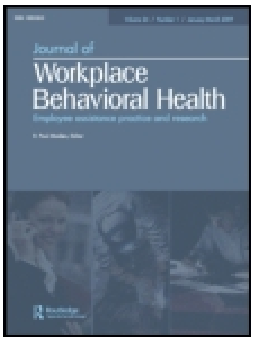

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Psychological health, behavior, and bodyweight (PBBW) model: An evaluation of predictors of health behaviors and body mass index (BMI)

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ABSTRACT
This study proposes and tests a theory driven model: the psychological health, behavior and body weight (PBBW) model. The model hypothesizes an indirect relationship between psychological health and body weight, mediated by health behaviors. Correctional employees ($N = 317$) completed physical assessments and self-report surveys that measured body mass index (BMI), perceived stress, psychological health (overall mood and depressive symptoms), and health behavior (as indicated by reported diet and exercise quality). The authors used structural equation modeling to evaluate the relationships between variables and test the model. Results supported the PBBW model, and findings suggested that psychological health and stress affected body weight. Furthermore the effect of psychological health on body weight was mediated by health behaviors.

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Body weight; correctional employees; employee health; health behavior; psychological health; stress; structural equation modeling

Introduction

Currently, one-third of the United States population is overweight and an additional one-third is obese (Flegal, Carroll, Ogden, & Curtin, 2010). Obesity is a recognized risk factor for multiple adverse health conditions (National Institutes of Health [NIH], 1998) and poses an economic burden on the individual, the employer, and the nation's health care costs (Finkelstein, DiBonaventura, Burgess, & Hale, 2010). Much of this cost is associated with the increased premiums paid by the employees and employers. Hence, employers have a strong motivation to promote healthy behaviors in their employees (Claxton, Dijulio, Finder, & Lundy, 2010).

Multiple factors have been identified in the development of overweight/obesity and associated chronic diseases. They include environmental, social, behavioral, cultural, physiological, genetic, and metabolic factors (NIH, 1998). Behaviors including diet and physical activity are considered two of

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the major contributors to body weight (Drapeau, Hetherington, & Tremblay, 2011). Emotional characteristics have been related to body weight and health behaviors (Faith, Matz, & Jorge, 2002), however the mechanistic pathway through which this association occurs is not well understood and merits study.

Stress and mood states such as depression may serve as risk factors of obesity through mediated behavioral processes (Block, He, Zaslavsky, Ding, & Ayanian, 2009). (Faith et al., 2002) conducted a meta-analysis that suggested that health behaviors serve as a causal link in which psychological factors are related to physical activity & eating habits, which in turn affect weight gain. For example, depressive symptoms have been related to lower levels of physical activity, lower self-efficacy for physical activity (Azar, Ball, Salmon, & Cleland, 2010), and poorer dietary habits (Lopresti, Hood, & Drummond, 2013). Of importance is the recognition that reverse associations may occur. Research has suggested that the relationship between depression and obesity may be bidirectional, with obesity increasing the likelihood of depression and with depression increasing the likelihood of obesity (Luppino et al., 2010).

Among adults, work stress has been associated with increased levels of obesogenic habits such as poor diet (Wardle, Steptoe, Oliver, & Lipsey, 2000), low physical activity (Kirk & Rhodes, 2011), and increased risk of weight gain, abdominal obesity (Wardle, Chida, Gibson, Whitaker, & Steptoe, 2011), and metabolic syndrome (Chandola, Brunner, & Marmot, 2006). The relationship between work stress and weight gain are not fully understood, and mechanistic processes must be elucidated (Caban et al., 2005).

The theoretical demands–control (DC) model endeavors to explain occupational stress with two main components, job demands and job control (decision latitude) (Karasek, 2008). The DC model hypothesizes that job stress results from the combination of high job demands and low decision latitude, increasing the risk of psychosomatic health problems and exhaustion (de Jonge, van Vegchel, Shimazu, Schaufeli, & Dormann, 2010). The consequence of occupational stress is the inability to cope with the challenges of the work, which may lead to physiological and emotional reactions and serve as pathways of physical and mental health disorders (Denhof & Spinaris, 2013). Correctional employees, including correctional officers and all staff working within a correctional facility, experience occupational factors characterized by high job demands and low job control (Dollard & Winefield, 1998), putting employees at risk of job stress and associated adverse consequences.

