones, which intensifies subjective hunger (Sumithran et al., 2011). The average person expends most of their energy–approximately 60%–on resting, automatic functions (e.g., resting cardiopulmonary activity and the maintenance of cells; Leibel, Rosenbaum, & Hirsch, 1995). In formerly obese persons, there is a 28% decrease in energy expended per unit of body-surface area, which suggests a metabolic resistance to weight-loss maintenance (Leibel & Hirsch, 1984). In other words, after a significant amount of weight has been lost, powerful homeostatic forces trigger a commanding drive to eat. The brain then enters a "civil war" between the regions of the brain that control hunger and the parts of the brain that are responsible for higher-order functions, such as exerting willpower. As Friedman (2003) eloquently phrases it, “Those who doubt the power of basic drives, however, might note that although one can hold one's breath, this conscious act is soon overcome by the compulsion to breathe” (p. 2). By and large once genes and the environment interact to settle a person at a given body weight, biological systems work to maintain a person within a relatively narrow range of what is considered “normal” for that individual (Keesey & Powley, 2008).

Psychosocial Factors & Higher Body Weight

The psychosocial factors underlying HBW are often under-recognized by the biomedical community. This is a detriment to our understanding of HBW because the addition of these variables yields a more critical analysis of the direction of causality between HBW and negative health outcomes. There is a growing body of literature that suggests that fitness, not fatness, is a better predictor of health (Do Lee, Blair, & Jackson, 1999; Farrell, Braun, Barlow, Cheng, & Blair, 2002). In fact, exercise alone, even in the absence of weight loss, can lead to improved health outcomes (King, Hopkins, Caudwell, Stubbs, & Blundell, 2009). Therefore, there is a risk of falsely attributing improvements in health to weight loss as opposed to the adoption of a healthy lifestyle. In addition, the incorporation of certain foods in a person’s diet (e.g., fiber, fruits, and vegetables) can also lead to positive health results (Mozaffarian et al., 2003; Steinmetz & Potter, 1996). Furthermore, research by Tomiyama, Ahlstrom, and Mann (2013) suggests that there are modest health benefits associated with weight loss interventions as evidenced by slight improvements in levels of cholesterol, triglycerides, systolic and diastolic blood pressure, fasting blood glucose, and incidence of diabetes and stroke. However, none of these results were correlated with the amount of weight that participants lost. This implies that weight loss itself may not play a causal role in the health effects of dieting. Instead, increased exercise, social support, healthcare access, and increased consumption of healthy foods may be the factors driving the observed health benefit. These studies have powerful implications for the factors that are most important in achieving the positive health outcomes that are desired by both those that endorse a biomedical view and a psychosocial perspective.

Mental health is also an important consideration for HBW persons. As with many areas of study regarding HBW, the relationship between HBW and mental health is not straightforward. Some studies report a negative relationship between mental health and obesity (e.g., Dong, Sanchez, & Price, 2007; Heo, Pietrobelli, Fontaine, Sirey, & Faith, 2006), while other studies identify a positive or non-significant relationship (e.g., Carr, Friedman, & Jaffe, 2007; Jorm, et al., 2003). Thus, meta-analyses of this topic have produced mixed or non-significant results. One such meta-analysis by Faith, Matz, and Jorge (2002) that yielded non-significant results between obesity and depression postulated that grouping heterogenous subjects together may be masking important mediating and moderating variables. They concluded that there are likely many obesity-depression covariations (e.g., quality of social support, physical health, and daily functioning), rather than a simple association. One fairly established moderating variable between HBW and negative affect is gender (Carpenter, Hasin, Allison, & Faith, 2000; Istvan, Zavela, & Weidner, 1992). HBW females tend to exhibit more negative affect than HBW males. Another study added that HBW, high-SES women were significantly more depressed than HBW, low-SES women (Moore, Stunkard, & Srole, 1962). Proposed mediating variables between HBW and depression are negative verbal commentary (i.e., weight teasing; Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999), eating and physical activity (Babyak et al., 2000; Paluska & Schwenk, 2000), and physiological factors (e.g., cortisol secretion; e.g., Chalew, Nagel, & Shore, 1995). Another study by Carr, Friedman, and Jaffe (2007) suggests that excessive body weight itself is not distressing, but rather, poor physical health and strained personal relationships (i.e., critical, distressing, or discriminatory interactions) may account for the impairment in mood for persons with higher body weight. Other research has found a significant link between perceived discrimination due to weight among HBW individuals and psychiatric disorders (e.g., major depressive episode, dysthymia, generalized anxiety disorder, social phobia) as well as nicotine, alcohol, and drug dependence. This association did not change when perceived stress and social support were introduced into the model (Hatezenbuehler, Keyes, & Hasin, 2009). A mechanistic study by Hunger and Major (2015) helped elucidate the process by which HBW influenced self-reported psychological health. It was found that perceived discrimination and concerns over weight-based stigma mediated the relationship between BMI and psychopathology. Additional studies that examine the causal relationship between these variables are needed.

Prospective studies that examine the relationship between HBW and depression provide evidence that support the possibility of both causal pathways (i.e., obesity causing depression and depression causing obesity), although results are mixed. A study by Stunkard, Faith, and Allison (2003) found that major depression in adolescence was predictive of higher BMI in adulthood. The authors propose a genetic susceptibility for both outcomes, gene-environment interactions, and adverse childhood experiences as possible explanations for this relationship. Likewise, a study by Pine, Goldstein, Wolk, and Weissmann (2001) found that persons with depression in adolescence had statistically significantly higher BMI in adulthood (mean BMIs=26.1 and 24.2), although this result is arguably not clinically meaningful. Another study found that the effect of adolescent depression on weight depended on baseline weight (Barefoot, Heitmann, Helms, Williams, Surwit, & Seigler, 1998). That is, adolescents in the highest BMI quintile who were depressed were more likely to gain at least 10 kilograms over 20 years compared to non-depressed adolescents. A five-year prospective study found that obesity was a risk factor for depression, even after controlling for covariates such as baseline depression, but the reverse was not true (Roberts, Deleger, Strawbridge, & Kaplan, 2003). There is also evidence to support that weight stigma in and of itself may be a contributor to negative health outcomes. HBW is considered to be one of the most enduring, under-addressed social stigmas (Cahnman, 1968). Persons of HBW are subject to both institutional (Carr & Friedman, 2005; Puhl & Brownell, 2003) and interpersonal discrimination (Schwartz, Chambliss, Brownell, Blair, & Billington, 2003), which has significant implications for their health. Social determinants of health, such as adequate finances, access to health care, education, and social support all lead to increased longevity and less illness (Wilkinson & Marmot, 2003). Discrimination in these domains towards people of HBW have been well-documented in the literature. Obese persons are evaluated as less favorable job candidates (Sartore & Cunningham, 2007), earn 10 cents less per dollar than their lower body weight counterparts (Baum & Ford, 2004), and are underrepresented in institutions of higher education (Burmeister, Kiefner, Carels, & Musher-Eizenman, 2013). Additionally, physicians tend to display less warmth towards patients of higher body weight (Gudzune, Beach, Roter, & Cooper, 2013). In addition, patients who experience stigma are less likely to receive preventative health care and more likely to cancel medical appointments (Amy, Aalborg, Lyons, & Keranen, 2006; Jones, 2010). Persons that experience weight discrimination are also more likely to smoke cigarettes, drive while intoxicated, and engage in risky sex/drug use behaviors, even when depression and other demographic variables are controlled for (Sutin & Terraciano, 2017). Taken together, this suggests that weight stigma and discrimination could significantly contribute to less favorable health outcomes for HBW individuals (Hatzenbuehler, Keyes, & Hasin, 2009; Hunger & Major, 2015; Sutin, Stephan, & Terracianno, 2015; Sutin & Terracianno, 2013).

A model proposed by Tomiyama (2014) called the Cyclic Obesity/Weight-Based Stigma (COBWEBS) model characterizes the "vicious cycle" between weight stigma and weight gain. She cites two main mechanisms that lead to weight gain in response to stress: Increased eating and increased cortisol secretion (a hormone that promotes fat storage and eating behavior). "Comfort eating" has been cited in the literature as a common response to stress and negative affect (Adam & Epel, 2007; Greeno & Wing, 1994). Experimental studies have suggested that people increase their intake of foods that are higher in sugar and fat when exposed to stress (Epel, Lapidus, McEwen, & Brownell, 2001). Another experimental study found that when women perceived themselves as HBW, they consumed more calories in a condition in which they read about workplace weight stigma than in a control condition (Major, Hunger, Bunyon, & Miller, 2014). A potential moderator of this finding is baseline affect. A study by Jansen and colleagues (2007) classified higher body weight people into two groups: Those with baseline low and high negative affect. They found that higher body weight individuals with high baseline negative affect overate in response to a negative mood induction and food exposure compared with higher body weight persons with low negative affect and normal weight controls.

Providing further evidence for the COBWEBS model, Dickerson, Gruenwald, and Kemeny (2004) argued that the potential for negative evaluation from others in a social context (i.e., shame) is one of the stressors most likely to activate the hypothalamic-pituitary-adrenocortical (HPA) axis, which results in the secretion of cortisol. Not only does this drive short-term eating behavior and fat storage (Adam & Epel, 2007), but prolonged exposure mediates a number of health conditions, such as hypertension and cardiovascular disease

(Muennig, 2008). Additional considerations are that obese individuals exposed to weight stigma are more likely to overeat and avoid dieting (Puhl & Brownell, 2006) and to avoid exercise (Vartanian & Novak, 2011). The COBWEBS model highlights the irony of the plight of persons of HBW. The same conditions that result from being HBW–discrimination, body shaming, and social undesirability–are the same factors that contribute to weight gain. Finally, social influence plays a significant role in body size and health. Social rejection and a lack of social support have been shown to lead to both weight gain and poorer health outcomes (Björntorp, 2001; Cohen, 2004; Dallman, 2010; Logel et al., 2014). On the other hand, increased social support has been associated with salubrious outcomes (e.g., improved cardiovascular and immune functioning) independent of health behaviors (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). One mechanism that may mediate the relationship between social support and health is the buffer of the relationship against distress associated with weight stigma and health problems (House, Landis, and Umberson, 1988). Conversely, strained relationships may contribute to the onset and maintenance of obesity as well as exacerbate weight-related health problems (Okun & Keith, 1998). Therefore, the finding by Carr and Friedman (2006) that persons classified as 'extremely obese' by their BMI reported significantly higher levels of strain and lower levels of support in their family relationships has troublesome implications. It is noteworthy that this effect is conditional upon a person's adolescent body weight. The authors discovered that people who were overweight at age 21 perceived a decline in social support from family as their adult BMI increased. This effect was not observed for relationships between spouses, friends, or coworkers. Interestingly, a longitudinal, network-analysis conducted by Christakis and Fowler (2007) found that a person was more likely to become obese if certain others in their social network also became obese, independent of physical proximity or smoking behavior. The odds of a person becoming obese increased by 171% if a mutual friend became obese, 40% for a sibling, and 37% for a spouse. The study particularly highlights the biopsychosocial nature of obesity and the impact social connections can have on potentially multiple domains. It should be noted this study has been at the heart of some controversy. Adherents of the psychosocial model argue that a more balanced and nuanced conclusion could be how weight stigma itself impairs the quality maintenance and development of close interpersonal relationships, which in turn, impacts people's health and well-being.

The more treatment providers understand the biopsychosocial associated factors of obesity, the better able providers are to identify and recommend personalized treatment plans that could have the most benefit for individuals. From the evidence presented, it is patent that psychosocial variables have tangible effects on a person's biology. When taking a biopsychosocial approach to understanding HBW, this factor cannot be ignored. The evidence reviewed thus far suggests tenuous causal links directly from HBW to negative health outcomes. Rather, many factors such as stigma, mental health, quality of interpersonal relationships, quality and frequency of medical care, socio-economic status, genetics, and lifestyle could explain the associations between HBW and various diseases (Carr & Friedman, 2006; Logel, Stinson, Gunn, Wood, Holmes, & Cameron, 2014; Schwartz, Chambliss, Brownell, Blair, & Billington, 2012). Therefore, a shift in focus from weight-loss to weight-neutral, health-based outcomes could yield more promising results than those obtained from the biomedical weight-loss paradigm, which has demonstrated limited efficacy. Although the pathways (i.e., weight-loss) that are traditionally utilized in a biomedical model may be incompatible with the methods implemented in the psychosocial approach (i.e., weight neutral outcomes), the ultimate goals of each model (i.e., health promotion) can readily be integrated. A well-being-based approach that melds the aims of the biomedical and psychosocial models will be discussed below.

Psychological Well-Being as an Alternative Approach

Physicians' concern over obesity can be understood as an outcome of their understanding that it has negative implications for physical health. Similarly, psychologists and other mental health professionals focus on this issue because of their view that HBW increases one's risk of poor mental health and overall well-being. A united, interdisciplinary approach to address obesity that focuses on health-outcomes, as opposed to weight-loss, is potentially equipped to handle this complex issue. In terms of interventions, the incorporation of psychoeducation on weight loss can be very beneficial to counteract the potentially iatrogenic effects of traditional weight loss approaches. There is a growing body of evidence to suggest that a new lens is needed through which to view the "obesity problem" (Logel et al., 2015). Instead of focusing on weight loss and caloric restriction as the primary metrics of success, positive outcomes should be regarded as the inclusion of clinical biomarkers, healthy behaviors, and the holistic fulfillment of a person's needs that are not just relegated to the physical. There is promising literature that will be reviewed below that suggests that a focus on well-being, rather than weight-loss, could potentially fulfill the aims and goals of both a biomedical and psychosocial viewpoint since the related literature takes both into account.

Eudaimonic well-being is characterized as meaning, purposeful engagement and the realization of one's true potential, while hedonic well-being is summarized as pleasure attainment, avoidance of negative affect, and the satisfaction of human appetites (Ryan & Deci, 2001; Ryff & Singer, 1996; Ryff, Singer, Love, 2004; Waterman, 1993). In 1989a, Carol Ryff wrote a ground-breaking article following in the footsteps of others who sought to answer the age-old question, what makes for a life well-lived? Through the review of philosophical literature, past psychological theory (e.g., Maslow, Jung, Erickson, Frankl; Ryff, 1989b), and the stringent incorporation of statistical methods, she derived six separate factors of psychological well-being (PWB): Self-acceptance- the willingness to accept one's strengths and weaknesses; Positive Relations with Others- having intimate and valued connections with significant others; Purpose in Life- having goals that give life meaning; Positive Growth- feeling that one's potential is being realized over time; Environmental Mastery- being able to navigate the demands of everyday life; and Autonomy- having the strength to follow one's personal conviction, even if they go against conventional wisdom (Ryff, Singer, & Love, 2004).

As Ryff (1989b) described it, the ultimate goal is to achieve balance in each domain, as being too extreme in either direction can impair functioning. For example, an optimal level of Self-acceptance allows a person to acknowledge and accept multiple aspects of oneself. A person too low on this facet feels dissatisfied with one's past and current life and/or wishes to be different than one is currently. Alternatively, someone that is too high on this dimension has narcissistic and egocentric traits. A person with inadequate Positive Relations with Others is isolated and finds it difficult to establish warm, open relationships with others. A person that is balanced on this trait understands the give and take of human relationships, while someone who is excessive on this trait is overly enmeshed with others and seeks the approval of others to the detriment of their own needs. Someone with a healthy balance of Purpose in Life feels that their life has meaning and has aims and objectives for living. On the other hand, a person with a hypo-level of this trait lacks a sense of direction; but a person with a hyper-level may pursue passions to the point of obsession and be overly rigid. A balanced level of Personal Growth reflects openness to new experience, improvement, and the realization of one's potential over time. Someone with a depressed level of this trait may experience boredom or stagnation, while someone who is excessive may set unrealistic expectations for themselves. Those with an optimal sense of environmental mastery effectively use surrounding opportunities and can create or choose external contexts that are conducive to one's needs. Those too low in this facet are unable to manage everyday tasks, while those who are too high are unable to savor the moment or relax. Finally, someone with a balanced sense of autonomy evaluates the self by personal standards and can resist social pressures to think and act in ways that are congruent with one's beliefs. Those with too high levels are unable to ask for help or to effectively work as part of a team; conversely, those with diminished levels of this trait rely on the judgment of others to make important decisions and are overly concerned with external influences.

Although the facets of PWB were constructed to reflect predominantly eudaimonic, as opposed to hedonic values, the two facets that are especially existential (i.e., Purpose in Life and Positive Growth) are more strongly divergent with hedonic well-being (Ryff, Singer, & Love, 2004). Hedonic and eudaimonic well-being are related constructs that reciprocally influence each other (King & Hicks, 2012). That is, positive affect promotes the search for meaning and the search for meaning promotes positive affect. In earlier years, scientific research mainly focused on the outcomes of hedonic factors, such as happiness and life satisfaction; however, an emerging body of evidence in recent years may warrant an additional focus on the salubrious effects of eudaimonia (Ryan & Deci, 2001).

Psychological Well-Being and Overall Health

PWB has been shown to predict future health over and above its relationship with current physical health, stress, depression, and other affective states (Bower, Kemeny, Taylor, & Fahey, 1998; Chida & Steptoe, 2008; Koizumi, Ito, Kaneko & Motohashi, 2008; Krause, 2009; Moskowitz, Epel, & Acree, 2008). Also, the combination of hedonic and eudaimonic well-being has been shown to be a protective factor in the relationship between aging and the presence of chronic health conditions (Keyes, 2005) as well as all-cause mortality in older adults (Boyle, Barnes, Buchman, & Bennett, 2009). These findings highlight the potential interplay of biopsychosocial factors in obesity-related health outcomes.

Certain facets of PWB have been linked to health outcomes traditionally believed to be related to HBW. Purpose in life is prospectively associated with lower risk of myocardial infarctions in those with coronary heart disease (Kim, Sun, Park, Kubzansky, & Peterson, 2013). Additionally, those with higher levels of Environmental Mastery, Purpose in Life, and Positive Relations with Others had longer sleep duration as well as earlier onset and longer duration of REM sleep (Friedman, 2012; Friedman et al., 2005; Ryff, Singer, & Love, 2004). The relationship between PWB and sleep is of interest because of the association between inadequate and low-quality sleep and HBW (e.g., Patel, Malhotra, White, Gottlieb, & Hu, 2006). Sleep has also been known to mediate the relationship between socio-economic status and health (Moore, et al., 2002), maintain the body's defenses against cancer (Sephton & Spiegel, 2003), and to be a protective factor against mortality in older adults (Dew et al., 2003). Metabolic syndrome has also been identified as an obesity-related outcome (Black, 2003; Janssen, 2004). Aspects of eudaimonic and hedonic well-being have been shown to predict reduced risk of metabolic syndrome in a national sample both cross-sectionally as well as longitudinally (Boylan & Ryff, 2015).

The study of PWB and genetic and biological markers has also yielded intriguing results. The 2004 study by Ryff, Singer, and Love demonstrated that Personal Growth and Purpose in Life were significantly related to decreased salivary cortisol, which is a marker for stress and tied to various health outcomes (Lindfors & Lundberg, 2002). In this study, as well as a study by

Friedman and colleagues (2007), a significant negative correlation was observed between the Positive Relations with Others subscale of PWB and interleukin 6 (IL-6), an inflammatory cytokine. Chronic inflammatory processes have been implicated in negative health outcomes, such as atherosclerosis, type-II diabetes, and metabolic syndrome (Black, 2003). The finding of an inverse relationship between well-being and IL-6 as well as C-reactive proteins (another marker for inflammation) was replicated by Friedman and Ryff in 2012. Fredrickson and colleagues (2013) analyzed leukocyte basal gene expression in those assessed for eudaimonic and hedonic well-being and found even starker contrasts. They discovered that those with higher levels of hedonic well-being had an up-regulation of a stress-related conserved transcriptional response to adversity (CTRA; increased expression of proinflammatory genes and decreased expression of genes involved in antibody synthesis). Conversely, those with higher levels of eudaimonic well-being showed CTRA down-regulation. The finding that hedonic and eudaimonic well-being engage in distinct genetic processes despite their similar effects on total well-being "implies that the human genome may be more sensitive to qualitative variations in well-being than are our conscious affective experiences" (Fredrickson et al., 2013, p. 1). This quote beautifully illustrates what a profound impact a shift in our mental outlook can have on our health. Although eudaimonia reveals a distinct genetic benefit over hedonia, this result does not imply that one would be better off without one form of well-being; rather, it speaks to the form of well-being one would not want to do without (Fredrickson, 2013).

It is notable that one study found that Spanish, obese patients did not have lower health-related quality of life compared to normal-weight control group; however, they did have significantly lower levels of PWB as measured by Ryff's PWB scale (Margallares, Benito de Valle, Irles, Bolaños-Rios, & Jauregui-Lobera 2014; Ryff, 1989a). All facets, except for the Self-

Acceptance facet, were significantly different between obese and normal weight controls. However, this study did not control for any potentially confounding variables. A thorough review of the literature reveals that only one other published study has explored this relationship. Using an older version of the database (MIDUS I- see methods section for description) that is used in the present study, Bookwala and Boyar (2008) found that women had less well-being across all four categories of HBW (i.e., overweight- $25 \leq BMI < 30$; obese I- $30 \leq BMI < 35$; obese II- $35 \leq BMI < 40$; and obese III- $BMI \geq 40$) than normal-weight controls, while this pattern was only observed for men in the two highest BMI categories. This study provides preliminary evidence that gender moderates the relationship between HBW and PWB. It also suggests that each gender has unique experiences surrounding HBW.

One study found that Positive Growth, Purpose in Life, Positive Relations with Others, and Environmental Mastery were negatively correlated with glycosylated hemoglobin (HA_{1c}; a marker of diabetes), waist-hip ratios, total/ HDL cholesterol ratios, and weight in a sample of older women (Ryff, Singer, & Love, 2004). In a separate longitudinal study, it was found that Purpose in Life, Positive Growth, and positive affect moderated the relationship between socioeconomic status and HbA_{1c} in older women without diabetes (Tsenkova, Love, Singer, & Ryff, 2007).

Psychological Well-Being and Higher Body Weight

While the study of PWB and its relationship to biological health-outcomes is still in a rudimentary state, there has been some work on how PWB and each of its facets contribute specifically to HBW related-outcomes. There is also a large body of literature on theories that propose similar mechanisms as PWB. For example, the application of Self-Determination Theory (SDT; Deci & Ryan, 1980) to samples of HBW individuals has yielded many successful health-related outcomes. SDT posits that maximizing a person's autonomy (analogous to Autonomy from PWB scale), competence (analogous to Environmental Mastery), and relatedness (analogous to Positive Relations with Others) helps to internalize positive health behaviors, and therefore, make change more sustainable (Ryan & Deci, 2000). One study that examined the effect of intrinsic motivation within a context of SDT found an increase in eating self-regulation and physical activity in a group of women actively engaged in weight control (Mata et al., 2011). Multiple other studies found autonomous motivation/support for weight control to be related to outcomes such as improved adherence, more weight loss as well as weight loss maintenance (Elfhag & Rössner, 2005; Silva et al., 2011; Webber, Tate, Ward, & Bowling, 2010; Williams, Grow, Freedman, Ryan & Deci, 1996). Finally, a large meta-analysis that examined the effect of extrinsic rewards on intrinsic motivation revealed that external rewards attenuated motivation (Deci, Koestner, & Ryan, 1999). It seems that internal motivation that is embedded within a person's value system is a better indicator for change in the adoption of healthy behaviors than external rewards/threats.