Compared to the general U.S. population, correctional employees have higher rates of overweight (86.6% vs. 66%) and obesity (55.8% vs. 32%) (Ferraro, Faghri, Henning, Cherniack, & Center for the Promotion of Health in the New England Workplace Team, 2013) and higher rates of chronic disease when compared to employees in other occupations (Cheek, 1984). Correctional employees are exposed to exceptional workplace stresses (McCraty, Atkinson, Lipsenthal, & Arguelles, 2009) and have shown elevated prevalence of depression, poor work–family balance, perceived shortened life expectancy, and high rates of suicide (Agid, Kohn, & Lerer, 2000; Stack & Tsoudisa, 1997). Correctional employees also report poor health behaviors including poor diet, snacking on low-nutrient foods, low physical activity, sedentary behaviors, and poor sleep patterns (Kivimaki et al., 2006; Morse, Dussetschleger, Warren, & Cherniack, 2011).

The high rates of overweight and obesity in correctional employees indicate a need for highly effective workplace health promotion programs (Ferraro et al., 2013). Traditionally, workplace health promotion programs have a narrow focus of changing individual's lifestyle behaviors off the job (e.g., diet, exercise). The National Institute for Occupational Safety and Health (NIOSH) Total Worker Health (TWH) Initiative recognizes the need to integrate occupational health and safety efforts with workplace health promotion, noting that health interventions should have a comprehensive view of employee risk profiles (behavioral/mental/physical health) rather than compartmentalized approaches (Punnett, Cherniack, Henning, Morse, Faghri, & CPH-NEW Research Team, 2009).

Based on pervious literature review and the theoretical DC model outlined in the introduction, a multivariate theoretical model titled the psychological health, behavior and body weight (PBBW) model is proposed for statistical confirmation. This model proposes a relationship in which psychological health (mood & depressive symptoms) affect body mass index (BMI) via health behaviors (diet & exercise) that act as mediating factors. We tested the PBBW model on data collected from a sample of correctional employees to assess determinants of body weight identified by the PBBW model (psychological health, health behaviors, & stress). Although relationships between psychological health, health behaviors, and obesity may be bidirectional, the purpose of this model is to test the theory that psychological health impacts health behaviors and ultimately body weight.

Method

Design

This was a cross-sectional observational study.

Participants

The study setting was two correction facilities in the same northeastern state, matched on inmate population, security level, size, and workforce demographics. Participation was voluntary and open to all employees of the two facilities including correctional officers, lieutenants, captains, deputy wardens, wardens, correctional treatment officers, counselors, maintenance, administration, teachers, chaplains, and medical staff. All participants were required to sign a consent form approved by the Institutional Review Board (IRB). Analyses were done on individuals who completed a self-reported Health Risk Assessment (HRA) survey, an extended organizational and individual health survey, and physical testing ($N = 317$).

Procedure

Cross-sectional physical and survey assessments were conducted to better understand correctional employee health and safety. Research began with engagement of line officers and supervisor union leadership. Following this, Department of Corrections (DOC) administration including wardens and deputy wardens were contacted. After 1 year of preparation and engagement with such individuals survey and physicals were conducted to initiate a multiyear intervention.

Researchers received extensive assistance from DOC employees and supervisors to schedule visits during working hours and determine a location within the facility for physical assessment and survey data collections. All physical and survey assessments were conducted onsite in a private space protected from inmate or other employee scrutiny. Physical assessments took approximately 20 to 30 minutes to complete and survey assessments took 45 to 60 minutes to complete. Advertisements were provided (flyers, roll call announcements) and a $25 financial incentive was administered for each assessment (survey and physical) to increase participation. A team of researchers was trained by experienced staff on proper physical assessment techniques, survey administration, and in providing consents. This team spent approximately 2 months at each correctional facility collecting surveys and physical assessment data. In total, 40% of employees participated in data collection.

Measurements

For these analyses, we used the survey items regarding diet, exercise, sleep habits, stress, and depression and items from the physical assessment data. Survey items were used to create latent construct variables (please see Data Analysis for explanation of latent constructs).

Weight measures

A calibrated Seca 700 physician balance beam scale was used to measure weight to the nearest 0.1 kg and height was measured to the nearest mm. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared and categorized (NIH, 2013).

Health risk assessment

The Personal Wellness Profile, Health Risk Assessment (HRA) (Wellsource, Inc, 2011) which is a 39-question survey assessing participants' self-reported weight, physical activity, nutrition, overall mood, stress, safety, substance use, chronic disease, overall health, health history, and readiness to change was utilized for the study. Additionally, participants completed an extended organizational and individual health survey. From this survey a subsection containing a 10-item survey from the Center for Epidemiological Studies Depression Scale (CES-D) was used to assess depression level (Radloff, 1977).

Health behaviors

Diet quality was based on six HRA survey items on 4- or 5-point Likert-type scales, with 5 points compressed to 4 items for normalization. Survey items assessed food consumption category and frequency (daily consumption of fruits and vegetables, breads/grains, fat, snacking, added salts, and frequency of eating breakfast). Responses could range from *almost never make the healthier choice* (1) to *almost always make the healthier choice* (4). Higher diet quality score indicated better overall diet quality. Exercise quality was assessed with three survey items, each having a 4-point Likert-type scale. Questions asked frequency of weekly engagement in aerobic exercise, strength-building exercises, and stretching exercises. Again, multi-item responses in the HRA were compressed to four items. High scores represented better exercise quality.