There is a plethora of literature on self-compassion, body satisfaction, and self-acceptance in relation to higher body weight, which all relate to the Self-Acceptance facet of PWB. Some key examples of the literature will be reviewed here. Carr and Friedman (2005) found that obese persons were lower in the Self-Acceptance facet of PWB than normal weight controls, although this relationship was mediated by perceived discrimination. A study by Blake and colleagues (2013) found that weight dissatisfaction was linked to "yo-yo" dieting, consuming fewer meals, being less active, and overall poorer health (e.g., higher rates of hypertension, diabetes, and hypercholesterolemia)–especially in persons who are HBW. Other studies have found that self-compassion mitigates the relationship between eating and distress

(Adams & Leary, 2007). For example, mindfulness and self-compassion mediated the negative relationship between weight loss, avoidance, and negative thoughts, thereby supporting long-term weight loss better than a control program (Mantzios & Wilson, 2014). It was found that self-compassion with meditation outperformed meditation only or control conditions for weight loss (Mantzios & Wilson, 2015). These findings carried through to a six-month follow-up, but were paradoxically reversed one year later. One possible explanation for this finding is that using a "weight- loss" paradigm in and of itself, regardless of the intervention's content, is detrimental to long-term change. Conversely, an approach that adopts a self-acceptance approach without focusing on weight-loss, Health at Every Size (HAES; Bacon, 2010), has demonstrated promising results in physiological measures (e.g., blood lipids), health behaviors (e.g., physical activity and dietary quality), and psychosocial outcomes (e.g., self-esteem) regardless of actual weight loss (e.g., Bacon & Aphramor, 2011; Tylka, Annunziato, Burgard, Shuman, Davis, & Calogero, 2014). Notably, in randomized control trials (RCTs) using the HAES approach, the retention rates of the experimental groups were significantly higher than the control groups (Bacon & Aphramour, 2004). Given that traditional weight loss programs have marked recidivism rates (Wing, Blair, Marcus, Epstein, & Harvey, 1994), this is a significant advantage. These studies highlight the clinical benefit of incorporating elements of self-acceptance in health care settings.

The facet Positive Relations with Others is especially relevant to a higher body weight population. In principle, social identity theory states that members of a distinct group are more likely to view in-group members more positively and out-group members relatively negatively (Tajfel & Turner, 1986). However, this principle does not appear to hold for persons of HBW. One study found that HBW people exhibited significant implicit and explicit anti-fat bias (Wang, Brownell, & Wadden, 2004). Consequently, overweight individuals do not enjoy the protective barrier and increased self-esteem that ingroup preference confers, unlike most other groups that experience stigma (Crocker & Major, 1989). Other studies have discovered that a particular type of social support, autonomy support, is predictive of better biological markers (e.g., HbA_{1c} values) and increased weight loss (Gorin, Powers, Koestner, Wing, & Raynor, 2014; Powers, Koestner, & Gorin, 2008; Williams, Freedman, Deci, 1998). Autonomy support is defined as a non-directive environment that fosters intrinsic motivation by acknowledging a person's unique perspective and providing choices while refraining from excessive control (Deci & Ryan, 2000; Reeve, Bolt, & Cai, 1999; Silva et al., 2010). Autonomy support is in line with the theoretical underpinnings of PWB because it strives for an egalitarian social connection that is driven by a person's intrinsic values.

Lastly, Environmental Mastery is also supported by the literature to be a potentially effective component of adopting healthy behaviors. One study found that mastery moderated the relationship between unhealthy food options (i.e., number of fast-food restaurants) and metabolic outcomes (Paquet, Dubé, Gauvin, Kestens, & Daniel, 2010). Based on these findings, Environmental Mastery is very relevant to engaging in healthy lifestyle behaviors, especially when an individual's environment is saturated with unhealthy alternatives. In addition to the successful navigation of one's external environment, one must also be able to effectively navigate his or her internal environment. Elfhag and Rössner (2005) found that successful weight loss maintenance was enhanced by more effective coping strategies and the ability to handle life stressors. These findings lay the groundwork to establish PWB as well-suited to address the multi-faceted needs of a higher body weight population. Below is a table delineating the connection between each of the facets of PWB and its connection to persons of higher body weight and health outcomes.

Table 1.

Relationship of Psychological Well-Being Facets to Higher Body Weight & Health

Facet of Well-Being	**Theoretical Relation to HBW & Health**	**Health Effects**	**Citations**
Purpose in Life	Engagement in healthy behaviors that are embedded within a person's intrinsic value system, as opposed to external motivation	Lower risk of myocardial infarctions[1] Longer sleep duration[2,3,4] Decreased salivary cortisol[5] Lower levels of interleukin 6[6] Lower HA_{1c}[4] Lower waist-to-hip ratios and weight[4] Lower Total/HDL cholesterol ratios[4] Moderates the relationship between socio-economic status and HbA_{1c}[7]	1. Kim, Sun, Park, Kubzansky, & Peterson, 2013 2. Friedman, 2012 3. Friedman et al., 2005 4. Ryff, Singer, & Love, 2004 5. Lindfors & Lundberg, 2002 6. Friedman et al., 2007 7. Tsenkova, Love, Singer, & Ryff, 2007
*Autonomy *(Social-Determination Theory)*	The conviction to stand against weight bias and discrimination, even if it goes against the grain	*Improved adherence[7,8,9,10] *More weight loss[7,8,9,10] *More weight loss maintenance[7,8,9,10] *Increase in eating regulation and physical activity[7,8,9,10]	8. Elfhag & Rössner, 2005 9. Silva et al., 2011 10. Webber, Tate, Ward, & Bowling, 2010 11. Williams, Grow, Freedman, Ryan & Deci, 1996
Environmental Mastery	Skills to navigate available resources to cope with stress and pursue a healthy lifestyle	Longer sleep duration[2,3,4] Lower HA_{1c}[4] Lower waist-to-hip ratios and weight[4] Lower Total/HDL cholesterol ratios[4]	
Self-Acceptance	Acceptance of current body size, even if it differs from desired image with increased emphasis on health rather than weight	*Mitigates relationship between eating and distress[12] *Mediates negative relationship between weight loss, avoidance, and negative thoughts[13]	12. 12. Adams & Leary, 2007 13. 13. Mantzios & Wilson, 2014
Personal Growth	Stamina to pursue positive health-related outcomes over time	Decreased salivary cortisol[5] Lower levels of interleukin 6[6] Lower HA_{1c}[4] Lower waist-to-hip ratios and weight[4] Lower Total/HDL cholesterol ratios[4] Moderates the relationship between socio-economic status and HbA_{1c}[7]	
Positive Relations with Others	Fortitude to pursue positive connections with others and create bonds with health care providers and others that counteract negative stereotypes	Longer sleep duration[2,3,4] Lower HA_{1c}[4] Lower waist-to-hip ratios and weight[4] Lower Total/HDL cholesterol ratios[4]	

**Construct was measured by a proxy for Ryff's PWB scales*

Purpose of the Current Study

This study is unique because, to date, no one has used the MIDUS database (see Methods section for description) in a way that examines PWB in a population of HBW individuals from both a psychosocial as well as a medical point-of-view. That is, no other study directly examines the relationship between PWB and obesity-related health outcomes. In general, there has been very limited research on the well-being of higher body weight persons. This study seeks to expand our understanding of positive psychological attributes in a population of people who may be at risk for a myriad of health complications (e.g., Janssen, 2004) and consequently, significant increases in medical spending (Thorpe, Florence, Howard, and Joski, 2004). First, this study will explore the relationship between PWB and body weight as defined by BMI and waist circumference. Next, PWB will be explored as a potential moderator of higher body weight and negative biomarkers as well as health outcomes. Finally, the relationship between PWB and HBW will be examined to determine if it has any bearing on health outcomes both at a single time point as well as longitudinally.

Chapter III: Method

Hypotheses

1. Adiposity (defined by a combined measure of BMI and waist circumference) will negatively predict individual facets of psychological well-being; however, this relationship will no longer be significant after controlling for perceived discrimination, gender, age, race (white, black, other), income, depressed affect, marital status (married or not), and weight perception (perceived very overweight or not). A study by Margallares and colleagues (2014) found that a group of obese, Spanish individuals had significantly lower PWB on all facets except for Self-Acceptance when compared to normal weight, Spanish controls. It is noteworthy that this study did not control for any potentially confounding variables. Another study by Bookwala and Boyar (2008) expanded on this topic by breaking HBW into more discrete categories by BMI (i.e., overweight, obese I, obese II, and obese III) and found that gender moderated the relationship between body weight and PWB. Specifically, women had lower total PWB in all four categories, while men only experienced this effect in the two highest BMI categories. This study will expand on the literature by using a more robust version of the Psychological Well-Being scale than the Bookwala and Boyar study (the 7-item versus 3-item measure). Finally, this hypothesis takes steps toward bridging the gap between biomedical and psychosocial paradigms by including perceived discrimination and other psychosocial variables as control variables.
2. Individual facets of PWB (e.g., Environmental Mastery) will be negative predictors of a combined measure of negative blood biomarkers (i.e., CRP, IL6, HA1c, triglycerides, and total cholesterol/HDL ratio) after controlling for the covariates mentioned above in addition to the year data was collected for each participant. Several contradictory studies

exist in the literature regarding the relationship between eudaimonia (e.g., Ryff's PWB scale) and the metabolic network (e.g., gene expression, blood biomarkers). One study found that eudaimonia predicted lower levels of a stress-related gene expression profile (CTRA), while hedonic well-being demonstrated the opposite relationship (Fredrickson et al., 2013). Another study by Friedman and Ryff (2012) found modest significant relationships between Purpose in Life and Positive Relations with Others (using Ryff's scale) and CRP levels, but not IL6. A study by Boylan and Ryff (2015) discovered that Personal Growth (but none of the other PWB facets) was a cross-sectional and longitudinal predictor of some components of metabolic syndrome (e.g., triglyercides, HDL cholesterol). However, another study found that hedonic well-being was a negative, distal predictor of HbA1c, while none of the PWB facets were significant predictors (Tsenkova, Love, Singer, Ryff, 2007). These studies included mainly demographic and physical measures as covariates (e.g., medication use, alcohol & smoking history) and occasionally psychosocial variables (e.g., negative affect). This study expands the literature by focusing on an aggregate measure of biomarker outcomes unique to a HBW population (e.g., triglycerides & HA1c) as well as a more thorough inclusion of psychosocial control variables.

3. Individual facets of PWB will moderate the relationship between adiposity and blood biomarker outcomes using hierarchical linear regression analyses. To this researcher's knowledge, no other studies measure the moderating relationship of PWB between HBW and metabolic outcomes. One related research study by Friedman and Ryff (2012) suggests a relationship among these variables may exist. Friedman and Ryff's paper found modest significant interactions of Purpose in Life on CRP/IL6 and number of

chronic medical conditions. That is, if a person had higher levels of Purpose in Life, CRP/IL6 went up less rapidly in those with a higher number of chronic conditions. Therefore, this research will serve as a starting point from which future research can be informed.