Stress

Overall stress was assessed with six HRA items each providing for a *yes* or *no* response. Questions assess presence of stress signals and resemble those on the General Health Questionnaire (GHQ) (Goldberg, 1978). Higher scores indicate higher reported stress levels.

Psychological health

Two variables were assessed to represent psychological health: overall mood and depressive symptoms. The ***overall mood*** variable was created from six HRA survey items each relying on a 6-point Likert-type scale. Questions resemble the psychological health profile of the SF-12 (Bjorner & Turner-Bowker, 2009). Answers range from *none of the time* (1) to *all of the time* (6), with higher score representing more a positive mood. Depressive symptoms was based on 10 CES-D survey items, each question having a 4-point Likert-type scale assessing frequency and severity of feelings to represent depression risk (Radloff, 1977). Answers range from *rarely* or *none of the time* (1) to *all of the time* (4), with a higher score representing more depressive symptoms.

Data analysis

HRAs were scanned using the Wellsource Inc. Data Processing Package (Wellsource, Inc, 2011). Data from the HRA, CES-D, and physical assessments were transferred to Microsoft Excel, and IBM SPSS version 21.0 software (IBM

Corp, 2012) for analysis. Descriptive statistics were developed for all variables. All analyses were conducted on dependent variables with and without outliers for sensitivity analysis purposes (assessed as ± 3 *SD* away from the mean). Normality of all dependent variables was assessed and confirmed using visual assessment of quartile probability plots and histograms. All binary variables were coded as 0 and 1 to allow for regression in path analyses. Variables were reverse coded if needed. Multiple indicators for diet and exercise quality were collapsed into a smaller number of categories so they could be used in latent variable analyses. Prior to collapsing categories chi-squared analyses ensured there was no variability in outcome between the categories collapsed.

Model testing

The PBBW model is a structural model examining associations between latent constructs and BMI (Figure 1). The latent variables in this analysis were: depressive symptoms, overall mood, diet quality, exercise quality, and stress.

As indicated in Figure 1, the PBBW model identifies psychological health, health behaviors, and stress as determinants of body weight. Psychological health encompasses an individual's self-reported emotional state. In this study overall mood and depressive symptoms were used to represent psychological health. For the purpose of the PBBW model, health behaviors are those behaviors that are hypothesized to be influenced by psychological health and to affect body weight. In this study diet and exercise quality were used to represent health behaviors. Body weight, in the model is a simple outcome, with the presumption that the direct health behavioral cause (diet and exercise) is affected by psychological health. These three factors (psychological health, health behavior, and body weight) represent the restricted PBBW model. A full

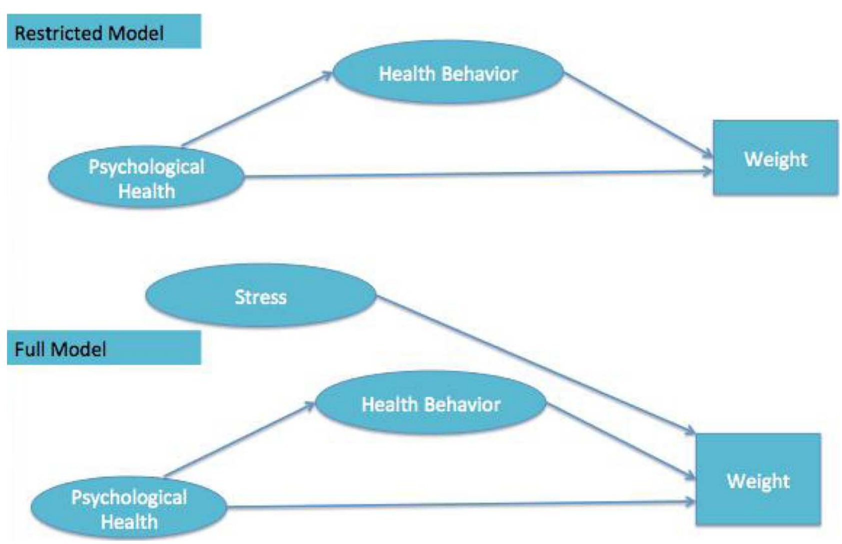

Figure 1. Theoretical psychological health, behavior and body weight (PBBW) model.

model, with the addition of stress as a moderator of body weight, is also theorized. Stress is an assessment of self-reported stress signals. This study tested if adding stress to the model (full model) better predicts body weight.