4. Individual PWB facets at Time 1 will be longitudinal predictors of a dichotomous measure of disease outcomes (i.e., 0 or ≥1 instances of diabetes, heart trouble, stroke, and/or cancer) at Time 2 (7-10 years later) after controlling for the aforementioned covariates plus the year data was collected from each participant. There have been only a limited number of studies in the literature that assessed the link between eudaimonic/hedonic well-being on longitudinal health outcomes. For example, Krause (2009) found that meaning in life (not measured by the PWB scale) was a negative, longitudinal predictor of all-cause mortality until measures of physical health were added (suggesting that physical health potentially mediates this relationship). Another longitudinal study found that how much one 'enjoyed life' significantly predicted lower risk of mortality while controlling for age, race or ethnicity, self-reported health status, and physical activity (Moskowitz, Epel & Acree, 2008). Further, Koizumi, Ito, Kaneko, and Motohashi (2008) discovered that having purpose in life (also not measured by the PWB scale) lowered the risk of death as a result of all-causes, stroke, and CVD, but not of malignant tumors in Japanese men while controlling for physical health measures and perceived stress. It is noteworthy that this finding was not replicated for women. An association was also found by which each unit increase of Purpose in Life (measured by Ryff's scale) was associated with a 27% reduction in the odds of a myocardial infarction 2 years later (Kim, Sun, Park, Kubzansky, & Peterson, 2013). This study expands the

literature by testing this concept in a distinct sample and controlling for different psychosocial covariates, such as perceived discrimination.

5. The PWB facets will moderate the relationship between adiposity and the dichotomous variable of longitudinal disease outcomes mentioned above after including the covariates discussed in the previous hypotheses. This is an association that also never been directly examined in previous literature to the best of this researcher's knowledge. One paper found that low levels of Personal Growth and Purpose in Life amplified that adverse effects of low income on a longitudinal measure of HA1c (Tsenkova, Love, Singer, & Ryff, 2007). It remains to be seen if the facets of PWB will have similar moderating effects on adiposity and longitudinal disease outcomes.

Participants

Sample characteristics. The MIDUS II, Project 1 sample, which was collected from 2004 to 2006 is comprised of 4,963 non-institutionalized, English-speaking adults across the U.S. The total sample was comprised of four subsamples: (1) a main random-digit-dialing (RDD) sample (N = 2,257); (2) oversamples from select metropolitan areas in the U.S. (N = 489); (3) siblings of persons from the RDD sample (N = 733); and (4) twin-pairs of individuals from the RDD sample (N = 1,484). The sample was surveyed twice more; a subset from the original sample was assessed in person from 2004-2009 to collect biomarkers (MIDUS II, Project 4; N = 1,255) and again from 2013-2014 (MIDUS 3; N = 3294). The sample ranged from 28 to 84 years-of-age (M = 55.43, SD = 12.45) for MIDUS II Project 1, 34 to 84 years-of-age for MIDUS II Project 4 (M = 54.52, SD = 11.71), and 39 to 93 years-of-age for MIDUS 3 (M = 63.64, SD= 11.35).

The body weight of the total sample is as follows: 28% of the total MIDUS II sample was 'normal-weight' according to the CDC's classification based on BMI (Freedman, Horlick, & Berenson, 2013; Garrow & Webster, 1985; Wohlfahrt-Veje et al., 2014); 27% of persons were 'over-weight'; 19% were 'obese'; 8% of the sample fell into the category of 'extremely obese'; and 18% of participants did not disclose their BMI. The total MIDUS II sample was approximately equal in terms of gender distribution; 53% of the sample was female, while 1% refused to disclose their gender. Most of the sample was highly educated with over 62% having more than a high school education (31% had some college experience, 18% obtained a bachelor's degree, 13% received education beyond a bachelor's degree); 29% obtained a high school degree or GED; and 9% received less than 12 years of education. The sample was mostly White (79%); 5% were Black; 1.7% identified as Other; 0.6% of participants said they were Multiracial; 0.5% were Native American; 0.8% were Asian or Pacific Islander; and 2% refused this question. Eighty eight percent of the sample spoke English only, and the remainder of the sample spoke English in addition to (an)other language(s). Only a small portion of participants did not speak English (.02%). Total household income ranged between $0 to over $300,000 dollars. The bottom quartile earned less than $29,000 dollars, the median household income was $57,500, while the upper quartile made over $95,500. This sample appears to be more affluent than the national average according to the 1995 census, which reported that the median income in the U.S. was $34,076.

Setting

The data that will be used in this study were obtained from an existing dataset, Midlife in the United States [MIDUS II, Project 1; MIDUS II, Project 4 (blood biomarker variables); & MIDUS 3 (repeat of measures collected in MIDUS II- Project 1)]; completed from 2004-2006, 2004-2009, & 2013-2014, respectively). Data from participants in this sample were originally collected in 1995 (MIDUS I), and this study was based on an effort to follow up with the baseline sample several years later. This large-scale data collection effort offers both a large sample size as well as a breadth and depth of information on numerous psychological, sociological, demographic, as well as biological variables. MIDUS II and MIDUS 3 data will be used for the analyses of the present hypotheses because these datasets include an expanded version of a scale of interest (the Psychological Well-Being scale) whereas MIDUS I used a less reliable version of the measure. In addition, MIDUS II is unique in that it includes a subsample of participants for which blood biomarker data were collected. The following information pertaining to participants, measures, and procedure was obtained from the Midlife in the United States Field Reports (Ryff et al., 2011; Ryff et al., 2015) as well as the Description of MIDUS Samples document (Brim et al., 2016).

Procedure

The current study (IRB #: 2017-319) was reviewed by Nova Southeastern University's Institutional Review Board (IRB) on 5/19/2017 and was determined exempt from further IRB review. This study utilized a secondary data set collected by The Midlife Development in the U.S. (MIDUS) project. These surveys were collected at three-time points across the span of 18 years. This multidisciplinary study was innovative in that it collected data on many psychological variables (e.g., well-being, positive and negative affect, personality traits) on a national sample of Americans and provided an opportunity to empirically link them with variables on demographics, lifestyle, health care usage, and biomarker data in one subset of participants. These data files are publicly available to download through the Inter-University Consortium for Political and Social Research (ICPSR).

Sampling Procedures. These secondary datasets were downloaded from ICPSR. The MIDUS study was funded by the John D. and Catherine T. MacArthur Foundation, Research Network on Successful Midlife Development, and then by the United States Department of Health and Human Services, National Institute on Aging (5-PO1-AG20166-04; PO1AG020166) at the second and third data collection phases. The first wave of data collection used in this study happened from 2004-2006. Respondents were drawn from a nationally representative, random-digit-dial sample selected from working telephone banks across the U.S. Respondents were offered $60 for their participation. Respondents were asked to participate in a phone interview that took approximately 30 minutes to complete and to complete two self-administered questionnaires (SAQs) that were each 100 pages in length. The telephone response rates were 70% for the Main RDD sample (response rates could not be calculated for the total sample), and the SAQ response rates were 89% for the full sample. The longitudinal retention rates adjusted for mortality for MIDUS 3 phone interviews and SAQs responses were high at 77% and 83%, respectively.

Data collection. Interviewers at the University of Wisconsin Survey Center were debriefed on the scope of MIDUS issues as well as MIDUS instruments. They received over 12 hours of training and completed an additional 12 hours of observation with an experienced telephone interviewer. Telephone interviews were conducted using computer-assisted telephone interviewing (CATI) technology. The CATI system used by the University of Wisconsin Survey Center was CASES 5.5, which is copyrighted by the University of California-Berkeley. In the CASES CATI system, the interview questions appeared line-by-line on a computer screen for the interviewer to read to the respondent. The interview advanced based on pre-programmed skip logic, and questions were adapted according to previously provided answers. The system was built for pre-coded questions, open-ended questions, and combinations of the two. When an invalid response was entered into the system, the interviewer was asked to reenter the response.

The self-administered questionnaire (SAQ) was programmed for double data entry in the CASES 5.5 system. The text of the question appeared on a computer screen and a data entry operator entered the response given by the study participant. Skip logic was again pre-programmed in the system. Similar to the telephone interview, the system allowed for pre-coded questions, open-ended questions and a combination of the formats. Again, the system only allowed valid responses, so the operator was asked to enter a new value if the previous one was invalid. Finally, trained editors reviewed all SAQs and clarified questionable responses before the first-pass data entry. When the data were entered a second time, the CASES system monitored any discrepancies and prompted the operator to resolve inconsistencies.

Biomarker data were collected from 2004 to 2009 from a subset of the sample that participated in MIDUS II (N = 1,255). The Biomarker Project of MIDUS II obtained samples (e.g., fasting blood draw) that reflected functioning several systems relevant to this study (e.g., lipid/fat metabolism markers) which allow for the study of diverse health outcomes. Data collection was carried out at University of California Los Angeles, University of Wisconsin, and Georgetown University. Trained clinicians and staff also performed assessments to gather collateral information, including medication use, vital signs, functional capacities, and a physical exam.

Measures

Psychological well-being. Unless otherwise noted, the below variables were taken from the MIDUS II Project 1 database (Ryff et al., 2004). The original *Psychological Well-Being Scale* (PWB; Ryff, 1989a) is a 42-item measure that assesses eudaimonic well-being across six domains: Positive Relations with Others (e.g., "Maintaining close relationships has been difficult and frustrating for me"), Self-Acceptance (e.g., "I like most parts of my personality"), Autonomy ("I was not afraid to voice my opinions, even when they were in opposition to the opinions of most people"), Personal Growth ("For me, life has been a continuous process of learning, changing, and growth"), Environmental Mastery (e.g., "The demands of everyday life often get me down"), and Purpose in Life (e.g., "Some people wander aimlessly through life, but I am not one of them"). Participants respond to each item on a scale of 1 = *Strongly agree*, 2 = *Somewhat agree*, 3 = *A little agree*, 4 = *Neither agree nor disagree*, 5 = *A little disagree*, 6 = *Somewhat disagree*, 7 = *Strongly disagree*. The internal consistency of this measure reaches acceptable levels (computed based on the final sample for this study; Autonomy: $\alpha = .71$, Environmental Mastery: $\alpha = .78$, Personal Growth: $\alpha = .75$, Positive Relations with Others: $\alpha = .78$, Purpose in Life: $\alpha = .70$, and Self-Acceptance: $\alpha = .84$). Each subscale score was calculated by obtaining the sum of all the items. Items that reflect lower PWB (e.g., "I am not interested in activities that will expand my horizons") were reverse-coded, so that higher scores reflect greater PWB (see Appendix A for a copy of the measure).

Perceived discrimination. This variable was based off The Daily Discrimination Scale, which is a 9-item scale created for a study by Williams, Jackson, and Anderson (1997) for use in a study of racial discrimination in Detroit (see Appendix B for a copy of the measure). This scale has been used to assess perceived discrimination based on variables such as gender, race, age, height, and weight (Kessler, Mickelson, & Williams, 1999). In this study, all types of perceived discrimination (not just discrimination based on height/weight) were examined to maximize the sample size. Questions included items such as "You are treated with less courtesy than others" and "People act as if they think you are not smart." Coding was based on a scale of 1 = *Often*, 2

= *Sometimes*, 3 = *Rarely*, 4 = *Never*. The scale total can be derived from calculating the sum of reverse coded values of the items. The scale has good reliability- α = .97.

Biomarker outcomes. Blood biomarkers were assessed for a subset of participants for the MIDUS II Project 4 study (*N* = 1,255; Ryff et al., 2007). Five blood biomarkers frequently associated with obesity (i.e., triglycerides, total cholesterol/HDL ratio, hemoglobin A1c, c-reactive protein (CRP), and interleukin-6 (IL6) were chosen as biomarker outcomes variables (e.g., WHO, 2000). An aggregate biomarker measure was obtained by standardizing and then taking the average of the five variables mentioned above.