As illustrated in Figure 1 the PBBW model predicts that better diet and exercise quality will result in reduced body weight and that poorer diet and exercise quality will result in higher body weight. We further hypothesize that the model expands on a single explanatory factor approach, by proposing an indirect relationship between psychological health and body weight, in which psychological health's impact on health behaviors may ultimately affect body weight. The assumption is that health behaviors will mediate the relationship between psychological health and body weight and the direct path between psychological health to body weight will be insignificant. Correspondingly, individuals with poorer psychological health scores will have a higher body weight, as their health behavior quality is reduced. Thus, the PBBW model is a multivariate, theory-based approach to conceptualizing predictors of body weight.

Latent variables and structural equation models

After assessing data for normality, a two-step process begins (Buhi, Goodson, & Neilands, 2007). All analyses for latent variables and structural models were conducted using Mplus version 7.11 (Muthén & Muthén, 2010).

In Step 1 measurement models are used to assess latent variables—constructs not measured directly but denoted by representative scales (survey items). Decision to include indicators for latent variables was made by assessing their factor loads, *p* value for significance, and model fit indexes. Latent variable modifications were made (e.g., remove indicators, covary errors among indicators) to find the latent variable with the best model fit to be used for analyses.

Step 2 involves testing structural models to examine the underlying relationships between the latent constructs tested in the measurement model and other (observed) variables proposed by the theory. Structural models account for the direct, indirect, and total effects among factors. An indirect effect is a relationship in which two variables are related to each other only through another variable. It represents an independent variables influence on the dependent variable through one or multiple mediating variables (Buhi, Goodson, & Neilands, 2007). Here we evaluated the hypothesized PBBW model by assessing the presence of an indirect effect between psychological health and BMI via health behaviors was assessed (Figure 1).

Model fit for latent variables & structural models was assessed via the root mean square error of approximation (RMSEA) (Steiger, 1990; Hu & Bentler, 1999), the Comparative Fit Index (CFI), and the Tucker Lewis Index (TLI) (Bentler, 1990). Cutoffs used were 0.06 for RMSEA, 0.95 for CFI, and 0.95 for TLI (Hu & Bentler, 1999). In addition, chi-squared model fit indices were assessed to compare the restricted structural model (containing only psychological health, health behavior, and BMI) and full structural model (additionally containing stress) to determine which competing model structure might offer a better explanation of the data. A significant chi-squared value signifies that the full model fits better to the data. A nonsignificant chi-squared value indicates both models have equal fit, therefore the restricted model should be accepted for being more parsimonious (Bollen, 1989; Schermelleh-Engel, Moosbrugger, & Muller, 2003). Four good-fitting models that support the PBBW model are discussed below.

Results

Participant characteristics

Gender distribution was unequal with a greater percentage of males (72.6%) than females, though this proportion accurately depicts the corrections workforce. A majority of participants were White (80.4%). A majority had either graduated high school (67%) or graduated college (32.7%). More than three fourths (76.5%), were correctional staff with the remainder support staff (23.5%). Of the correctional staff, 59.4% worked first shift, 29.2% worked second shift, and 11.4% worked third shift. Average tenure was 13.17 ± 9.69 years. Only 12% of participants were in the normal weight range, the majority being overweight or obese with an average BMI of 30.62 ± 5.51 (Grade I obese) and average body weight of 204.25 ± 46.47 pounds. Results showed that a majority of correctional employees do not report having the stress signals indicated on the survey. Percentage that report not experiencing each stress signal ranged from 81.4% to 91.2%. Reasons for low self-reported stress rates are considered in the discussion.

Latent variable factor analysis

All latent variables and indicators are depicted in Table 1. After assessing model fit, two of the six diet items (eating breakfast and salt intake) were not effective in the latent variable model and therefore were removed. All three variables associated with exercise quality fit the model. Ultimately, five of the six stress items were included with the statement “minor things throw me for a loop” not being meaningful. Overall mood variable was indicated by all six indicators, and depressive symptoms was indicated by all 10 indicators with good model fit criteria. Further adjustments were made to latent variables to ensure good fit to the data. All adjustments are illustrated in Table 2.

Structural equation model: PBBW model

Four examples of models to assess the theoretical PBBW model were tested (substituting overall mood and depressive symptoms & substituting diet

Table 1. Latent variables and survey item indicators.

Latent variable	Indicator	Standard estimate	*p* value
	Health habits		
Diet quality[a]	Snacks	0.332	0.000**
	Breads/grains	0.606	0.000**
	Fruits/vegetables	0.428	0.000**
	Fat intake	0.782	0.000**
Exercise quality[a]	Stretching	0.784	0.000**
	Strength exercise	0.907	0.000**
	Aerobic exercise	0.753	0.000**
Stress[a]	Difficult to get along with people I used to	0.121	0.000**
	Nothing gives me pleasure anymore	0.138	0.000**
	I can't stop thinking about my problems	0.153	0.000**
	I feel angry much of the time	0.190	0.000**
	I feel tense/anxious much of the time	0.223	0.000**
Mood[a]	Energy	0.853	0.000**
	Relaxed	1.002	0.000**
	Calm & peaceful	0.986	0.000**
	Happy	0.984	0.000**
	Downhearted & blue	0.687	0.000**
	Worthless	0.384	0.000**
Depression[b]	Bothered by things that don't usually bother me	0.602	0.000**
	Trouble keeping my mind on what I was doing	0.499	0.000**
	Felt depressed	0.555	0.000**
	Felt everything was an effort	0.478	0.000**
	Felt hopeful about the future	0.242	0.000**
	Felt fearful	0.334	0.000**
	Sleep was restless	0.520	0.000**
	Happy	0.435	0.000**
	Lonely	0.386	0.000**
	Could not "get going"	0.386	0.000**

[a]Health Risk Assessment (HRA).
[b]Center for Epidemiological Studies Depression (CES-D) Scale (Radloff, 1977).
*$p < .05$, **$p < .01$.

Table 2. Latent variable model fit with comparison of model fit before and after improvements were made.

	Number of indicators	χ^2 *p* value	RMSEA	CFI	TLI	Changes to improve model fit
Diet quality	6	0.007	0.069	0.950	0.917	
Diet quality (final)	4	0.280	0.029	0.997	0.992	Remove indicators
Exercise quality (final)[1]	3	0.000	0.000	1.000	1.000	
Stress	6	0.042	0.055	0.940	0.900	
Stress (final)	5	0.361	0.017	0.996	0.993	Remove indicator
Overall mood	6	0.000	0.137	0.926	0.877	
Overall mood (final)	6	0.173	0.038	0.995	0.990	Covary indicators
Job stress	6	0.000	0.088	0.971	0.951	
Job stress (final)	6	0.1300	0.042	0.994	0.989	Covary indicators
Depression	10	0.000	0.073	0.923	0.901	
Depression (final)	10	0.011	0.045	0.972	0.962	Covary indicators
Emotional labor (final)[1]	3	0.000	0.000	1.000	1.000	
Job satisfaction (final)[a]	3	0.000	0.000	1.000	1.000	

RMSEA = root mean square error of approximation; CFI = Comparative Fit Index; TLI = Tucker Lewis Index.
[a]Just identified models do not have accurate model fit information and modifications were not possible.

quality and exercise quality). It is important to note the rationale for choosing overall mood and depressive symptoms as predictors in the model. Analyses suggested that stress did not have a direct effect on either diet ($\beta = -0.112 \pm 0.077$, $p = .144$) or exercise quality ($\beta = -0.119 \pm 0.083$, $p = .152$) and therefore was not further tested. Overall mood significantly affected diet ($\beta = .163$, $p = .006$) & exercise quality ($\beta = .318$, $p < .001$). Overall depressive symptoms affected exercise quality ($\beta = .28$, $p < .001$) but not diet quality ($\beta = -0.126$, $p = .012$). For this reason mood and depressive symptoms were tested as an influencer of health behaviors in further models but stress was not. However, as prior research has suggested a link between stress and BMI (Block et al., 2009) we also tested the direct effect of stress on BMI in each model combination to examine if stress could further explain BMI variation in our sample. When testing the direct effect of mood and depressive symptoms on BMI neither were significant, we then tested the models for an indirect effect between psychological health & BMI via health behaviors.

Model fit criteria for all models with full and restricted model results are listed in Table 3. One example model with its factor loading (regression coefficient) and associated *p* values is represented in Figure 2. For all models tested model fit was adequate. The PBBW model was first assessed as a restricted model containing three variables: psychological health, health behavior, BMI, and not stress. The mediated structural hypothesis of the PBBW model was supported, showing partial mediation in which the mediating variable (diet quality & exercise quality) accounted for a portion of the variance between psychological health and BMI suggesting indirect effect by health behaviors. Psychological health related significantly to health behaviors but did not directly relate to BMI at the specified level of significance. Furthermore, health behaviors significantly and negatively predicted BMI. Results were consistent with the hypothesis that psychological health indirectly affects BMI through health behaviors. For example, better mood significantly predicted better diet quality, resulting in lower BMI (indirect effect: $p = .0013$). Good model fit and statistically significant indirect effects were found in all models.

Table 3. Structural model fit indices and indirect effects.