Disease outcomes. The most problematic/strongly associated comorbidities with overweight and obesity according to the World Health Association (2000) are diabetes, cardiovascular heart disease, stroke, dyslipidemia, and certain types of cancer. Therefore, these were chosen as the main disease outcome measures. First, an aggregate score of presence of any of the aforementioned disease outcomes from the MIDUS 3 database (Ryff et al., 2015; i.e., diabetes, stroke, heart trouble, and cancer) were tallied for each participant. Next, due to the limited sample size of those that endorsed more than 1 medical condition, this variable was further divided into two categories–presence (1 or more health conditions) or absence (0 diseases) of disease. Disease outcomes were assessed by self-report in the following manner. To assess diabetes, participants were asked “In the past twelve months, have you experienced or been treated for any of the following—diabetes or high blood sugar?” Heart trouble was identified by asking “Have you ever had heart trouble suspected or confirmed by a doctor?” Of note, heart attack, angina, high blood pressure, valve disease, hole in heart, blocked artery, irregular heartbeat, heart murmur, heart failure, and other all fell under this umbrella. Participants were queried regarding stroke history with the question, “Do you have any history of any of the following medical conditions—Stroke?" Cancer history was assessed by asking, "Have you ever had cancer?" Breast, cervical, colon, lung, lymphoma/leukemia, ovarian, prostate, skin, uterine, and other were included in this broad category. It is noteworthy that all illnesses were assessed for lifetime prevalence, except diabetes which was noted only for the last 12 months.

Adiposity. Adiposity was measured by standardizing and then averaging measures of BMI and waist circumference. Waist circumference was assessed with the following prompt, "The next questions are about body measurements. We have enclosed a tape measure to help you. The information will be more accurate if you follow these suggestions: Make measurements while standing. Avoid measuring over clothing (even thin clothing can add a ¼ inch). Try to record answers to the nearest quarter (¼) inch. What is your waist size–that is, how many inches around is your waist? Please measure at the level of your navel. They also assessed height ("How tall are you? Feet; How tall are you? INCHES") and weight (How much do you currently weigh? (POUNDS), from which BMI was calculated.

Perceived weight. To assess perception of weight, MIDUS study researchers asked participants, "Which of the following do you consider yourself?–Very overweight, somewhat overweight, about the right weight, somewhat underweight, very underweight".

Gender. Respondent gender was obtained through self-report and was coded as male or female.

Income. Household income was assessed by asking participants their total household income (including spouse's wages) from wages, pension, social security, and government assistance.

Age. During MIDUS II data collection, a stringent methodology was used to validate participant identity and age, including asking the participant for their birth date and confirming their previous address. Then, age was computed using a standard formula: Birth date was subtracted from phone interview dates to obtain respondent age at M1 and M2 age. The result was rounded down to a whole number. In other words, the new variables represent the participant's age as of his or her last birthday prior to the phone interview.

Race. Participants were asked, "What are your main racial origins–that is, what race or races are your parents, grandparents, and other ancestors?" FIRST RESPONSE–Options were White, Black and/or African American, Native American or Alaska Native Aleutian Islander/Eskimo, Asian, Native Hawaiian or Pacific Islander, Other (Specify), Don't know, Refused, or inappropriate.

Smoking behavior. This variable was obtained by self-report by asking participants, "Have you ever smoked cigarettes regularly?" Answers were coded as Yes, No, Don't Know, Refused, or Inappropriate.

Chapter IV: Results

Overview of the Analytical Procedure

As this is a fairly nascent area of research, a somewhat exploratory approach was taken. That is, adiposity was explored as a potential predictor of each facet of PWB and every facet of PWB was explored as a potential predictor of each health outcome (biomarker and disease). In addition, all facets were tested for their moderative effects on adiposity and health outcomes (biomarker and disease). Given the paucity of past research in the area of PWB and obesity-related health outcomes, there was not compelling evidence to exclude any PWB facet from exploration. First, descriptive statistics for all predictive and outcome variables were run and are presented in Table 2. Next, bivariate associations between key predictor variables identified from the literature and outcome measures were assessed and are presented in Table 3. Next, logistic (used to assess dichotomous outcome variables; Peng, Lee, & Ingersoll, 2002) or hierarchical regressions (to assess continuous dependent variables) were run to test study hypotheses. For the logistic regressions, the Hosmer-Lemeshow goodness of fit tests indicated that the models were a good fit ($p > .05$). The sample size was more than adequate for the regression analyses conducted [Urdan (2010) recommends at least N=30 plus 10 case per predictor variable]. For all relevant analyses, collinearity diagnostics indicated that associations among these measures were not sufficiently great to compromise the models. Part correlations and odds ratios (Tajeu, Sen, Allison, & Menachemi, 2012) were used to quantify the magnitude of various effects of interest, where appriopriate. In accord with previous research on this topic with comparable sample sizes (e.g., Friedman & Ryff, 2012), the threshold for statistically significant associations was set to $\alpha = .05$. A tabulation of all results by hypothesis can be found in Appendix C.

Descriptive and Correlational Data

Means, standard deviations, range, skew, kurtosis, and percent were calculated for variables of interest and are reported in Table 2. For all variables except BMI, income, daily discrimination, depressed affect, and blood biomarker outcomes, skewness and kurtosis values are consistent with a normal distribution. Transformations of the data were not performed because research indicates that large samples (e.g., where the number of observations per variable is >10) are fairly robust to violations of normality (Schmidt & Finan, 2018). In addition, this paper notes that these transformations may bias model estimates. Table 3 delineates the associations between independent and dependent variables.

Table 2

Descriptive Statistics for Continuous Variables

Hypothesis 1 (*N* = 657); Hypotheses 2 & 3 (*N* = 653); Hypotheses 4 & 5 (*N* = 406)

	Mean	*SD*	Range	Skew	Kurtosis
Environmental Mastery	38.74	7.52	11–49	-.737	.215
Autonomy	37.36	6.70	14–49	-.326	-.403
Personal Growth	39.65	6.59	14–49	-.790	.514
Positive Relations	41.05	6.83	14–49	-.881	.184
Purpose in Life	39.59	6.51	10–49	-.761	.317
Self-Acceptance	38.74	8.19	7–49	-.963	.641
Adiposity	-.091	.93	-1.99–4.03	.832	1.30
BMI	28.01	5.53	18.64–58	1.216	2.54
Waist Circumference	37.29	5.80	18–60	.418	.616
Age	55.20	11.78	34–83	.303	-.681
Household Income	7704	60675	0–3000000	1.58	.932
Daily Discrimination	12.76	4.37	9–30	1.19	.935
Depressed Affect	.56	1.68	0–7	2.87	6.68
Blood Biomarker Aggregate	.001	.58	-.96–4.78	1.78	6.26
Triglycerides	132.53	99.6	25–2073	8.46	144.22
HA1c	5.98	.59	3.8–13.40	3.50	17.73
Tot Choles/HDL ratio	3.75	1.42	1.34–12.0	1.44	3.61
CRP	2.66	3.90	.14–32.60	4.17	22.81
IL6	2.74	2.62	.16–21.82	3.53	16.69

**Note.* Statistics presented are based on the largest available sample size.

Table 3

Descriptive Statistics for Categorical Variables

	Percent	*n*
Gender		
Male	47	2316
Female	53	2647
Race		
White	94	932
*Other	6	58
Marital Status		
Married	71	3505
*Other	29	1452
Smoke Cigarette Ever		
Yes	65	2419
No	35	1274
Weight Perception		
Very over	14	562
*Other	86	3390
M2 Binary Disease		
0 diseases	65	2635
1 or more	35	1406
M3 Binary Disease		
0 diseases	56	1858
1 or more	43	1436

**Note*. Other race = Black and/or African American, Native American or Aleutian Islander, Asian or Pacific Islander, Other, or Multiracial; Other marital status = separated, divorced, widowed, never married; Other Weight Perception = Somewhat overweight, About the right weight, somewhat underweight, very underweight.

Table 4

Correlations between Key Study Variables (*N* = 885-3294)

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. EM	1	---	---	---	---	---	---	---	---
2. Aut	.50**	1	---	---	---	---	---	---	---
3. PG	.57**	.43**	1	---	---	---	---	---	---
4. PR	.62**	.37**	.57**	1	---	---	---	---	---
5. PL	.63**	.38**	.66**	.58**	1	---	---	---	---

Table 4 (continued)

6. SA	.77**	.49**	.63**	.66**	.68**	1	---	---	---
7. Adipos	-.05	.07*	-.13**	-.08*	-.08*	-.09**	1	---	---
8. Bio-Markers	-.10**	.04	-.09**	-.02	-.10**	-.11**	.46**	1	---
9. M3 Tot Disease	.03	.10**	-.01	.03	-.03	-.01	.16**	.21**	1

**p* < .05 (2-tailed); ***p* < .01 (2-tailed)
**Note*. EM = Environmental Mastery; Aut = Autonomy; PG = Personal Growth; PR = Positive Relations with Others; PL = Purpose in Life; SA = Self-Acceptance

Hypothesis 1: Higher Body Weight and Psychological Well-Being

Six hierarchical, linear, multiple regression analyses were conducted with 657 adults between the ages of 34 and 83 to determine how well adiposity (i.e., a standardized measure of waist circumference and BMI) predicted six separate facets of Psychological Well Being (i.e., Environmental Mastery, Autonomy, Personal Growth, Positive Relations with Others, Purpose in Life, and Self-Acceptance). After adiposity was entered into the model in step 1; age, race (white or other), income, marital status (married or not), depressed affect, gender (male or female), perceived discrimination, and weight perception (perceived very over or other) were entered into step 2 of the model as control variables. In model 1 (without the inclusion of control variables), adiposity significantly predicted four of the six facets of PWB–Autonomy (B = .657, $t = 2.37$, $p = .018$, $sr^2 = .0085$), Personal Growth (B = -.884, $t = -3.18$, $p = .002$, $sr^2 = .015$), Positive Relations with Others (B = -.610, $t = -2.098$, $p = .036$, $sr^2 = .0067$), and Self-Acceptance (B = -.845, $t = -2.44$, $p = .015$, $sr^2 = .009$). Adiposity was a positive predictor of Autonomy and a negative predictor of the other significant facets. Environmental Mastery and Purpose in Life were the only facets for which adiposity was not a significant predictor. However, in the second step, when relevant demographic and psychological control variables were added to the model, adiposity was no longer a significant predictor of any of the facets of PWB.