Model		RMSEA	CFI	TLI	χ^2	χ^2 *p* value	Indirect effect *p* value	Nesting (*p* value)
Mood-DQ-BMI	Restricted	0.035	0.984	0.978	55.514	0.0523	0.013*	
	Full	0.039	0.963	0.955	144.807	0.0015	0.010*	0.0134*
Mood-EQ-BMI	Restricted	0.058	0.966	0.95	60.260	0.0013	0.005**	
	Full	0.054	0.94	0.925	154.907	0.0000	0.006**	0.0014**
Depression-DQ-BMI	Restricted	0.043	0.952	0.941	136.080	0.0005	0.023*	
	Full	0.042	0.933	0.922	255.201	0.0000	0.026*	0.0836
Depression-EQ-BMI	Restricted	0.036	0.969	0.962	103.254	0.0114	0.029*	
	Full	0.04	0.944	0.935	218.897	0.0001	0.034*	0.0573

RMSEA = root mean square error of approximation; CFI = Comparative Fit Index; TLI = Tucker Lewis Index; DQ = Diet quality, EQ = Exercise quality; BMI = body mass index.
*$p < .05$, **$p < .01$.

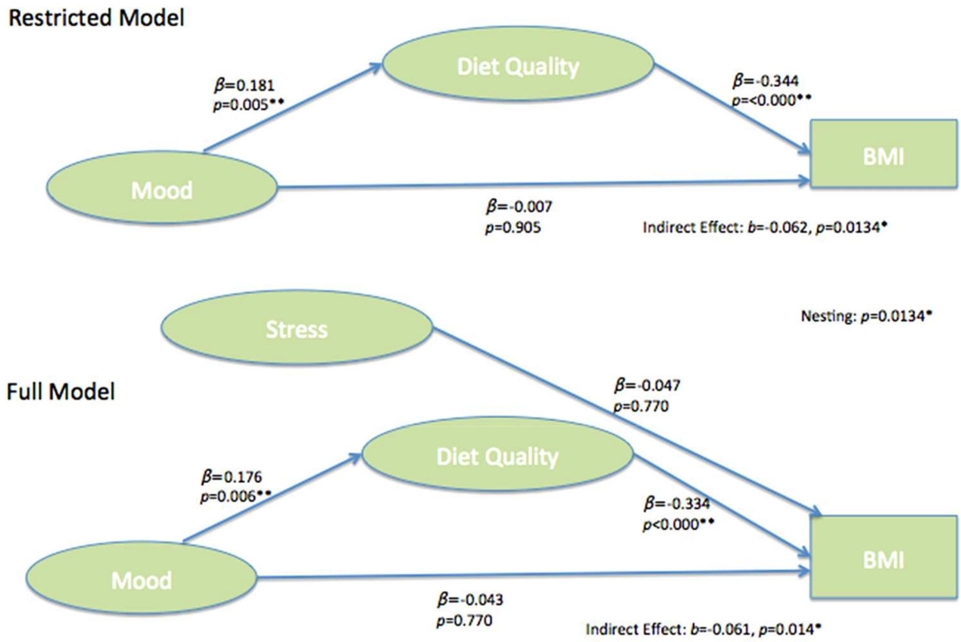

Figure 2. Psychological health, behavior and body weight model with the variables: overall mood, diet quality, and body mass index. $^{*}p < .05$, $^{**}p < .01$.

Next, the PBBW model was assessed as a full model containing all four variables; psychological health, health behavior, BMI, and stress. The full models also demonstrated good fit to the sample data suggesting indirect effect by health behaviors. Chi-squared difference testing was done to evaluate if the full model (containing stress) or restricted model (without stress) better explained BMI. For both models, when overall mood was used as the psychological health latent variable, the addition of stress explained BMI better than the restricted model alone (△ χ^2 difference: 52.76.51/130.78, $p = .0134$ and 62.16/146.05, $p = .0013$). When substituting depressive symptoms as the latent variable of psychological health, chi-squared difference tests only approached significance (△ χ^2 difference: 125.12/229.77, $p = .0573$ and 97.44/199.34, $p = .0836$). Lack of statistical significance suggests that the full and restricted model explain the same amount of variance in predicting BMI when depressive symptoms is used. Because the PBBW model appears to work with or without the inclusion of stress as a direct effector on BMI, parsimony would suggest its exclusion. Step-by step documentation of testing the Structural Equation Models is available upon request.

Discussion

This research proposed and tested a novel theoretically driven statistical model, the PBBW model (Figure 1). This model was developed based on previous research linking psychological health, health behaviors, and body weight. To our knowledge, the PBBW makes a unique contribution by interrelating all of the aforementioned factors in a multivariate model. The PBBW model hypothesizes that good overall mood and low rates of depressive symptoms are critical for good health behavior and maintaining a normal body weight. Furthermore, results support the presumption that the relationship between psychological health measures and body weight is mediated by health behavior (e.g., diet and exercise quality). A second hypothesis in the PBBW model was that high stress negatively affects body weight, assuming an individual with poor psychological health and/or high stress will have more difficulty practicing healthy behaviors and maintaining a healthy body weight. This is a situation often reported in occupational stress research (Chandola et al., 2006; Fransson et al., 2012).