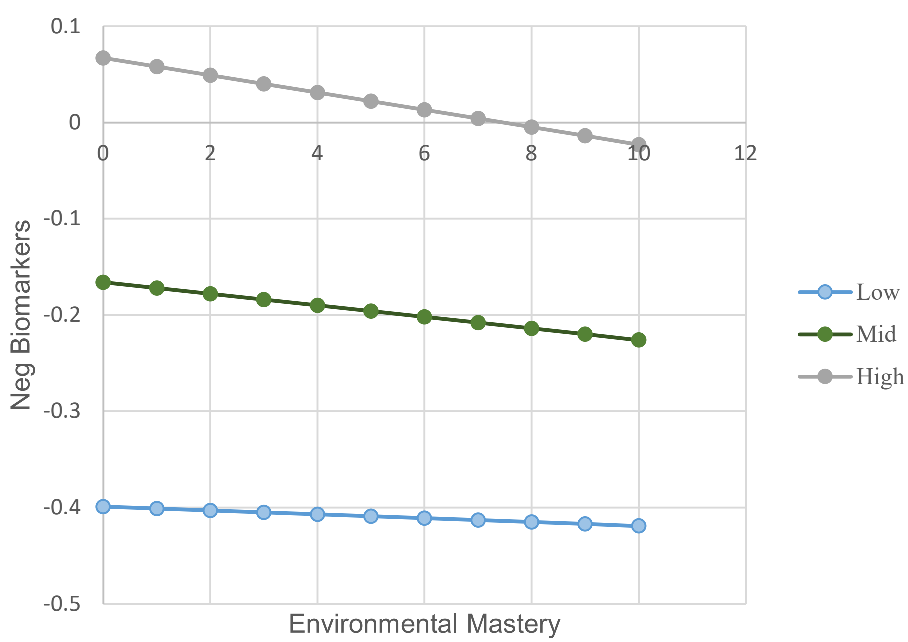
Hypotheses 2 & 3: Facets of Psychological Well-Being and Blood Biomarkers

Prediction. The second hypothesis evaluated the predictive qualities of Psychological Well-Being facets on an aggregated blood biomarker outcome measure. First, levels of C-reactive protein, interleukin-6, triglycerides, hemoglobin A1c, and total cholesterol/HDL ratio were standardized and averaged to create a single aggregate blood biomarker variable. A hierarchical regression was run with 653 individuals. PWB facets were the predictor variables and an aggregate measure of blood biomarkers associated with adiposity was the dependent variable. In model 1 (without the addition of covariates), both Autonomy (B = .014, $t = 3.60$, $p < .01$, $sr^2 = .019$) and Positive Relations with Others (B = .011, $t = 2.45$, $p = .015$, $sr^2 = .0088$) were significant, positive predictors of negative blood biomarkers. In model 2, the addition of significantly correlated covariates did not nullify this finding for Positive Relations with Others (B = .013, $t = 3.05$, $p = .002$, $sr^2 = .011$). However, it did eliminate the significant predictive relationship between Autonomy and negative blood biomarkers. Additionally, a negative, significant relationship emerged between Environmental Mastery and the blood outcome measure (B = -.013, $t = -2.659$, $p = .008$, $sr^2 = .0084$).

Moderation. To test the third hypothesis (PWB facets will moderate the relationship between adiposity and blood biomarker outcomes), interactions were created between adiposity and each facet of PWB, resulting in a total of six interaction terms. Next, key predictor (i.e., adiposity, PWB facets, and interaction terms) and outcome continuous variables (i.e., an aggregate measure of blood biomarkers) were centered by subtracting the mean of each variable from each individual case in order to reduce multicollinearity. Hierarchical regression was again used to test moderation effects of PWB facets between adiposity and negative blood biomarkers. In the first step, centered variables for the facets of PWB, adiposity, and interaction terms between PWB and adiposity were entered into the model with a centered measure of negative blood biomarkers as the dependent variable. The interaction between Environmental Mastery and adiposity was significant (B = -.012, t = -2.217, p = .027, sr2= .0059). The interaction was then probed to determine effects of PWB on blood biomarkers at high, mid, and low levels of adiposity. The relationship between PWB and blood biomarkers was not significant at low levels of adiposity. However, at both mid and high levels, there was a very modest, significant, negative relationship (B = -.006, t = -2.16, p = .031, sr2 = .0041; B = -.009, t = -2.65, p = .008, sr2 = .0061, respectively). However, this effect was no longer upheld in the full model once covariates were entered in the next step. No other interactions were significant in either model.

Figure.

Interaction of Adiposity by Environmental Mastery on Negative Biomarkers



Hypotheses 4 & 5: Facets of Psychological Well-Being and Longitudinal Health Outcomes

The fourth hypothesis examined the long-term predictive capabilities of facets of PWB on health outcomes. A measure of health outcomes [i.e., an affirmative response to ever being diagnosed with diabetes (within the last 12 months), cancer, heart trouble, or stroke] was added into an aggregate measure of disease burden (scores ranged from 0-4). This was further classified into a dichotomous variable (the presence of 0 or 1 or more health conditions). The models were set up as above with a few notable exceptions. Namely, binary, logistic regression analyses were used instead of hierarchical linear regression models. The same covariates were entered in the same hierarchical fashion as above (i.e., age, race, income, marital status, depressed affect, gender, perceived discrimination, weight perception, and the year data was collected). Binary disease variables from Time 2 (7-10 years after Time 1) were used as outcome measures. For the analyses of longitudinal outcomes, subjects with presence of one or more disease outcomes at Time 1 were eliminated.

Prediction. A binomial, hierarchical logistic regression model ($N = 406$) was conducted to determine the distal effects of PWB facets on a dichotomous measure of health outcomes (i.e., diabetes, stroke, heart trouble, or cancer) 7-10 years later. For the outcome measure, people were categorized as either having no disease or one or more diseases at Time 2 (people that endorsed presence of any disease at Time 1 were excluded from analysis). In the first step of the model with only PWB facets entered as predictors of long-term health outcomes, Environmental Mastery (B = .068, $p = .013$, Odds ratio = 1.07) and Autonomy (B = .060, $p = .004$, Odds ratio = 1.06) were both positively and significantly associated with long-term health outcomes. In the full model with added control variables, Autonomy remained a positive, significant predictor (B=

.058, p = .009, Odds ratio = 1.06). However, Environmental Mastery was no longer a significant predictor.

Moderation. Another binomial, hierarchical logistic regression was run to determine moderation effects of PWB facets between adiposity and long-term disease outcomes (those that endorsed any of the aforementioned diseases at Time 1 were once again excluded from the analysis). Centered values for adiposity, facets of PWB, and each interaction term (e.g., adiposity x Environmental Mastery) were entered into model 1 and covariates (same as above) were entered into model 2. There were no significant interactions between PWB and adiposity in relation to long-term health outcomes in either model (with or without covariates).

Chapter V: Discussion

The main goal of the current study was to provide a bridge between biomedical and psychosocial models of obesity by examining psychological and health outcome measures that are relevant to both perspectives. In contrast to previous literature, it was found that adiposity was not a significant predictor of any facet of PWB once covariates (such as perceived discrimination) were included in the model. Rather, daily discrimination and depressed affect were much stronger and more consistent predictors of the PWB facets. With regard to biomarker outcomes, in the full model, Positive Relations with Others was a predictor of worse biomarker outcomes, while Environmental Mastery was a predictor of more favorable outcomes. Finally, this study provided modest, preliminary support that Autonomy was a positive predictor of future disease outcomes after controlling for covariates. Taken together, these results add to and in many ways contradict previous research on this topic.

Higher Body Weight and Psychological Well-Being

In the first step of the model (in which adiposity was entered as the sole predictor), adiposity was a significant positive predictor of Autonomy and a negative predictor of Personal Growth, Positive Relations with Others, and Self-Acceptance. Adiposity was not a significant predictor of Environmental Mastery or Purpose in Life. Without the addition of covariates, these results point to adiposity having a negative impact on one's psychological well-being, which appears to be congruent with the limited prior quantitative and theoretical literature in this area. Prior literature on this topic found that adiposity was a negative predictor of all PWB facets except Self-Acceptance (Margallares et al., 2014). The current study found similar results in the first model without covariates. Another study found that adiposity consistently predicted lower PWB in women, but only in the highest BMI categories for men (Bookwala & Bowyer, 2008).

From a theoretical standpoint, it is unsurprising that adiposity is a positive predictor of Autonomy. Autonomy is defined as the strength to follow one's personal convictions, even if they go against the grain (Ryff, Singer, & Love, 2004). Prior studies have indicated that HBW people exhibited significant implicit and explicit anti-fat bias (Wang, Brownell, & Wadden, 2004), which potentially means that HBW individuals do not enjoy the usual protective barrier that ingroup preference confers, unlike most other groups that experience stigma (Crocker & Major, 1989). Therefore, it is possible that HBW persons develop self-reliance that is borne out of this predicament.

However, in the full model, the results changed significantly once relevant demographic and psychological variables were entered as control variables. That is, adiposity was no longer a significant predictor of any facet of PWB. Even before covariates were added, effect sizes were very small (accounting for .55%-1.6% of the total variance). Of note, the psychosocial control variables (i.e., depressed affect and perceived discrimination) were much more consistently predictive of all PWB facets, and these variables accounted for .60 – 4.2% of the variance. The results imply that the relationship between adiposity and PWB found in model 1 of this study as well as other literature is better explained by other psychosocial factors (especially perceived discrimination). Generally speaking, there is more research available on the relationship between negative affect and HBW (e.g. Carr, Friedman, & Jaffe, 2007; Dong, Sanchez, & Price, 2007), which is why this less represented work on the relationship between HBW and positive psychological traits is needed to fill an important gap in the literature.

Psychological Well-Being and Blood Biomarkers

Prediction. Based on a literature review, it was hypothesized that PWB facets would predict a healthier profile of blood biomarkers (i.e., lower levels). Instead, mixed results were found. In the initial model (with only PWB facets), Autonomy and Positive Relations with Others were both predictive of higher levels of blood biomarkers. In the full model with covariates added, Positive Relations with Others still predicted higher levels, while Environmental Mastery emerged as a predictor of healthier levels of blood biomarkers. When interpreting these results, it is important to keep in mind the small effects of these findings and not over-interpret these results (i.e., significant predictors only accounted for .88-1.9% of the outcome variance). Although all facets of the PWB scale are considered to be under the umbrella of eudaimonic well-being, some of the facets have more overlap with hedonic well-being than others (Ryff, Singer, & Love, 2004). The work by Fredrickson and colleagues (2013) found that those with higher levels of hedonic well-being had an up-regulation of a stress-related conserved transcriptional response to adversity. Thus, this finding potentially suggests that Positive Relations with Others may be more toward the hedonic end of the spectrum compared with the other facets with regard to its effect on biomarker outcomes. In addition, scoring highly on the Positive Relations with Others subscales implies that one is concerned about the welfare of others and is capable of strong empathy (Fava, 1999). Thus, it is plausible that at hyper levels of this trait one might put others' needs ahead of their own to the detriment of their own health. An article by Ruini and Fava (2012) provides preliminary support for this by suggesting that individuals who have exaggerated levels on the Positive Relations with Others can sacrifice their own needs and well-being for those of others, which in the long term can become detrimental. Finally, this finding may also tie in with the work of Christakis and Fowler (2007), which found that people were more likely to become obese if certain people in their social network also became obese. Perhaps this illuminates that Positive Relations with Others in and of itself does not lead to poorer biomarker outcomes, but rather that one's social context (the lifestyle behaviors of one's social network) is more indicative of outcomes. Further study on the mechanism of these findings would be interesting and worthwhile research.

Environmental Mastery can be conceptualized as one's ability to meet goals and overcome obstacles. Therefore, these results indicate that being able to effectively meet one's needs may also translate more specifically to the domain of health. This finding supports theoretical underpinnings of PWB and HBW [e.g., research findings that suggest mastery moderated the relationship between unhealthy food options and metabolic outcomes (Paquet, Dubé, Gauvin, Kestens, & Daniel, 2010)]. This outcome provides further support that the ability to navigate one's environment leads individuals to be more equipped to engage in healthy behaviors, such as eating healthy foods and exercising, which in turn helps to slightly improve biomarker outcomes.

Moderation. Initially, a small, but significant, moderating effect of Environmental Mastery was found between adiposity and biomarker outcomes. When this interaction was further probed, it was discovered that Environmental Mastery was not significant for low levels of adiposity; however, there was a slight negative relationship between EM and blood biomarkers in mid and high levels of adiposity that accounted for .44% and .61% of the outcome variance, respectively. This would suggest that if a person has mid or high levels of adiposity (i.e., more than 1 standard deviation above the mean), Environmental Mastery can act as a very modest protective factor against poor biomarker outcomes. However, in the full model after covariates were entered, no moderation effects between adiposity and any facet of PWB was found to be statistically significant, indicating that the effect found above is better explained by these other variables.