Overall the analysis of the PBBW model on this data set of correctional employees suggested that one's psychological health may affect his or her healthy behaviors (diet and exercise quality) and ultimately BMI. The restricted model showed that higher depressive symptoms and more negative overall mood were negatively associated with health behavior quality (poorer diet and exercise quality), and that health behaviors were in turn negatively related to BMI. The direct relationship between psychological health and BMI were nonsignificant as was hypothesized. The full model (incorporating stress's effect on BMI) provided additional information. When overall mood (rather than depressive symptoms) is used to represent psychological health, the addition of stress explained more variation in BMI than the restricted model alone. When using depressive symptoms rather than mood to represent psychological health, the addition of stress was not significant and the restricted model was more parsimonious. A possible explanation for stress's nonsignificance impact when using depressive symptoms may be the overlap in survey items between the three different surveys (mood, depressive symptoms, and stress). Only a small percentage of correctional employees reported experiencing stress. Although corrections and law-enforcement occupations in general are thought to be high-stress occupations, previous research has also found such employees to report low levels of stress and stress-related symptoms. It is possible our sample is under-reporting their stress level preventing for meaningful contribution to the statistical model (McCraty, Atkinson, Lipsenthal, & Arguelles, 2003; Morse et al., 2011). Overall, the restricted and full PBBW were supported with different variables used. Future investigations of this model with other data sets should consider testing the restricted and full model to find the most appropriate and informative model and to assess if other markers of psychological health work within the PBBW model.

We found that correctional employees are heavier than the general population. Based on BMI, 12.3% of participants were normal weight, 37.9% were overweight, and 49.8% were obese. In comparison with data from the National

Health and Nutrition Examination Survey (NHANES), of the U.S. population 31.2% are normal weight, 33.1% are overweight, and 35.7% are obese (Flegal et al., 2010). This fact supports the observation that epidemic overweight/obesity in the U.S. is worse in high stress workplaces such as corrections (Ferraro et al.,), first responders (Tsismenakis et al., 2009), and police (Thayyil, Jayakrishnan, Raja, & Cherumanalil, 2012).

Currently approaches to preventing obesity in general, and specifically in high-stress occupations, appear to be inadequate. Deeper and more comprehensive understandings of the behavioral, emotional, and physical factors that influence obesity appear essential for vulnerable workforces. Results from this empirical test of the PBBW model suggests that health behaviors (e.g., diet and exercise) affect obesity, an observation that has been well established in previous research (Punnett et al., 2009). For example, correctional officers research has shown that nutrition knowledge and exercise confidence predicted a large percent of variation in weight change (Ferraro et al., 2013) and that educational approaches to nutrition and physical activity result in increased healthy behaviors & weight loss (Faghri, Duffy, Benson, & Cherniack, 2012). However, it is unlikely that obesity in vulnerable occupations can be addressed by encouraging individual lifestyle change alone.

Literature on the negative effects of job stress is compelling. Work stress has been related to reduced leisure time activity, obesity, and tobacco and alcohol use and has been recognized as detrimental to health and well-being (Chandola et al., 2008; McCraty, Atkinson, Lipsenthal, & Arguelles, 2009). As NIOSH and the Centers for Disease Control and Prevention have observed, health risks from job stress arise when there is a discrepancy between job demand and a worker's ability to control their work process because of environmental, organizational, and behavioral barriers. Kouvenen found that among Finish public sector employees, job strain was associated with co-occurrence of adverse health behaviors (smoking, heavy drinking, obesity, and low physical activity) that contributed to preventable chronic diseases (Kouvonen, Kivimaki, Vaananen, Heponiemi, Elovainio, Ala-Mursula, & Vahtera, 2007). A cross-sectional study by Barrington had similar findings, with higher reported stress associated with lower levels of eating awareness, physical activity, and walking (Barrington et al., 2012). Interestingly, one study found that employees reporting high stress had 46% higher health care costs compared to employees reporting lower levels of stress, making addressing employee stress a large priority (McCraty et al., 2009). In this study, though the proposed PBBW model did not have sufficient power to show a statistical effect of stress on body weight, the inclusion of stress in the model explained more variance in the outcome of BMI. A possible reason for insignificant findings may be the lack of ability to capture true stress levels with the survey items utilized. Using other indicators of psychological function and mental health in addition to survey items is important to further understand the impact that stress has on health outcomes.

The PBBW model found significant relationships between psychological health and health behaviors, similar to previous research (Loxton, Dawe, & Cahill, 2011; Macht, 2008; Udo et al., 2013). For example, mood has been shown to alter food choice and amount (Gibson, 2006), and it has been suggested that those characterized with negative affect have a harder time resisting dietary temptations (Jansen et al., 2008). One explanation may be that individuals with poor health behaviors are expressing adaptation or a coping response to stressors (Cohen, Janicki-Deverts, & Miller, 2007). Research on emotions and decision making found that emotions likely play a critical role in obesity-related behaviors yet are rarely addressed in behavior change attempts. Therefore, emotional education interventions may be useful in addressing obesity-related behaviors (Ferrer, Fisher, Buck, & Amico, 2011) and are important factors to consider in health promotion efforts.

In the PBBW model, after controlling for mediation by health behaviors, there was no significant direct relationship between psychological health and BMI. There was a significant indirect relationship, suggesting that psychological health may affect BMI by altering health behaviors. Previous research suggests that exercise serves as a mediator between the depression and obesity link in women (Beydoun & Wang, 2010). The importance of psychosocial health's effect on physical health is highlighted in a study which found employees reporting poor emotional health have elevated health care cost compared to employees without poor emotional health (70% higher for those reporting depression, 147% higher for those reporting psychosocial problems) (McCraty et al., 2009).

Overall, our findings suggest psychological health affects diet and exercise quality, which ultimately affects body weight. Individuals with poor psychological health (e.g., depression) may want to make healthy behavior changes but are hindered by their psychological health.

Limitations

This study has several limitations. All participation was voluntary, therefore our sample may not fully represent the population of correctional employees; however demographic data supports our sample as a good overall picture of the true population. Although height and weight were measured by trained staff, other variables were based on self-report that tends to result in either over- or under-reporting of health behaviors (Meichenbaum & Turk, 1987); and in correctional officers, under-reporting of stress/emotional problems has been observed (McCraty et al., 2009). Multiple survey items used to represent stress could in fact be used to represent depressive symptoms or mood instead, and vice versa. For example, the survey item regarding feeling happy is in the depressive symptoms scale and the mood scale. Similarities and overlaps in survey content may be contributing to insignificant findings. Choice of survey items for latent variables was based on preexisting previously validated surveys. In addition, to prevent overlap, after testing fit of each latent variable, indicators were removed if statistical load indicated sharing significant variance. It is important to note that the survey items were not work specific (e.g., work related stress). We assumed that as employees spend significant amount to their hours at work (almost two thirds of waking hours), and because they completed these surveys at work, these items should illustrate stress and psychological health as a result of employment as well. It is argued that due to the large amount of time spent in the workplace, the environment and experiences at work are a large contributor of an employees' overall stress, depressive symptoms, and mood, therefore these survey items are considered as adequate to represent employee stress and psychological health. Future studies may consider utilizing survey items to capture stress, depressive symptoms, and mood related to work specifically. In addition, the CES-D was used to represent depressive symptoms scores in participants, however it is important to note the survey is asking about levels of "depressive symptoms" rather than measuring depression directly. The cross-sectional study design only allows for exploring associations, therefore direction and causality cannot be determined. Although poor psychological health may affect diet and exercise quality, the reverse association may also occur as research has provided evidence for a bidirectional association between depression and obesity (Luppino et al., 2010; Rooke & Thorsteinsson, 2008). Longitudinal studies will need to examine reverse effects and causality.

Nonetheless, the strengths of this research in addressing a high-priority population and utilizing advanced statistical techniques to explore relationships offers good insight to the research community. A benefit of this model is its robustness with a variety of variables utilized. The PBBW model has the potential to function with other markers of psychological health and health behaviors in future research. Although the PBBW model was supported, it may not be applicable to all individuals; therefore further exploration of variables representing individual characteristics should be tested as moderators in the model (e.g., sex, age, tenure, job category, eating awareness). Future research using the PBBW model may also benefit from simultaneously testing diet quality and exercise quality variables in the model as they are exclusive of one another & may add more comprehension to the model.

Conclusion

The identification of vital determinants of body weight and how these factors inter-relate to affect health behavior is critical to develop effective interventions. This model suggests that psychological health and stress are important when considering health behaviors and weight status. Obesity interventions should consider the effects of psychological health and stress on health behaviors, especially in populations with poor psychological health and high levels of stress (e.g., correctional employees). Health promotion professionals should be educated on the links between psychological health and health behaviors and should pay close attention to health behaviors of employees working in high-stress occupations.

The PBBW model provides a more inclusive view of associations that have been tested separately. Adequate model fit with the use of multiple latent variable combinations: psychological health (mood and depressive symptoms) and health behaviors (diet and exercise quality), suggests the robustness of this model. It is plausible this model could be used on additional data sets that utilize similar variables in place. The model appears to work with or without the inclusion of stress's effect on BMI. Therefore, the model could be used whether the theoretical question involves stress. For further validation, the PBBW model should be tested on additional data sets using parallel measures and should be evaluated for its ability to produce effective weight-management interventions.

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