Facets of Psychological Well-Being and Longitudinal Health Outcomes

Prediction. The effects found for the longitudinal effects of PWB facets on health outcomes 7-10 years later are perhaps the most interesting. In the initial model, both Autonomy and Environmental Mastery at Time 1 were significantly and positively associated with the development of consequential disease outcomes (i.e., cancer, diabetes, stroke, and/or heart trouble) at Time 2 approximately one decade later. One commonality between Autonomy (i.e., the strength to stand up for one's personal convictions) and Environmental Mastery (being able to navigate the demands of everyday life) is, potentially, a desire for control. At excessive degrees, a strong desire for control can contribute to poor mental health, especially anxiety (e.g., Rapee, Craske, Brown, & Barlow, 1996). Anxiety was not controlled for in this study and may potentially mediate the observed relationships between Autonomy, Environmental Mastery, and negative future health outcomes, especially because of the link between anxiety and poorer health outcomes (Eisner et al., 2010; Matcham, Norton, Scott, Steer, & Hotopf, 2015).

In the full model with covariates, only Autonomy remained a positive, significant predictor. The fact that Environmental Mastery was no longer a significant predictor in the full model suggests that the covariates better accounted for this relationship. None of the other facets of PWB were statistically significant. As Ryff (1989b) described it, the ultimate goal is to achieve balance in each domain as being too extreme in either direction can impair functioning. Other studies have also found that extremely high levels of positive emotions can become harmful and are more related to mental health disorders and impaired functioning (Fredrickson & Losada, 2005). For example, one could be so consumed with being goal-oriented that they do not devote enough time to developing human connection or a person could be so focused on concerns outside themselves that they do not realize or develop their personal talents or capacities (Ryff & Singer, 2008). Wood and Tarrier (2010) articulate that characteristics that are typically regarded as positive (such as gratitude and autonomy) exist on a continuum–they are neither 'negative' nor 'positive.' Instead, their impact depends on the specific situation and the larger situational context. As a result, balance appears to inform not only the theory of PWB but also the empirical reality.

Therefore, having hyper levels of Autonomy could limit one's ability to work well in a team or reduce the likelihood that a person will adhere to medical recommendations. Because health care models are increasingly reliant on team approaches to patient care, someone with high levels of this trait may not fare as well in this team approach to healthcare. In addition, if one is less prone to ask for help, it may reduce the frequency that a person seeks medical care in general or follows recommendations if care is sought out. Reporting the magnitude of these findings is somewhat difficult in this case because research indicates when the outcome measure is relatively common (i.e., > 10%), authors should only report the direction of the relationship and statistical significance of the findings to avoid misinterpretation of the results (Holcomb, Chaiworapongsa, Luke, & Burgdorf, 2001; Katz, 2006; Tajeu, Sen, Allison, & Menachemi, 2012). In this study, nearly 30% of the sample developed one of the four diseases (i.e., cancer, heart trouble, stroke or diabetes) over the 10-year follow-up period. Therefore, risk ratios will not be presented so as to not misrepresent the significance of these results. However, it can be stated that these facets of PWB were stronger predictors of long-term health outcomes than even adiposity and cigarette smoking. This is especially relevant when put into the context of the original aim of the study to bridge the divide between biomedical and psychosocial approaches to HBW patients. It also insinuates that a more integrative approach to health care that takes into account not only biological factors, but also psychosocial variables (such as PWB), is warranted.

Moderation. Based on this research, no moderating effects of PWB on adiposity were found for long-term negative health outcomes in either the initial or full model. This suggests that, in this sample, PWB does not act as a buffer between adiposity and distal negative health consequences. This research question was one of the most exploratory as no prior research had been conducted in this area. This is not to say that further research should not be explored with different populations, but it may be beneficial to make slight modifications, such as having a shorter span between time points, in order to more precisely study this phenomenon.

Summary

The following findings, after the inclusion of relevant covariates [i.e., perceived discrimination, gender, age, race, income, depressed affect, marital status, weight perception, and year data was collected (for the timepoints after baseline)] were discovered as a result of this research. First, adiposity was not a significant predictor of any facet of PWB. Rather, perceived discrimination and depressed affect were more consistent predictors of these traits. In cross-sectional biomarker profiles, Environmental Mastery was associated with healthier profiles, while Positive Relations with Others was associated with higher levels of biomarkers indicative of poorer health. The interaction between Environmental Mastery and adiposity was also a significant predictor of blood biomarkers, but not after including relevant covariates. When examining longitudinal health outcomes, Autonomy was a significant predictor of worse future health outcomes.

In general, effect sizes in this line of research (i.e., PWB and health outcomes) tend to be modest (e.g, $sr^2 \sim .9 – 1.5$; e.g., Friedman & Ryff, 2012), and this research is no exception. These small effect sizes are likely a reflection that short- and long-term health outcomes are caused by a myriad of factors, any one of which is likely to have a relatively small effect. By the same token, given the small effect sizes, it is important not to overstate the significance of any result. In conclusion, taken together these results favor an integrative approach to health outcomes that takes into consideration both biological and psychosocial processes. If any single domain is unlikely to have a large effect on health outcomes, then it follows that a multimodal approach is warranted to yield maximal results.

Clinical Implications

In general, it appears that facets of PWB that lead to an increased drive or ability to change one's behavior (i.e., Environmental Mastery) were predictive of more favorable blood biomarker outcomes in cross sectional analyses. On the other hand, variables that were more closely related to hedonic well-being (i.e., Positive Relations with Others) or facets that may decrease the likelihood of a person changing their behaviors or conforming to societal standards (i.e., Autonomy) seem to lead to more negative health profiles in both cross-sectional and longitudinal models. It is possible that the drive/ability to change one's behavior extends to the realm of adaptive health behaviors, such as eating healthy and exercising, which could explain these results. As noted, it is prudent to not overstate the importance of any of these implications due to relatively small effect sizes and the nascency of this line of research. Therefore, it is necessary to replicate these results in multiple settings and with multiple samples before drawing conclusions that can be confidently applied in a clinical setting. With these limitations in mind, some clinical implications of the treatment of obesity in medical settings are offered below.

First, as a treatment provider, it appears to be important to examine one's beliefs, attitudes, and personal biases against patients with higher body weight. This entails not assuming that persons of HBW have lower levels of PWB. It would not be recommended to apply a blanket intervention to increase PWB in persons with HBW. However, it may be warranted to employ interventions to increase certain facets of PWB (e.g., Environmental Mastery) in persons with hypo-levels of relevant facets. It is also important to consider that balance in any domain is key (as opposed to higher scores being 'better') and that ideal levels of PWB depend on the context. Specifically, as mental health providers, focusing on alleviating depressed affect can yield positive results as it may allow the patient to have higher levels of PWB and be better able to engage in healthy behaviors.

Second, it seems that PWB facets that enable and encourage one to achieve change (i.e., Environmental Mastery) can have a positive effect on short-term biomarker profiles. Therefore, it may be worthwhile to focus on teaching patients how to achieve their goals and emphasizing the importance of adopting healthy behaviors framed in the context of a patient's own goals. In other words, health goals that do not resonate with a patient or the suggestion of medical recommendations that appear to be out of a person's reach will likely be ineffective. Despite the finding that high levels of Positive Relations with Others and Autonomy may lead to negative health outcomes, it is premature to infer that one would prefer to have lower levels of these traits in order to improve health. Rather, it is likely that balanced (rather than hyper) levels of these traits are preferable when examining biomarker levels and long-term acquisition of certain diseases related to obesity. As previously mentioned, balance appears to be the ideal with regard to psychological well-being levels (Ryff & Singer, 2008). In their article, Garamoni et al. (1991) suggest that psychopathology is marked by deviations from optimal balance of positive and negative emotions. They also emphasize that interventions that target increasing positive emotions should take into account the interaction of a number of issues and focus on more than just simply increasing psychological well-being.

Finally, in accord with a plethora of prior research on the benefits of a multidisciplinary approach in health care settings (e.g., Montesi et al., 2016), this work underscores this widely-accepted paradigm. It stands to reason that if any one factor only contributes modestly to overall health outcomes, a focus on multiple areas of a person's life (e.g., biological, psychosocial, spiritual) would be important to effect positive change in this area. Data that increasingly point to understanding both disease and wellness from multiple viewpoints provides an objective incentive for proponents of both biomedical and psychosocial perspectives to meet in the middle and see things from the other's point-of-view.

Limitations

There are several limitations of the current study that are worth noting. First, the correlational nature of this study (i.e., the absence of an experimental manipulation or control group) makes it impossible to determine causation among these variables. Consequently, alternative explanations of the observed effects should be considered. Specifically, it is possible that the changes observed for primary outcome variables are associated with factors other than the independent variables.

A second limitation is the self-selection bias of this sample, which almost all research encounters due to its voluntary nature. Although this was a nationally representative sample, the participants that self-selected to engage in this time-intensive study for limited monetary benefit may differ in important ways from those that chose not to participate. This sample was predominately white, was older, had higher education levels, and was more affluent than the national average. As a result, these results may not be generalizable to different groups. Findings of this study should be explored in more racially diverse and less educated groups.

Finally, there are some limitations with the variables included / not included in the study. As with most large secondary databases, what was gained in breadth of study is often lost in depth. This was the case with the specificity of the health outcome variables. For example, the variable that assessed heart trouble did not differentiate between ischemic versus non-ischemic or congenital versus acquired heart disease, which have different pathophysiology. These differences could produce variations on the effect of PWB on these outcomes. In addition, in order to increase sample size, all forms of perceived discrimination (e.g., based on height/weight, race, gender, or sexual orientation) instead of limiting only to perceived discrimination based on height and weight. There could be differences between perceived reasons for discrimination that could affect the results. Also, verification of disease outcome could not be obtained by medical record. However, self-ratings of disease outcomes have shown substantial agreement with medical record reports (Bergmann et al., 1998; Lampe et al., 1999; Psaty et al., 1995). Additionally, there have been studies (e.g., Kafka & Komza, 2002) that suggest that Ryff's PWB scale (Ryff, 1989a) does not produce a six-factor solution nor do the separate factors load on a single, higher order factor. However, these studies were based on 20-item subscales, as opposed to the seven item subscales used in this paper. An article by Dierendonck (2003) also brought into question the factorial validity of the PWB scale that used 14-item subscales, but found that the 3-item version adequately loaded onto six factors (but with compromised internal consistency). The author's proposed solution was to use a seven item per subscale model (like the scale used in this current study). Finally, this study did not control for medication use, anxiety, diet, or physical activity, which should be a focus of future research.

Strengths

Despite the limitations described above, this study had many strengths. First, the study's large sample size resulted in sufficiently powered statistical tests and likely lessened the impact of more extreme observations. Also, although the sample was not representative in some respects, the sample was collected through random-digit dialing, included participants from across the country, and had an approximately equal representation of women and men and adiposity appeared to be comparable to national prevalence rates. Second, effect size estimates were reported (and not reported when appropriate) to enhance interpretability regarding practical significance. Finally, the use of a well-resourced secondary dataset allowed for the rare opportunity to analyze data with longitudinal outcomes that span up to 10 years. While the non-experimental design of the study does not allow causal relationships to be inferred, the prospective nature of the fourth and fifth hypotheses provide certainty that the independent variables (facets of PWB) preceded the health outcomes. Overall, the current study provides a more comprehensive understanding of health implications for a HBW population in which mainstream treatment interventions (i.e., weight loss paradigms) are largely ineffective and in some cases iatrogenic.

Future Directions

As a result of the current study, several areas for future research have been identified. First, implementing a quasi-experimental design (i.e., including an intervention that manipulated levels of PWB and including a control group) would help to better determine causality of these observed relationships. Second, exploring potential mediating variables (e.g., healthy diet and exercise as well as anxiety) through which the effects of PWB on health outcomes work would help to elucidate the mechanics of these observed relationships and help better inform future interventions. For example, if it is thought that increasing Environmental Mastery would be beneficial to health outcomes, research that examines potential mediators could help determine what aspects of these facets are most likely to beget the desired outcomes. Next, it would be useful to examine quadratic (as opposed to only linear) relationships between PWB and health outcomes to test the theory that balanced levels of PWB facets are most desirable (Ryff, 1989b). Finally, past research by Ryff, Singer, and Love (2004) and Bookwala and Boyer (2008) found important moderating effects of age and gender. It would be useful to study the moderating effects of age and gender on PWB and health outcomes to further refine our understanding of these phenomena and determine if examining a heterogenous population potentially nullified significant results.

Conclusion

The findings of the current study provide further support for the inclusion of PWB when considering short- and long-term health outcomes in a HBW population. These results suggest that adiposity is not a significant predictor of any facet of PWB once other variables have been controlled. Therefore, it may be inappropriate to assume that a person with HBW has lower levels of PWB, as prior research might suggest. Rather, lower levels of PWB may be caused by other modifiable factors, such as perceived discrimination. Additionally, PWB facets that promote change (and possibly a change in lifestyle to adopt healthy behaviors) are especially likely to be associated with healthier blood biomarker profiles (e.g., Environmental Mastery). Facets that seem to discourage change were negative predictors of health (i.e., Autonomy). Although these effects were small, they were equivalent to or in some cases stronger predictors than variables that have traditionally been associated with negative health (e.g., cigarette smoking, age, and adiposity). These findings illustrate the potential positive impact of taking a biopsychosocial approach to obesity and health outcomes and bring the field one step closer to integrating the viewpoints of proponents of biomedical and psychosocial models.

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APPENDICES

Appendix A

Psychological Well-Being Scale

*For the **PAST TWO WEEKS**, please indicate your degree of agreement (using a score ranging from 1-6) to the following sentences.*

	Strongly Disagree					**Strongly Agree**
1. I was not afraid to voice my opinions, even when they were in opposition to the opinions of most people.	1	2	3	4	5	6
2. In general, I felt I was in charge of the situation in which I lived.	1	2	3	4	5	6
3. I was not interested in activities that would expand my horizons.	1	2	3	4	5	6
4. Most people saw me as loving and affectionate.	1	2	3	4	5	6
5. I lived life one day at a time and didn't really think about the future.	1	2	3	4	5	6
6. When I looked at the story of my life, I was pleased with how things have turned out.	1	2	3	4	5	6
7. My decisions were not usually influenced by what everyone else was doing.	1	2	3	4	5	6
8. The demands of everyday life often got me down.	1	2	3	4	5	6
9. I thought it was important to have new experiences that challenge how you think about yourself and the world.	1	2	3	4	5	6
10. Maintaining close relationships was been difficult and frustrating for me.	1	2	3	4	5	6
11. I had a sense of direction and purpose in life.	1	2	3	4	5	6
12. In general, I felt confident and positive about myself.	1	2	3	4	5	6
13. I tended to worry about what other people thought of me.	1	2	3	4	5	6
14. I did not fit very well with the people and the community around me.	1	2	3	4	5	6
15. When I thought about it, I haven't really improved much as a person over the years.	1	2	3	4	5	6
16. I often felt lonely because I have few close friends with whom to share my concerns.	1	2	3	4	5	6
17. My daily activities often seemed trivial and unimportant to me.	1	2	3	4	5	6
18. I felt like many of the people I know have gotten more out of life than I have.	1	2	3	4	5	6

19. I tended to be influenced by people with strong opinions.	1	2	3	4	5	6
20. I am quite good at managing the many responsibilities of my daily life.	1	2	3	4	5	6
21. I had the sense that I have developed a lot as a person over time.	1	2	3	4	5	6
22. I enjoyed personal and mutual conversations with family members or friends.	1	2	3	4	5	6
23. I didn't have a good sense of what it is I'm trying to accomplish in life.	1	2	3	4	5	6
24. I liked most aspects of my personality.	1	2	3	4	5	6
25. I had confidence in my opinions, even if they were contrary to the general consensus.	1	2	3	4	5	6
26. I often felt overwhelmed by my responsibilities.	1	2	3	4	5	6
27. I did not enjoy being in new situations that required me to change my old familiar ways of doing things.	1	2	3	4	5	6
28. People would describe me as a giving person, willing to share my time with others.	1	2	3	4	5	6
29. I enjoyed making plans for the future and working to make them a reality.	1	2	3	4	5	6
30. In many ways, I felt disappointed about my achievements in life.	1	2	3	4	5	6
31. It was difficult for me to voice my own opinions on controversial matters.	1	2	3	4	5	6
32. I have difficulty arranging my life in a way that is satisfying to me.	1	2	3	4	5	6
33. For me, life has been a continuous process of learning, changing, and growth.	1	2	3	4	5	6
34. I have not experienced many warm and trusting relationships with others.	1	2	3	4	5	6
35. Some people wander aimlessly through life, but I am not one of them.	1	2	3	4	5	6
36. My attitude about myself is probably not as positive as most people feel about themselves.	1	2	3	4	5	6
37. I judge myself by what I think is important, not by the values of what others think is important.	1	2	3	4	5	6
38. I have been able to build a home and a lifestyle for myself that is much to my liking.	1	2	3	4	5	6
39. I gave up trying to make big improvements or changes in my life a long time ago.	1	2	3	4	5	6
40. I knew that I could trust my friends, and they knew they could trust me.	1	2	3	4	5	6

41. I sometimes felt as if I've done all there is to do in life.	1	2	3	4	5	6
42. When I compared myself to friends and acquaintances, it made me feel good about who I am.	1	2	3	4	5	6

Appendix B

Daily Discrimination Scale

In your day-to-day life, how often do any of the following things happen to you?

	Often	Sometimes	Rarely	Never
A. You are treated with less courtesy than other people	1	2	3	4
B. You are treated with less respect than other people	1	2	3	4
C. You receive poorer service than other people at restaurants or stores	1	2	3	4
D. People act as if they think you are not smart	1	2	3	4
E. People act as if they are afraid of you	1	2	3	4
F. People act as if they think you are dishonest	1	2	3	4
G. People act as if they think you are not as good as they are.	1	2	3	4
H. You are called names or insulted	1	2	3	4
I. You are threatened or harassed	1	2	3	4

Appendix C

Tabulation of Results by Hypothesis

Hypothesis 1

Effects of adiposity on PWB facets

Model 1	*B*	*t*	*p*	sr^2
Environmental Mastery	-.24	-.76	.45	.001
Autonomy	.66	2.37	.02	.008
Personal Growth	-.88	-3.18	.00	.015
Positive Relations with Others	-.61	-2.10	.04	.007
Purpose in Life	-.45	-1.58	.12	.004
Self-Acceptance	-.85	-2.44	.02	.009
Model 2	*B*	*t*	*p*	sr^2
Environmental Mastery	.41	1.12	.26	.002
Autonomy	.44	1.29	.20	.002
Personal Growth	-.31	-.90	.37	.001
Positive Relations with Others	.19	.55	.58	.000
Purpose in Life	.12	.35	.73	.000
Self-Acceptance	.09	.21	.83	.000

Predictor Variable: Adiposity

Hypothesis 2

Facets of PWB as Predictors of Negative Blood Biomarkers

Model 1	*B*	*t*	*p*	sr^2
Environmental Mastery	-.01	-1.77	.08	.005
Autonomy	.01	3.60	.00	.019
Personal Growth	-.01	-1.28	.20	.002
Positive Relations with Others	.01	2.45	.02	.009
Purpose in Life	-.00	-.46	.65	.000
Self-Acceptance	-.01	-1.75	.08	.005
Model 2	*B*	*t*	*p*	sr^2
Environmental Mastery	-.01	-2.66	.01	.008
Autonomy	.01	1.56	.12	.003
Personal Growth	.00	.31	.78	.000
Positive Relations with Others	.01	3.05	.00	.011
Purpose in Life	.00	-.61	.54	.000
Self-Acceptance	.00	-.87	.39	.001

Dependent Variable: Blood Biomarker Outcomes

Hypothesis 3

Moderation of PWB Facets by Adiposity on Negative Blood Biomarkers

Model 1	*B*	*t*	*p*	sr^2
EM x Adipos	-.01	-2.22	.03	.006
AUT x Adipos	.00	1.09	.28	.001
PG x Adipos	.01	1.66	.10	.003
PR x Adipos	.01	1.68	.09	.003
PL x Adipos	.00	.38	.70	.000
SA x Adipos	-.01	-1.53	.13	.003
Model 2	*B*	*t*	*p*	sr^2
EM x Adipos	-.01	-1.95	.05	.004
AUT x Adipos	.00	1.07	.29	.001
PG x Adipos	.01	1.51	.13	.003
PR x Adipos	.01	1.31	.19	.020
PL x Adipos	.00	.28	.78	.000
SA x Adipos	-.01	-1.39	.16	.002

Dependent Variable: Blood Biomarker Outcomes
**Note*. EM = Environmental Mastery; Aut = Autonomy; PG = Personal Growth; PR = Positive Relations with Others; PL = Purpose in Life; SA = Self-Acceptance

Hypothesis 4

Facets of PWB as Predictors of Long-Term Health Outcomes

Model 1	*B*	*Wald*	*p*	Odds Ratio
Environmental Mastery	.07	6.16	.01	1.13
Autonomy	.06	8.40	.00	1.11
Personal Growth	-.05	3.77	.05	1.00
Positive Relationships with Others	-.04	2.95	.09	1.01
Purpose in Life	-.00	.02	.90	1.05
Self-Acceptance	-1.64	.26	.61	1.04
Model 2	*B*	*Wald*	*p*	Odds Ratio
Environmental Mastery	.05	2.60	.11	1.05
Autonomy	.06	6.75	.01	1.06
Personal Growth	-.04	2.68	.10	.96
Positive Relations with Others	-.04	2.29	.13	.96
Purpose in Life	.00	.00	.10	1.00
Self-Acceptance	.00	.02	.90	1.00

Dependent Variable: Dichotomous Disease Outcome Variable

Hypothesis 5

Moderation of PWB Facets by Adiposity on Long-Term Health Outcomes

Model 1	*B*	*Wald*	*p*	Odds Ratio
EM x Adipos	-.02	.25	.61	.98
AUT x Adipos	.01	.09	.77	1.01
PG x Adipos	-.01	.03	.86	1.00
PR x Adipos	.00	.02	.90	1.00
PL x Adipos	.03	.71	.40	1.03
SA x Adipos	-.01	.20	.70	1.00
Model 2	*B*	*Wald*	*p*	Odds Ratio
EM x Adipos	-.01	.09	.77	.99
AUT x Adipos	.02	.47	.49	1.02
PG x Adipos	-.01	.14	.71	.99
PR x Adipos	.00	.02	.88	1.00
PL x Adipos	.04	1.16	.28	1.04
SA x Adipos	-.02	.41	.52	.98

Dependent Variable: Dichotomous Disease Outcome Variable
**Note*. EM = Environmental Mastery; Aut = Autonomy; PG = Personal Growth; PR = Positive Relations with Others; PL = Purpose in Life; SA = Self-Acceptance